Subsurface Drain (SD)

Practice Description

A subsurface drain is a perforated pipe or continuous layer of porous material installed below the ground surface that intercepts, collects, and carries excessive groundwater to a stable outlet. Subsurface drains by themselves do not provide erosion control. The purpose of a subsurface drain is to improve soil moisture conditions, vegetation growth, and ground stability. Subsurface drains may reduce wet ground from interfering with construction activities. Drains may be constructed using a gravel-filled trench, perforated pipe in gravel bedding, or manufactured drain panel products. This practice applies where groundwater is at or near the ground surface or where adequate drainage cannot be provided for surface runoff.

Planning Considerations

To properly design and install this practice, a detailed site investigation will be required. This investigation should include a site survey to determine the location of the area to be drained, the depth of the area to be drained, the topography of the area to be drained, the outlet of the drain system, and the soils at the site.

When considering use of this practice, the qualified design professional should consider the intended use of the area to be drained. Base flow and interflow of groundwater may increase with installation of this practice due to excess soil water being removed. Groundwater recharge may also be reduced by this practice. Finally, surface runoff may increase due to this practice reducing deep percolation at the site.

All federal, state, and local laws and regulations should be adhered to when planning and installing this practice.

Design Criteria

Layout and Depth

In the absence of site-specific information, a depth of 3 feet and a spacing of 50 feet for drains should be adequate. However, it is recommended that site-specific information be obtained. Typical details of subsurface drain construction can be seen in Figures SD-1 and SD-2. The following guidelines should be followed.

The depth at which the drain is installed will determine how much the water table is lowered. The minimum depth for the drain is 2 feet under normal conditions. The maximum depth is limited by the depth of the impermeable layer and, if a pipe is used in the drain, by the allowable load on the pipe used.

Spacing

The permeability of the soil at the site and the depth of the drain will determine the spacing of the drain.

Multiple Drains

In some cases more than one drain will be needed to achieve the desired results. The first drain should be installed, and additional drains should be added only if seepage or high water table problems continue.

Location

Drains should be located a minimum of 50 feet from any trees to prevent damage to the trees.

Grade

In areas where sedimentation is not likely, the minimum grades should be based on site conditions and a velocity of not less than 0.5 ft/sec. Where a potential for sedimentation exists, a velocity of not less than 1.4 ft/sec should be used to establish the minimum grades if site conditions permit. Otherwise, provisions should be made for prevention of sedimentation by filters or collection and for periodic removal of sediment from installed traps. Steep grades should be avoided.

Gravel Bedding

Typically, 3″ or more of gravel is placed completely around the drain and graded to prevent the infiltration of fine-grained soils into the drain.

Filters and Filter Material

Filters will be used around conduits, as needed, to prevent movement of the surrounding soil material into the conduit. The need for a filter will be determined by the characteristics of the surrounding soil material (i.e. permeability), site conditions, and the velocity of flow in the conduit.

A suitable filter should be specified if

- Local experience indicates a need.

- Soil materials surrounding the conduit are dispersed clay, low-plasticity silts, or fine sands (ML or SM with plasticity index less than 7).
- Where deep soil cracking is expected.
- Where the method of installation may result in voids between the conduit and backfill material.

The filter can be geotextile filter fabric, sand, gravel, or sand-gravel combination. If a geotextile is used, it should meet the requirements of the material table found in the *Outlet Protection Practice*. Care should be taken when using geotextile filter fabric since small soil particles can clog the fabric. If a sand-gravel filter is specified, the filter gradation will be based on the gradation of the base material surrounding the conduit within the following limits:

- D_{15} size smaller than 7 times d_{95} size, but not smaller than 0.6 mm.
- D_{15} size larger than 4 times d_{15} size.
- Less than 5% passing No. 200 sieve.
- Maximum size smaller than 1.5″.

D represents the filter material, and d represents the surrounding base material. The number following each letter is the percent of the sample, by weight, that is finer than that size. For example, D_{15} size means that 15 percent of the filter material is finer than that size.

Specified filter material must completely encase the conduit so that all openings are covered with at least 3″ of filter material, except that the top of the conduit and side filter material may be covered by a sheet of plastic or similar impervious material to reduce the quantity of filter material required.

Clean-outs

In long sections of drain and in areas where sedimentation is concerned, clean-outs should be installed in the drain to facilitate removal of sediment deposits.

