

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**UNDERGROUND OUTLET**

(Ft.)

**CODE 620**

**DEFINITION**

A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet.

**PURPOSE**

Dispose of excess water from terraces, diversions, subsurface drains, surface drains, trickle tubes or principal spillways from dams (outside the dam area only), or other concentrations without causing damage by erosion or flooding.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies where: (1) excess surface water needs to be disposed of; (2) a buried outlet is needed for Conservation Practice Standards 362 Diversion, 600 Terrace, 638 Water and Sediment Control Basin, 558 Roof Runoff Structure or similar Conservation Practice Standards; (3) an underground outlet can be installed that will safely dispose of excess water; and (4) surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic.

**CRITERIA**

**Utilities and Permits.** The landowner shall be responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

The landowner shall obtain all necessary permissions from regulatory agencies, including the Illinois Department of Agriculture, US Army Corps of Engineers, US Environmental Protection Agency, Illinois Environmental Protection Agency and Illinois Department of Natural Resources – Office of Water Resources, or document that no permits are required.

**Capacity.** The underground outlet shall be designed, alone or in combination with other practices, with adequate capacity to ensure that the terrace, diversion, other practices function according to the standard for the specific practice. For example, an underground outlet can be used in combination with a grassed waterway or a surface drain to carry part of the design flow. The capacity of the underground outlet for natural or constructed basins shall be adequate for the intended purpose without causing excessive damage to crops, vegetation, or improvements.

**Inlet.** An inlet can be a collection box, a perforated riser, or other appropriate device. The capacity of the inlet shall be adequate to provide the maximum design flow in the conduit. Flow-control devices shall be installed as necessary. Perforated risers must be of durable material, structurally sound, and resistant to damage by rodents or other animals. If burning of vegetation is likely to create a fire hazard, the inlet shall be fire resistant. Blind inlets can be used where they are effective. Collection boxes must be large enough to facilitate maintenance and cleaning operations. The inlet must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging. It must also have an animal guard to prevent the entry of rodents or other animals.

**Relief Well.** Pressure-relief wells shall be designed and installed as needed to control pressure, where the outlet of flow on to the ground surface will be stable. Relief wells used as outlets shall have a positive hydraulic grade line to the relief well. Inline relief wells shall have a positive hydraulic grade line to the outlet of the system. If junction boxes or other structures are needed, they shall be designed and installed in a manner that facilitates cleaning and other maintenance activities.

**Conduit.** Underground outlets shall be continuous conduits, tubing, or tile. Joints shall be hydraulically smooth, and the materials and methods used shall be as recommended by the manufacturer. If a pressure system is used, joints shall be adequate to withstand the design pressure, including surges and vacuum.

Lines shall be adequate to carry the design flow when the outlet and all inlets are operating at design capacity. Positive conduit and hydraulic grade shall be maintained in all sections of an underground outlet. Capacity shall be based on the pipe size or on other flow control devices to prevent water from the upper inlets from discharging through the lower inlets. The minimum conduit diameter shall be 4 inches.

**Maximum Velocity.** The maximum velocity must not exceed the safe velocity for the conduit materials and installation (Table 1).

| Soil Texture          | Perforated | Non-Perforated |
|-----------------------|------------|----------------|
| Sand and sandy loam   | 3.5        | 8.0            |
| Silt and silt loam    | 5.0        | 10.0           |
| Silty clay loam       | 6.0        | 12.0           |
| Clay and clay loam    | 7.0        | 12.0           |
| Coarse sand or gravel | 9.0        | 12.0           |

Maximum Velocity for Dual Wall Polyethylene pipe and joints is 20 ft/s. All joints and fittings shall be watertight, capable of withstanding 10.8 psi internal pressure.

Polyvinyl Chloride (PVC), Smooth Steel or Corrugated Metal Pipe have no velocity restrictions if joints are watertight and pipe is aligned to prevent cavitation and water hammer.

