Greenville County Technical Specification for:

RC-02 SUBSURFACE DRAINS

1.0 Subsurface Drains

1.1 Description

A subsurface drain is a perforated pipe or conduit placed beneath the surface of the ground at a designed depth and grade. Subsurface drains may be used to do the following:

- Drain areas by intercepting and conveying groundwater.
- Lower the water table.
- Drain storm water detention structures.
- Prevent sloping soils from becoming excessively wet and subject to slippage.

There are two types of subsurface drains: relief drains and interceptor drains.

- Relief drains are used to de-water an area where the water table is high. They may be placed in a gridiron, herringbone, or random pattern.
- Interceptor drains are used to remove water where soils are excessively wet or subject to slippage. They are usually placed as single pipes instead of patterns. Generally, subsurface drains are suitable only in areas where the soil is deep enough for proper installation. They are not recommended where they pass under heavy vehicle crossings
- Subsurface drains should be placed so that tree roots will not interfere with drainage pipes. The drain design should be adequate to handle the volume of flow. Areas disturbed by the installation of a drain should be stabilized or they, too, will be subject to erosion. The soil layer must be deep enough to allow proper installation. Always check to make sure the area to be drained is not a delineated wetland.

1.2 Location

Tree roots can clog and damage subsurface drains. Therefore, subsurface drains should be located in areas where there are no trees within 50 feet of the drain.

1.3 Relief Drains

Relief drains shall be placed through the center of wet areas. They should drain in the same direction of the slope.

Relief drains installed in a uniform pattern shall remove a minimum of 1-inch of ground water in 24-hours (0.042 cfs/acre). The design capacity must be increased accordingly to accommodate any surface water that may directly enter the system.

Relief drains that are installed in a random pattern shall remove a minimum of 1.5 cfs per 1,000-feet of length. This value shall be increased for sloping land as shown in Table 1. In addition, the design capacity must be increased accordingly to accommodate any surface water that may directly enter the system.

Relief drains installed in a uniform pattern should have equal spacing between drains and the drains should be at the same depth. Maximum depth is limited by the allowable load on the pipe, depth to impermeable layers in the soil, and the outlet requirements.

The minimum subsurface drain depth is 24-inches under normal conditions, and 12-inches where the drain will not be subject to equipment loading.

Spacing between the drains is dependent on soil permeability and the depth of the drain. In general, a subsurface drainage system where the drains are buried to a depth of 3-feet and spaced 50-feet apart is an adequate design.

1.4 Interceptor Drains

Interceptor drains shall be placed on the up-slope side of wet areas. They should be installed across the slope and drain to the side of the slope.

Interceptor drains that are installed in a random pattern shall remove a minimum of 1.5 cfs per 1000-feet of length. This value shall be increased for sloping land as shown in Table 1. Also, the design capacity must be increased accordingly to accommodate any surface water that may directly enter the system.

Table 1. Water Removal Rates for Sloping Land

Land Slope	Water Removal Rate
0-2 %	1.50 cfs/1000 ft
2-5%	1.65 cfs/1000 ft
6-12%	1.80 cfs/1000 ft
> 12%	1.95 cfs/1000 ft

The depth of installation of an interceptor drain is influenced mainly by the depth to which the water table is to be lowered. The maximum depth is limited by the allowable load on the pipe and the depth to the impermeable layer. The minimum subsurface drain depth is 24-inches under normal conditions, and 12-inches where the drain will not be subject to equipment loading.

One interceptor drain is usually sufficient. If multiple drains are to be used, calculating the required spacing can become a difficult task. The best approach is to install the first interceptor drain. If seepage or high water table problems occur down-slope, install an additional drain where the down-slope problems occur.

1.5 General Design Criteria

Subsurface drain should be sized for the required flow capacity. The minimum diameter for a subsurface drain is **4-inches**.

The minimum velocity required to prevent silting is **1.4-feet/second**. The line should be graded to achieve at least this velocity.

Filter material and/or fabric should be used around all drains for proper bedding and filtration of fine materials. A minimum of 3-inches of material shall be placed on all sides of the pipe.

If free of sediment, the outlet of the subsurface drain should empty into a receiving channel, swale, or stable vegetated area adequately protected from erosion and undermining. The outlet point shall be located above the mean water level of the receiving channel. The outlet shall consist of a 10-foot section of corrugated metal, cast iron, steel or schedule 40 PVC pipe without perforations.

Acceptable materials for subsurface drains include perforated, continuous closed-joint conduits of corrugated plastic pipe meeting the requirements of AASHTO M252 for polyethylene tubing, AASHTO M278 Class PS 50 for polyvinyl requirements, or AASHTO A1 196 for Type III aluminum alloy pipe.

Subsurface drains are not designed to flow under pressure and the hydraulic gradient is parallel with the grade line. The flow is considered to be open channel and Manning's Equations can be used. The required subsurface drain size can be determined from the following steps:

- Determine the flow rate that the subsurface drain must carry.
- Determine the gradient of the drain.
- Determine the appropriate Manning's n value for the selected subsurface drain pipe.
- Select the appropriate subsurface drain capacity chart from Figures 8-8 through 8-10 in Appendix K.
- Enter the gradient of the pipe and the design flow of the pipe. The intersection of the two lines must be to the right of line representing 1.4 ft/sec. If the intersection is not to the right of 1.4 ft/sec, increase the gradient, the flow capacity, or both.

1.6 Construction Specifications

- The trench shall be constructed on a continuous grade with no reverse grades or low spots.
- Soft or yielding soils under the drain should be stabilized with gravel or other suitable material.
- Deformed, warped, or otherwise unsuitable pipe should not be used.
- Filter material should be placed or specified with at least 3-inches of material on all sides of the pipe.
- Backfiring should be done immediately after placement of the pipe. No sections of pipe should remain uncovered overnight or during a rainstorm. Backfill material should be placed in the trench in such a manner that the drain pipe is not displaced or damaged. Material used for backfill should be open granular soil that is highly permeable.
- The outlet shall consist of a 10-foot section of corrugated metal, cast iron, steel or schedule 40 PVC pipe without perforations. At least two-thirds of the outlet pipe shall be buried.
- The outlet should be stabilized and should direct sediment-laden storm water runoff to sediment trapping structures or another stabilized area.

1.7 Maintenance

Inspect subsurface drains on a regular schedule and check for evidence of pipe breaks or clogging by sediment, debris, or tree roots. Remove blockage immediately, replace any broken sections, and restabilize the surface. If the blockage is from tree roots, it may be necessary to relocate the drain. Check inlets and outlets for sediment or debris. Remove and dispose of these materials properly. Where heavy vehicles cross drains, the drainage line shall be checked to ensure that the pipe had not been crushed or damaged.