

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

**SUBSURFACE DRAIN
(Ft.)**

Code 606

DEFINITION

A conduit installed beneath the ground surface to collect and/or convey excess water.

PURPOSE

This practice may be applied as part of a resource management system to remove excessive soil water.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to agricultural land where a shallow water table exists and where a subsurface drainage system can mitigate the following adverse conditions caused by excessive soil moisture:

- Poor health, vigor and productivity of plants
- Poor field trafficability.
- Health risk and livestock stress due to pests such as flukes, flies, or mosquitoes
- Wet soil conditions around farmsteads, structures, and roadways, or needed to lower the water table for other conservation practices

CRITERIA

The design and installation will be based on adequate surveys and investigation.

Additional design criteria for subsurface drainage systems are contained in the “Drainage Guide for New York” (Guide)

Capacity: Design capacity must be based on drainage coefficient (for lowering the water table), inflow rates (for random “spot seepage” drainage), size of area being drained (when lowering the water table), grade of the drain, and internal roughness of the pipe.

Size: The size of subsurface drains must be computed by applying Manning’s formula, using roughness coefficients recommended by the manufacturer of the conduit. The size must be based on the maximum design flow rate as summarized below:

To control seepage (interceptor drains), size conduit in accordance to inflow rate, per 1,000’ of line, appropriate to soil texture and grade of conduit

For lowering the water table, use a drainage coefficient appropriate to the area to be drained and grade of the conduit.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [Field Office Technical Guide](#).

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All subsurface drains must have a nominal diameter that equals or exceeds 3 inches.

The size must be based on the maximum design flow rate and computed using one of the following assumptions:

- The hydraulic grade line parallel to the bottom grade of the subsurface drain with the conduit flowing full at design flow (normal condition, no internal pressure).
- Conduit flowing partly full where a steep grade or other conditions require excess capacity.
- Conduit flowing under internal pressure with hydraulic grade line set by site conditions, which differs from the bottom grade of the subsurface drain.
- The design internal pressure of drains must not exceed the limits recommended by the manufacturer of the conduit.

Horizontal Alignment: A change in horizontal direction of the subsurface drain must be made by one of the following methods:

- The use of manufactured fittings.
- The use of junction boxes or manholes.

A gradual curve of the drain trench on a radius that can be followed by the trenching machine while maintaining grade

Location, Depth, Cover and Spacing: The location, depth, and spacing of the subsurface drain must be based on site conditions including soils, topography, groundwater conditions, crops, land use, outlets and proximity to wetlands.

In mineral soils, the minimum depth of cover over subsurface drains must be 2.0 feet.

In organic soils, the minimum depth of cover after initial subsidence must be 3.0 feet.

If water control structures are installed and managed to limit oxidation and subsidence of the soil, the minimum depth of cover may be reduced to 2.5 feet.

For flexible conduits, maximum burial depths must be based on manufacturer's recommendations for the site conditions, or based on a site-specific engineering design consistent with methods in NRCS National Engineering Handbook (NEH), Part 636, Chapter 52, Structural Design of Flexible Conduits.

Minimum Velocity and Grade: In areas where sedimentation is not a hazard, minimum grades must be based on site conditions and a velocity of not less than 0.5 feet per second. If a sedimentation hazard exists, a velocity of not less than 1.4 feet per second must be used to establish the minimum grades. Otherwise, provisions must be made for preventing sedimentation by use of filters or by collecting and periodically removing sediment from installed traps, or by periodically cleaning the lines with high-pressure jetting systems or cleaning solutions.

Maximum Velocity: Design velocities for perforated or open joint pipe must not exceed those given in the Guide, unless special protective measures are installed.

On sites where topographic conditions require drain placement on steep grades and design velocities greater than indicated in the Guide. Special measures must be used to protect the conduit or surrounding soil, as explained in the Guide.

Outlets. Drainage outlets will be adequate for the quantity of water to be discharged.

Outlets to surface water will be designed to operate without submergence under normal conditions.

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For discharge to streams or channels, the outlet invert will be located above the elevation of normal flow and at least 1.0 foot above the channel bottom.