**Minimum Velocity.** In areas where sedimentation is not a hazard, the minimum grades shall be based on site conditions and a velocity of not less than 0.5 feet per second (ft/s). If a hazard exists, a velocity of not less than 1.4 ft/s shall be used to establish the minimum grades if site conditions permit. Otherwise, provisions shall 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 clearing solutions.

**Materials.** Materials shall meet or exceed the design requirements against leakage and shall withstand internal pressure or vacuum and external loading. Plastic, concrete, aluminum, and steel shall meet the requirements specified in the applicable ASTM standard. All materials specified for Illinois Conservation Practice Standard IL 606 Subsurface Drain can be used for underground outlets. Conduits can be perforated or non-perforated, depending on the design requirements. A filter fabric wrap (sock) or equivalent shall be used if migration of soil particles around conduit is anticipated. All exposed plastic materials shall be protected from degradation due to exposure to sunlight.

**Depth.** The minimum depth of cover over conduits in mineral soils shall be 2 feet. This minimum depth shall apply to normal field levels and may exclude sections of line near the outlet sections laid through minor depressions where the conduit is not subject to damage by frost action or equipment travel.

The minimum depth of cover in organic soils shall be 2.5 feet for normal field levels, as defined above, after initial subsidence. Structural measures shall be installed if it is feasible to control the water table level in organic soils within the optimum range of depths.

The maximum depth of cover for standard duty corrugated plastic tubing shall be 10 feet for trench widths of 2 feet or less (measured at tubing and to 1 foot above top of tubing). Heavy-duty tubing shall be specified for depths greater than 10 feet, trench widths more than 2 feet, or in rocky soils.

For computation of maximum allowable loads on conduits, use the trench and bedding conditions specified and the crushing strength of the kind and class of drain. The design load on the conduit shall be based on a combination of equipment loads and trench loads. Equipment loads are based on the maximum expected wheel loads for the equipment to be used, the minimum height of cover over the conduit, and the trench width. Equipment loads on the conduit may be neglected when the depth of cover exceeds 6 feet. Trench loads are based on the type of backfill over the conduit, the width of the trench, and the unit weight of the backfill material. A safety factor of not less than 1.5 shall be used in computing the maximum allowable depth of cover for a particular type of conduit.

**Outlet.** The outlet shall be sufficiently stable for all anticipated flow conditions. It shall be designed for the maximum anticipated water surface at design flow. A continuous section of closed conduit or a headwall shall be used at the outlet.

If a closed conduit is used (rather than a headwall), the conduit shall be at least 10 feet long, durable and strong enough to withstand all anticipated loads, including those caused by ice. At least two-thirds of the continuous section of closed conduit shall be buried in the ditch bank, and the cantilever section must extend to the toe of the ditch side slope or to the side slope protected from erosion.

Outlets shall not be placed in areas of active erosion. If fire is a hazard, the outlet shall be fire resistant. All outlets must have animal guards to prevent the entry of rodents or other animals. Animal guards must be hinged to allow passage of debris.

**Protection.** All disturbed areas shall be reshaped and regraded so that they blend with the surrounding land features and conditions. Visual resources must be given the same consideration as other design features. Areas that are not to be farmed or covered by structural works shall be established to vegetation or otherwise protected from erosion as soon as practicable after construction.

## CONSIDERATIONS

Consider effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Consider effects on the volume of downstream flow that might cause undesirable environmental, social, or economic effects.

Evaluate potential use for water management.

Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff.

Consider effects on the visual quality of downstream water resources.

Consider the construction-related effects on the quality of downstream watercourses.

Consider effects on wetlands or water-related wildlife habitats.

Evaluate potential impact on water quality due to agri-chemicals in outflow.

Consider depth of underground outlet in regard to tillage equipment depth and maintenance, if applicable.

Consider providing a pipe support on the outlet section for larger pipe sizes and long cantilever sections.