Outlet and Protection

The outlet must be protected against erosion and undermining of the conduit, entry of tree roots, damaging periods of submergence, and entry of rodents or other animals into the subsurface drain. A continuous section of rigid pipe without open joints or perforations will be used at the outlet end of the line and must discharge above the normal elevation of low flow in the outlet ditch. Corrugated plastic tubing is not suitable for the outlet section.

Materials

Pipe should be perforated, continuous closed-joint pipes of corrugated plastic, concrete, corrugated metal, or bituminous fiber. The pipe should have sufficient strength to withstand the load to be placed on it under the planned installation design.

Manufacturer's recommendations should be followed in designing the pipe to withstand design loads.

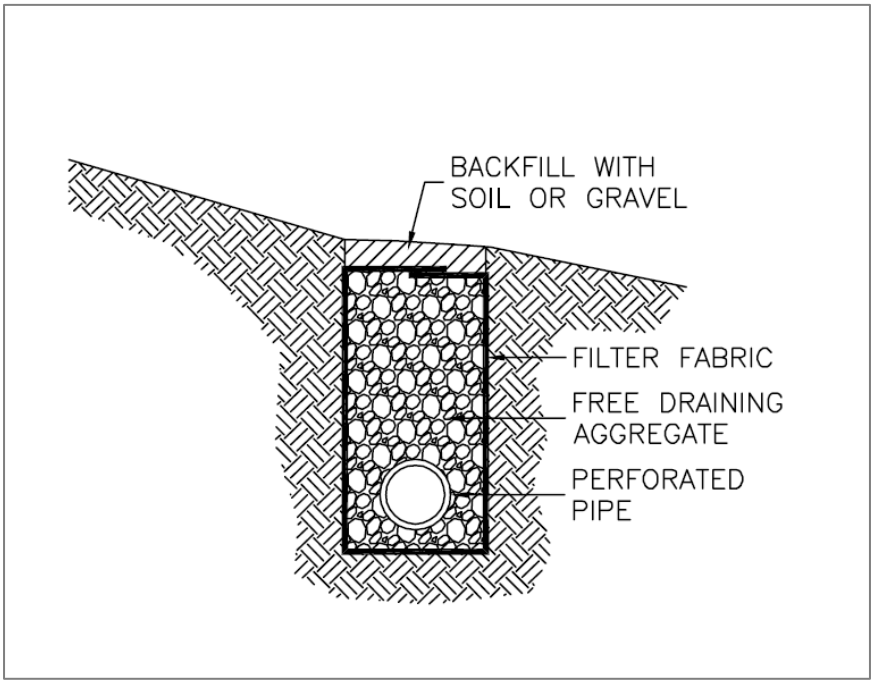

Figure SD-1 Details of Typical Subsurface Drain Construction

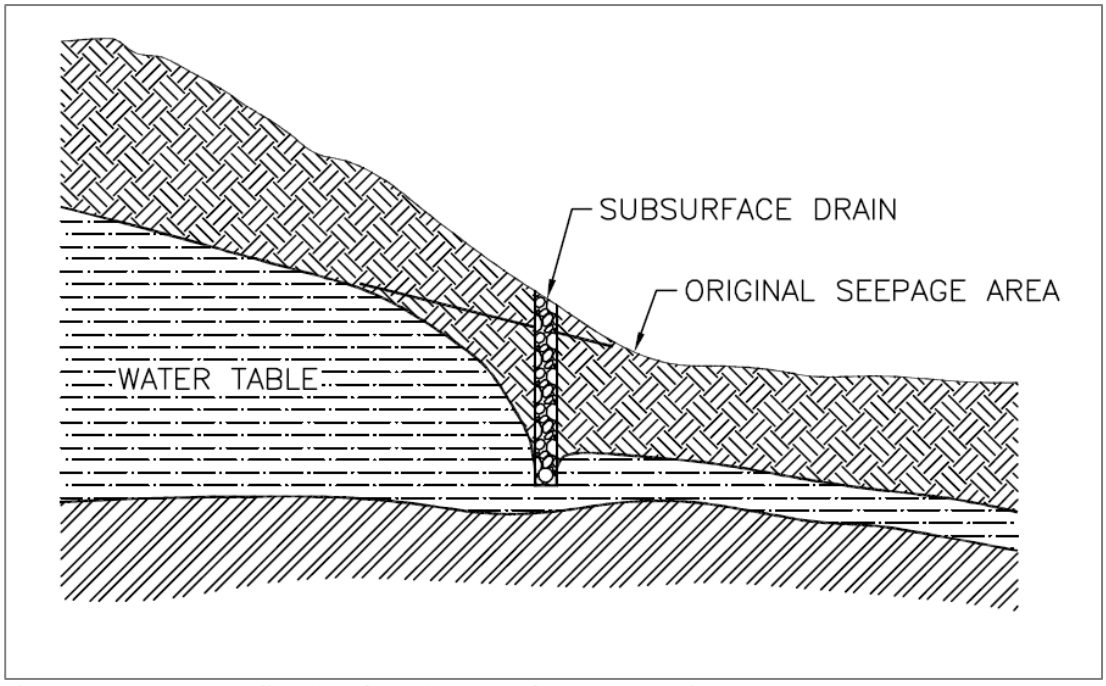

Figure SD-2 Details of Subsurface Drain Construction

Construction

Prior to start of construction, subsurface drains should be designed by a qualified design professional. Materials such as sand, gravel, geotextile filter cloth, and pipe must be properly designed in order for the subsurface drain system to function properly. Plans and specifications should be available to field personnel.

Site Preparation

Determine exact location of underground utilities. At least 3 days prior to construction, request Mississippi One-Call System (1-800-227-6477) to mark all underground utilities within the project area. See Appendix C for more information about utility marking.

Locate and mark the alignment of the drains as shown on the design plans.

Clear installation area of debris and obstacles, such as trees and stumps, that might hinder grading and installation of the subsurface drain.

Trench Excavation

Excavate the trench to the specified depth and grade shown in the design plan. To accommodate the gravel bedding or filter material, excavate the trench to at least 3″ below the design bottom elevation of the pipe (or as shown on the design plans).

Place materials excavated from the trench on the up-gradient side of the trench to prevent water from entering the trench during construction.

Grade the trench to prevent siltation into the drain.

Installation of Drain Pipe, Bedding Material and Geotextile Filter Cloth

Line trench with filter cloth (if specified), providing enough material to overlap over the top of the finished gravel bedding. This helps prevent movement of soil into the gravel.

Spread bedding material specified in the design plan, usually 3″ of gravel, to fill the over-excavated bottom of the trench.

