Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

CODE 620

(ft)

DEFINITION

A conduit or system of conduits installed beneath the ground surface to convey surface water to a suitable outlet.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Prevent concentrated flow erosion.
- Manage flooding and ponding.
- Maintain water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where—

- Removal of surface water is necessary.
- An outlet is needed for a terrace, diversion, water and sediment control basin, or similar practices.
- Removal of stormwater collected by roof runoff structures or similar practices is necessary.
- A surface outlet is impractical because of stability problems, topography, climatic conditions, land use, or equipment traffic.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct the underground outlet to meet all Federal, State, Tribal, and local regulations.

Capacity

Base the design capacity of the underground outlet on the requirements of the structure or practice it serves. An underground outlet can function as the only outlet for a structure or in conjunction with other types of outlets.

Design the outlet so the water storage time does not exceed the inundation tolerance of the planned crops, vegetation, or works of improvement.

Design the underground outlet to account for anticipated water surface conditions at the outlet during design flow.

Flood routing techniques may be used to determine the relationship between flooding duration, underground release rate, and basin storage volume.

Underground outlets can be designed for either pressure or gravity flow. Design all pipes and joints in pressure systems to withstand the design pressure, including surges and vacuum. For gravity flow systems, use a flow-restricting device such as an orifice or weir to limit flow into the conduit or choose conduit sizes that are large enough to prevent pressure flow. Design the orifice to be compatible with the inlet. Size the orifice based on the inundation time and potential crop residue. Gravity flow systems must maintain a positive grade throughout the conduit length towards the outlet.

If necessary, use pressure relief wells to allow excess flow to escape the conduit and flow over the ground surface. Use pressure relief wells only where there is a stable outlet for the discharge from the relief well. Cover pressure relief wells with a grate or other appropriate covering to prevent injury to animals and entry of debris.

Inlet
An inlet can be a collection box, blind inlet (gravel), perforated riser, perforated conduit, or other appropriate device. Design components of underground outlets, including inlet collection boxes and conduit junction boxes, with sufficient size to facilitate maintenance and cleaning operations.

Open inlets must have a trash guard. Design the inlet so any trash or debris entering the inlet will pass through the flow-restricting device and conduit without plugging.

Perforated riser inlets must be durable, structurally sound, and resistant to damage by rodents or other animals. Perforations must be smooth, free of burrs, and have adequate capacity to prevent the riser from restricting flow in the underground outlet.

Blind inlets may be used where the installation of an open or above ground structure is impractical. Design the blind inlet to prevent soil particle movement into the conduit.

Conduit
The minimum allowable diameter of conduits is 4 inches. Conduit joints must be hydraulically smooth and consistent with the manufacturer's recommendation for the conduit material and installation.

Design the underground outlet to ensure that maximum allowable loads on the conduit are not exceeded for the type and size of conduit. Assess the depth of cover requirements to prevent damage to the underground outlet from traffic, tillage operations, and frost action. Design perforated components of underground outlets to prevent soil particle movement into the underground outlet. In absence of manufacturer's data, use NRCS Conservation Practice Standard (CPS) Subsurface Drain (Code 606) criteria for filters, design loading, placement, and bedding requirements.

Provide thrust blocking or anchoring where needed to prevent undesired movement of the conduit. Evaluate placement, bedding, and backfill requirements for the conduit to ensure integrity of the installation. In absence of manufacturer's data, design thrust blocks in accordance with NRCS Title 210, National Engineering Handbook, Part 636, Chapter 52, "Structural Design of Flexible Conduits."

Minimum velocity and grade
In areas where sedimentation of fine sands and silts is not a hazard, design the minimum grade based on site conditions and a velocity of not less than 0.8 feet per second. If a sedimentation potential exists, either use a velocity of not less than 1.4 feet per second to establish the minimum grade or include provisions for preventing sedimentation. Use filters, collect and periodically remove sediment from installed traps, or periodically clean the lines with high-pressure jetting systems or cleaning solutions to address sedimentation. Prior to using high-pressure jetting systems, verify that the jetting system will not damage the pipe or the pipe embedment.

Maximum velocity
Limit the design velocities in perforated, high-density polyethylene (HDPE) pipe under open channel flow to 12 feet per second or the manufacturer's recommended limit. Limit design velocities for nonperforated

pipe to manufacturer's recommended limits applicable to the pipe diameter, material and joint type, and site condition.

Materials
Underground outlet materials include flexible conduits of plastic, metal, or other materials of acceptable quality. Materials must meet applicable site-specific design requirements for leakage, external loading, and internal pressure including vacuum conditions.

All conduits must meet or exceed the minimum requirements of the appropriate specifications 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).

Underground outlet conduits may be continuous tubing, tile, or pipe sections and may be perforated or nonperforated. Ensure any couplers joining pipe sections are compatible with the pipe and will withstand all required loads.

Use fire-resistant materials for underground outlet components if fire is an expected hazard. All plastics must be UV resistant or protected from exposure to sunlight.

Outlet
Stabilize the outlet and protect it against erosion and undermining for the range of design flow conditions.

An underground outlet may discharge into a structure that is designed to accommodate the additional inflow.