## 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, the plans and specifications shall include:

- A plan view of the layout of the underground outlet.
- Typical cross-sections or bedding requirements for the underground outlet.
- Profile of the underground outlet.
- Details of the inlet and outlet.
- Seeding requirements, if needed.
- Construction specifications that describe in writing the site specific installation requirements of the underground outlet.

## OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be prepared for and reviewed with the landowner or operator. The plan shall specify that the treated areas and associated practices are inspected annually and after significant storm events to identify repair and maintenance needs.

The O&M plan shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

Underground outlets shall be maintained by:

- Keeping inlets, trash guards, orifices and

collection boxes and structures clean and free of materials that can reduce the flow.

- Repairing leaks and broken or crushed lines to ensure proper functioning of the conduit.
- Repairing or replacing damaged inlets or structures.
- Checking outlet conduit and animal guards to ensure proper functioning of the conduit.

- Keeping adequate backfill over the conduit.
- Repairing any eroded areas at the pipe outlet.

#### **REFERENCES**

National Engineering Handbook, Part 650, Engineering Field Handbook, Chapters 3, 6, 8, 14, USDA Natural Resources Conservation Service.

**NATURAL RESOURCES CONSERVATION SERVICE**  
**ILLINOIS CONSTRUCTION SPECIFICATION**  
**UNDERGROUND OUTLET**

**Scope**

The work shall consist of furnishing and installing conduits and inlets for underground outlets as shown on the drawings and specified herein.

**Inspection and Handling of Materials**

Conduit and inlet materials shall be carefully inspected before installation. Where applicable, clay and concrete tile shall be checked for damage from freezing and thawing prior to installation. Bituminized fiber and plastic pipe and tubing shall be protected from hazards causing deformation or warping. Materials with physical imperfections shall not be installed.

**Placement**

All underground outlets shall be laid to line and grade and covered with approved blinding, envelope, or filter material to a depth of not less than 3 inches over the top of the drain. No reversals in grade of the conduit shall be permitted. Material used for blinding shall contain no rocks greater than 1½ inches in diameter. The cover over all buried conduit lines shall be at least 2 feet deep.

All conduits shall be installed in accordance with ASTM F449 Standard Recommended Practice for Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control.

Rigid conduits such as clay or concrete tile will not need the 90° V groove, but all other applicable placement and bedding requirements will be adhered to. Joints between drain tiles shall have the closest possible fit.

**Backfill**

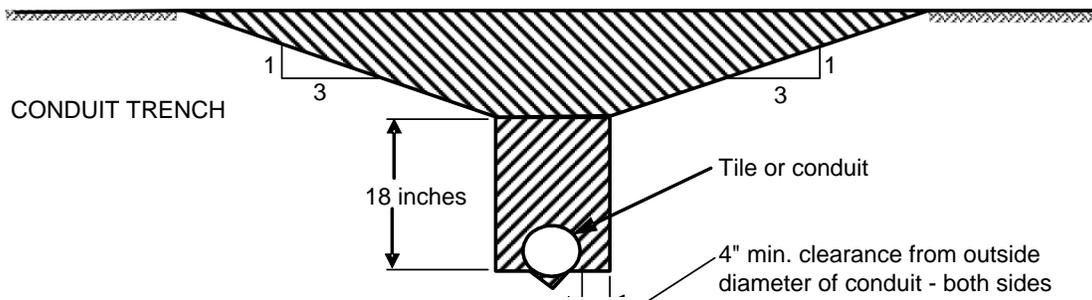
Earth backfill material shall be placed in the trench in such a manner that displacement of the conduit will not occur and so that the filter and bedding material, after backfilling, will meet the requirements of the drawings and specifications. Backfill within 2 feet of conduit shall have no rock particles larger than 2 inches in diameter.