Minimum lengths for the outlet section of conduit are provided in Table 1 (below) provided at least 2/3 of the pipe is embedded into the bank to provide for cantilever support. The cantilever section must extend to the toe of the ditch side slope, or the side slope will be protected from erosion.

An animal guard must be installed in the end of the outlet pipe.

Single-wall Corrugated Plastic Pipe is not suitable for the section that outlets into a ditch or channel.

For outlets into sumps, the discharge elevation will be located above the elevation at which pumping is initiated.

Table 1. Minimum Length of Outlet Pipe Sections.

Pipe Diameter, in.	Min. Section Length, ft.
8 and smaller	10
10 to 12	12
15 to 18	16
Larger than 18	20

Protection from Root Clogging: The following step may reduce the incidence of root intrusion:

- Install a continuous section of non-perforated pipe or tubing with sealed joints, through the area of potential root intrusion.
- Remove water-loving trees for a distance of at least 100 feet on each side of the drain, and locate drains a distance of 50 feet or more from non-crop tree species.
- Provide for intermittent submergence of the drain to limit rooting depth by installing a structure for water control (e.g. an inline weir with adjustable crest) that allows for raising the elevation of the drain outlet.

Thrust Control: Follow pipe manufacturer's recommendations for thrust control or anchoring if the following conditions exist:

- Axial forces that tend to move the pipe
- Thrust forces from abrupt changes in pipeline grade or horizontal alignment, which exceeds soil bearing strength
- Reductions in downstream pipe size

In the absence of manufacturer's data, thrust blocks must be designed in accordance with NEH, Part 636, Chapter 52, and Structural Design of Flexible Conduits.

Water Quality: Septic systems must not be directly connected to the subsurface drainage system, nor must animal waste be directly introduced into the subsurface drainage system. Perforated tile will be installed at ½ the Guide spacing away from potential pollution sources.

Materials: The conduit must meet strength and durability requirements listed in the NY Specification for Subsurface Drainage and/or the appropriate specification published by the American Society for testing and Materials (ASTM), American Association of State Highway transportation Officials (AASHTO), or the American Water Works Association (AWWA).

Filters and Filter Material: Filters must be used around conduits if any of the following conditions exist:

- Local experience with soil site conditions indicates a need.
- Soil materials surrounding the conduit are dispersed clays, silts with a Plasticity Index less than 7, or fine sands with a Plasticity Index less than 7.
- The soil is subject to cracking by desiccation.

The method of installation may result in inadequate consolidation between the conduit and backfill material. In all cases, the resulting flow pattern through filter material will be a minimum of 3 inches in length.

If a sand-gravel filter is specified, the filter gradation must be designed in accordance with NEH, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters.

Geotextile filter material must not be used where the silt content of the soil exceeds 40 percent.

Auxiliary Structures and Protection: The capacity of any structure installed in the drain line must be no less than that of the line or lines feeding into or through them.

Structures for water table management, with provisions to elevate the outlet and allow submergence of the upstream drain, must meet applicable design criteria in NRCS Conservation Practice Standards, Structure for Water Control (587), and Drainage Water Management (554).

If the drain system is to include Underground Outlets (620), the capacity of the surface water inlet must not be greater than the maximum design flow in the downstream drain line or lines.

Covers or trash racks must be used to ensure that no objectionable materials are allowed in the drain lines. Inlets must be protected from entry of animals or debris. If sediment may pose a problem, sediment traps must be installed.

The capacity of a relief well system must be based on the flow from the aquifer, the well spacing, and other site conditions, and must be adequate to lower the artesian water head to the desired level. Relief wells must not be less than 4 inches in diameter.

Junction boxes, manholes, catch basins, and sand traps must be accessible for maintenance. A clear opening of not less than 2.0 feet will be provided in either circular or rectangular structures.

The drain system must be protected against turbulence created near outlets, surface inlets or similar structures. Continuous non-perforated or closed-joint pipe must be used in drain lines adjoining the structure where excessive velocities will occur.

Junction boxes must be installed where three or more lines join or if two lines join at different elevations. If the junction box is buried, a solid cover should be used, and the junction box should have a minimum of 1.5 feet of soil cover. Buried boxes must be protected from traffic.