Lay pipe on the design grade and elevation, avoiding reverse grade or low spots, after checking to ensure the pipe meets specifications.

Cap the upper end of each drain with a standard cap made for this purpose or with concrete or other suitable material to prevent soil from entering the open end.

Place bedding material around pipe, on all sides, with the amount shown in the design plan.

Fold filter cloth over the top of the gravel bedding.

Backfill Installation

Backfill immediately after placement of the pipe and bedding. Ensure that the material does not contain rocks or other sharp objects, and place it in the trench in a manner that will not damage or displace the pipe. Overfill the trench slightly to allow for settlement.

Installation of Clean-Out Device

Install clean-outs for maintenance of the subsurface drain in the locations shown on design plan.

Outlet Installation

Construct the outlet of the subsurface drain at the elevation in the design plan. The outlet section of the drain should be at least 10 feet of non-perforated corrugated metal, cast iron, steel, or heavy-duty plastic pipe. Cover at least half of the pipe length with well-compacted soil. Place a suitable animal guard securely over the pipe outlet to keep out rodents.

Stabilization

Keep the settled fill over the pipe outlet slightly higher than the surrounding ground to prevent erosion, rills and gullies.

Stabilize all bare areas of the trench with temporary seeding and mulching unless construction will disturb the area within 13 days.

Safety

Narrow trenches are subject to collapse and can be a safety hazard to persons in the trench. No person should enter a trench without shoring protection or properly sloping the sides of the trench.

Construction Verification

Verify the dimensions during construction with those shown on the plans for location, length, depth, and cross section of trench.

Verify the dimensions and specifications of the aggregate used in the bedding and manufactured materials such as pipe, tile or panel drain.

Common Problems

Consult with a qualified design professional if any of the following occur:

Variations in topography on site indicate subsurface drains will not function as intended or originally designed.

Design specifications for aggregate or manufactured products cannot be met; substitutions may be required. Unapproved substitutions could result in failure of the drain to function as intended.

Pipe is crushed by construction traffic.

Maintenance

Check subsurface drains periodically to ensure that they are free-flowing and not clogged with sediment.

Keep outlet clean and free of debris.

Keep surface inlets open and free of sediment and other debris.

Where drains are crossed by heavy vehicles, check the pipe to ensure that it is not crushed.

References

BMPs from Volume 1

Chapter 4