**Backfill Under Ridge Area**

When conduits are installed two or more seasons prior to construction of terrace or diversion ridges, backfilling operations should be performed at an angle to the trench so that loose backfill material flows down the advancing frontslope. In all other cases the conduit under the ridge area shall receive special backfilling as shown in Figure 1.

Backfill shall have adequate moisture for compaction. The moisture content can generally be considered as satisfactory if the fill material can be molded into a round ball between the hands without readily separating or squeezing out free water. Backfill within 6 inches of conduit shall be hand-compacted. Subsequent layers of backfill shall be placed in 6 inch lifts and mechanically compacted.

Water packing may be used as an alternative to mechanical compaction. If the conduit is non-perforated, it shall be filled with water during the water packing procedure. The initial backfill, before wetting, shall be of sufficient depth to ensure complete coverage of the pipe after consolidation has taken place. Water packing is accomplished by adding water in such quantity as to thoroughly saturate the initial backfill without inundation. The wetted fill shall be allowed to dry until firm before final backfill is begun.



**Figure 1.**

**NATURAL RESOURCES CONSERVATION SERVICE  
ILLINOIS CONSTRUCTION SPECIFICATION  
UNDERGROUND OUTLET**

**Inlets for Underground Outlets**

Inlets for underground outlets shall be installed in accordance with IL NRCS Standard Drawing IL-ENG-118, or approved equivalent.

**Outlet**

A continuous section of non-perforated conduit shall be used at the outlet, unless a headwall is used. All outlets shall have an animal guard, hinged to allow passage of debris.

The continuous section of non-perforated conduit shall be long enough to satisfy all requirements of the standard:

- At least two-thirds of the pipe shall be buried in the ditch bank.
- The cantilever section must extend to the toe of the ditch side slope or to the side slope protected from erosion.
- The continuous section must be at least 10 feet long.

Acceptable materials for use at the outlet include the following:

- Corrugated metal pipe, galvanized or aluminum, 16-gauge, minimum thickness,
- Smooth steel pipe with 3/16 of an inch minimum thickness,
- Smooth plastic pipe, polyvinyl chloride (PVC), with a SDR of 35 or less or schedule 40 or heavier, and
- Dual wall corrugated polyethylene pipe.

All plastic and polyethylene pipe outlets shall include an ultra-violet stabilizer. Conduit ends shall be protected during installation.

**Materials**

Materials for underground outlets shall meet the requirements as shown in the plans and specifications. They shall be field inspected for any deficiencies such as thin spots or cracking prior to installation.

The following reference specifications pertain to products currently acceptable for use as underground outlets:

| <b>REFERENCE SPECIFICATIONS FOR UNDERGROUND OUTLET MATERIALS</b> |                                    |
|--|------------------------------------|
| <b>Description</b>   | <b>ASTM</b>                        |
| <b>Plastic</b>   |                                    |
| Corrugated Polyethylene (PE) Pipe and Fittings                   | F405<br>F667                       |
| Poly Vinyl Chloride (PVC) Pipe and Fittings                      | F949<br>D1785                      |
| Styrene-Rubber (SR) Plastic Drain Pipe and Fittings              | D2852                              |
| <b>Dual Wall Polyethylene Pipe</b>                               |                                    |
| Corrugated Polyethylene (PE) Pipe and Fittings                   | F2306<br>F667                      |
| Elastomeric Seals and Joints (Gaskets)                           | F477<br>D3212                      |
| <b>Clay</b>  |                                    |
| Clay Drain Tile and Pipe   | C4<br>C700<br>C301                 |
| <b>Concrete</b>  |                                    |
| Concrete Drain Tile and Pipe                                     | C412<br>C118<br>C14<br>C76<br>C444 |
| Test Methods for Concrete Pipe                                   | C497                               |
| Portland Cement  | C150                               |
| <b>Metal</b>   |                                    |
| Corrugated Aluminum Pipe   | B745                               |
| Corrugated Steel Pipe  | A760                               |

**Utilities**

The landowner shall be responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.