For discharge to streams or channels, locate the outlet invert above the elevation of normal flow and at least 1 foot above the channel bottom.

Specify a continuous section of pipe for the outlet section, without open joints or perforations, and with stiffness necessary to withstand expected loads, including those caused by ice. Use table 1 for the minimum length for the outlet section of the conduit.

Table 1. Minimum Length of Outlet Pipe Sections

Pipe Diameter (inches)	Minimum Section Length (feet)
8 and smaller	10
10 to 12	12
15 to 18	16
Larger than 18	20

A shorter section of closed conduit may be used if a headwall is used at the outlet of the conduit.

The use and installation of outlet pipe must conform to the following requirements:

- Bury at least two-thirds of the rigid outlet pipe section in the ditch bank and project the cantilever section past the toe of the ditch side slope; or protect the side slope from erosion below the outlet pipe.
- If ice or floating debris may damage the outlet pipe, protect the pipe by recessing the cantilevered part of the pipe to protect it from the current of flow in the ditch or channel.
- Headwalls used for subsurface drain outlets must be adequate in strength and design to avoid washouts and other failures.

Specify animal guards on all outlets to prevent the entry of rodents or other animals. Design animal guards to allow passage of debris while blocking the entry of animals large enough to restrict the flow in the conduit.

Use a vertical outlet to discharge water to the ground surface where topography does not allow adequate conduit cover using a horizontal outlet, or where it is practical to discharge over a vegetated filter strip. Design the vertical outlet to allow the system to drain during periods when not in use.

Pressure relief wells and vertical outlets, if not properly identified, can present a safety hazard for people or animals and may be damaged by field equipment. Identify pressure relief wells and vertical outlet locations with a high visibility marker.

Stabilization
Reshape and regrade all disturbed areas so they blend with the surrounding land features and conditions. For areas that will not be farmed, refer to NRCS CPS Critical Area Planting (Code 342) for establishment of vegetation criteria. Establish permanent vegetation on all noncrop disturbed areas as soon as possible after construction.

CONSIDERATIONS

Consider climate change impact on determining outlets's capacity.

Consider impacts on downstream source water due to erosion and sediment load and impacts on important fish and wildlife habitats such as streams, creeks, riparian areas, groundwater, and wetlands.

Consider the effects of the underground outlet on the hydrology of adjacent lands, especially potential or delineated wetlands and existing wetland easements. Where wetlands may be affected, advise the cooperator that current USDA wetland policy will apply.

Seasonal water sources can be beneficial for migratory waterfowl and other wildlife. Consider the use of a water control structure at the inlet of an underground outlet to provide water for wildlife during noncropping periods. Use NRCS CPS Shallow Water Development and Management (Code 646) to manage seasonal water sources for wildlife and NRCS CPS Structure for Water Control (Code 587) for the structure.

Underground outlets may provide a direct conduit to receiving waters for contaminated runoff. Install underground outlets and the accompanying structures or practices as part of a conservation system that addresses issues such as nutrient and pest management, residue management, and filter areas. Consider providing an increased level of designed treatment for sites with high priority areas for source water protection or are upstream of community drinking water withdrawal sites.

The construction of an underground outlet in a riparian corridor can have an adverse effect on the visual resources of the corridor. Consider the visual quality of the riparian area when designing the underground outlet.

Consider potential effects of soil physical and chemical properties on areas where a conduit or system of conduits are installed to convey surface water. Refer to soil survey data as a preliminary planning tool for assessment of areas. Consult the Web Soil Survey to obtain soil properties and qualities information.

When revegetation is needed, consider using species or diverse mixes that are native or adapted to the site and have multiple benefits. In addition, where appropriate, consider a diverse mixture of forbs and wildflowers to support pollinator and other wildlife habitat. if project is for USDA certified-organic and transitioning-to-organic operations, all materials need to comply with the USDA National Organic Program (NOP) Standards, including all seeds, planting stock, fertilizers, and other production inputs.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for underground outlets that describe the requirements for applying this practice according to this standard. The plans and specifications for an underground outlet may be incorporated into the plans and specifications for the structure or practice it serves. As a minimum include—

- A plan view of the layout of the underground outlet.
- Typical cross sections and bedding requirements for the underground outlet.
- Profile of the underground outlet.
- Details of the inlet, pipe, and outlet.
- Seeding requirements if needed.

Prepare construction specifications describing site-specific installation requirements of the underground outlet.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in a written operation and maintenance plan are—

- Periodic inspections, especially immediately following significant runoff events, to keep inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce flow.
- Prompt repair or replacement of damaged components.
- Repair or replacement of inlets damaged by farm equipment.
- Repair of leaks and broken or crushed lines to ensure proper functioning of the conduit.
- Periodic inspection of the outlet and animal guards to ensure proper functioning.
- Repair eroded areas at the pipe outlet.
- Maintenance of adequate backfill over the conduit.
- Maintenance of the permeability of surface materials of blind inlets by periodic scouring or removal and replacement of the surface soil layer.

REFERENCES

USDA NRCS. 2021. National Engineering Handbook (Title 210), Part 650, Chapter 6, Structures. Washington, D.C. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=46256.wba

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