Watertight conduits designed to withstand the expected loads must be used where subsurface drains cross under irrigation canals, ditches, or other structures.

CONSIDERATIONS

When planning, designing, and installing this practice, the following items should be considered:

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- Protection of shallow drains, auxiliary structures, and outlets from damage due to freezing and thawing
- Proper surface drainage to reduce the required intensity of the subsurface drainage system
- Designs that incorporate drainage water management practices (or facilitate its future incorporation) to reduce nutrient loading of receiving waters
- Drainage laterals oriented along elevation contours to improve the effectiveness of drainage water management structures.
- The effects of drainage systems on runoff volume, seepage, and the availability of soil water needed for plant growth.
- Confirmation of soil survey information with site investigation, including auguring and shallow excavations to identify soil profile hydraulic characteristics, soil texture layering, water table depth, etc.
- The effects of drainage systems on the hydrology of adjacent lands.
- The effects of drainage systems on wetlands, wetland related vegetation, and fish and wildlife habitat.
- Subsoiling or ripping of soils with contrasting texture layers to improve internal drainage.
- Installations in dry soil profile to minimize problems of trench stability, conduit alignment, and soil movement into the drain.
- Use of temporary flow blocking devices to reduce risk of drain water contamination from surface applications of manure
- Using metal outlet pipes if the burning of vegetation along a bank is probable by the landowner
- If ice or floating debris may damage the outlet pipe, consider recessing the outlet pipe to the extent that the cantilevered part of the pipe will be protected from the current of flow in the ditch or channel.
- The effects to water quality when installing a blind inlet in fields where manure is also spread. Maintain a buffer area around the inlet.

Use an envelope around drains to improve flow characteristics. Materials used for envelopes do not need to meet the gradation requirements of filters, but they should not contain materials that will cause an accumulation of sediment in the conduit, or materials that will render the envelope unsuitable for bedding of the conduit. Envelope materials should consist of sand-gravel, organic, or similar material. 100 percent of sand-gravel envelope materials must all pass a 1.5-inch sieve; not more than 30 percent should pass a Number 60 sieve; and not more than 5 percent should pass the Number 200 sieve. Organic or other compressible envelope materials must not be used below the centerline of flexible conduits. All organic or other compressible materials should be of a type that will not readily decompose.

Drains in certain soils are subject to clogging of drain perforations by bacterial action in association with ferrous iron, manganese, or sulfides. Iron ochre can clog drain openings and can seal manufactured (fabric) filters. Manganese deposits and sulfides can clog drain openings. Where bacterial activity is expected to lead to clogging of drains, consider providing access points for cleaning the drain lines periodically.

Where possible, outlet individual drains to an open ditch to isolate localized areas of contamination and to limit the translocation of contamination throughout the system.

PLANS AND SPECIFICATIONS

Plans and specifications for installing subsurface drains must be in keeping with this standard and must describe the requirements for applying the practice to achieve its intended purpose.

At a minimum, plans specifications must include, as applicable: location of drainage system; wetland delineation(s); conduit lengths, grades, sizes, and type of materials; structure locations, dimensions, and

elevations; outlet locations, elevations, and protection required; and normal water level elevations in outlet ditches or streams.

Operation and maintenance

The Operation and Maintenance (O&M) Plan must provide specific instructions for operating and maintaining the system to insure proper function as designed. At a minimum, the O&M Plan must address:

- Necessary periodic inspection and prompt repair of system components (e.g. structures for water control, underground outlets, vents, drain outlets, trash and rodent guards).
- Winterization protection from freezing conditions for drainage systems in cold climates.

References

USDA-NRCS, National Engineering Handbook, Part 624, Chapter 4, Subsurface Drainage
<http://policy.nrcs.usda.gov/>

USDA-NRCS, National Engineering Handbook, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters
<http://policy.nrcs.usda.gov/>

USDA-NRCS, National Engineering Handbook, Part 636, Chapter 52, Structural Design of Flexible Conduits
<http://policy.nrcs.usda.gov/>

SDA-NRCS Drainage Guide for New York State, June 2008
ftp://ftp-fc.sc.egov.usda.gov/NY/engineering_tools/drainage_guide_ny.pdf