

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATIONS**

LINED WATERWAY OR OUTLET

1. Scope

The work shall consist of a waterway or outlet having an erosion-resistant lining of concrete, stone, synthetic turf reinforcement fabrics, or other permanent material.

2. Location

The location of the work shall be as shown on the plans or as staked in the field.

3. Site Preparation

Clearing. The limits of the areas to be cleared will be marked by means of stakes, flags, tree markings, or other suitable means. Trees outside this area will be left standing and uninjured. Trees and other woody vegetation will be cut off no higher than 4 inches above the ground surface, unless otherwise specified in the "Construction Details."

Areas designated for grading to a uniform surface will have all stumps, root clusters, and roots larger than 1 inch in diameter grubbed to a depth of at least 1 foot below the subgrade elevation, unless otherwise specified in Section 14, "Construction Details."

Stripping. Undesirable material such as large stones, rubbish, and soil high in organic matter shall be removed from areas where the materials may interfere with the intended use of the area.

Waste material shall be placed, spread, leveled, or shaped as shown on the plans or as specified in Section 14, "Construction Details."

Disposal. All materials removed from cleared or grubbed areas shall be burned, buried, or piled at locations shown on the plans or as directed by the inspector. Burning shall comply with all state and local policies pertaining to open burning.

4. Excavation

All excavations shall conform to the lines, grades, and elevations shown on the plans or as staked in the field.

Excavated surfaces against which earthfill or concrete is to be placed shall be preserved in the most sound condition possible and protected from drying that may cause the formation of shrinkage cracks.

The completed work shall conform to the lines, grades, and elevations shown on the plans or as staked in the field.

5. Earthfill

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable materials. Fill materials shall be obtained from required excavations and/or designated borrow areas. Cuts and fills shall be balanced to the greatest extent possible. Fill materials shall contain no sod, brush, roots, or other perishable materials. Rock particles larger than the maximum size specified shall be removed prior to compaction of the fill.

The earthfill materials shall be placed in nearly horizontal layers not exceeding 9 inches before compaction or as shown on the plans. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted.

During placement and compaction of earthfill and earth backfill, the moisture content of the material being placed shall be sufficiently moist to prevent dusty conditions. The material will also be sufficiently dry to be workable (without excessive rutting of the compacted surface by the earthmoving equipment). Tracks from the earthmoving equipment should not exceed one-half of the compacted fill layer depth. The top surface of the preceding layer of fill shall have adequate moisture to permit suitable bonding with the next layer of fill prior to the placement of additional fill.

Machine compaction shall be accomplished by the controlled movement of hauling and spreading equipment over the fill area. Every point on the surface of each lift shall be traversed by not less than one tread track of the equipment.

The completed work shall conform to the lines, grades, and elevations shown on the plans or as staked in the field.

6. Concrete

Concrete shall have a minimum design strength of 3500 psi at 28 days with a maximum net water content of 6.0 gallons/bag.

Portland cement shall be Type I or II. Air-entraining admixture shall be used to provide an air content of 5 to 8 percent of the volume of concrete.

Coarse aggregate shall be hard and free from dirt and organic materials and shall consist of well-graded gravel, crushed stone, or other suitable materials larger than a #8 sieve. Maximum size shall be 1 inch.

Fine aggregate shall consist of well-graded natural or manufactured sand particle gradation ranging from coarse (1/4 inch) to fine (#200 sieve).

Mixing water shall be clean and free from oil, alkali, or acid.

The proportions of the aggregates shall be such to produce a concrete mixture that will work readily into the corners and angles of the forms and around steel reinforcement when consolidated. The slump at the time of placing shall be 3 to 5 inches.

Forms shall be wood, plywood, steel, or other approved materials and shall be mortar-tight. The forms shall be unyielding and shall be constructed so the finished concrete conforms to the specified dimensions and contours.

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings.

Inspection and approval of the forms and steel placement by designated personnel shall be made prior to the placement of concrete. Copies of the concrete delivery tickets shall also be furnished to verify proper concrete was delivered and placed.

Concrete shall be conveyed from the mixer to the forms as rapidly as practical by methods that will prevent segregation of the aggregates and loss of mortar. Concrete shall not be dropped more than 5 feet vertically except where suitable equipment is used to prevent segregation.

Immediately after the concrete is placed in the forms, it shall be consolidated by spading, hand tamping, or vibration as necessary to ensure smooth surfaces and dense concrete.

Forms shall be removed in such a way to prevent damage to the concrete.

The minimum period from completion of the concrete placement to the removal of the forms shall be 12 hours.

All exposed surfaces of the concrete shall be accurately screeded to grade and then wood-floated.

Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied.

Concrete shall not be mixed nor placed when the atmospheric temperature is less than 40° F or more than 90° F unless facilities are provided to prevent freezing or for cooling as required.

If concrete is placed when temperatures may fall below 40° F during the curing period, it will be insulated or heated to maintain a temperature of 50° F for the first 3 days of the curing period. The Natural Resources Conservation Service (NRCS) will be notified a minimum of 2 days before placing concrete in cold weather to allow for inspection.

7. Welded Wire Reinforcing

Welded wire reinforcing shall conform to the requirements of American Society for Testing and Materials (ASTM) A 185. All joints are to be double-reinforced by laps of 15 inches or more.

8. Contraction joints.

Contraction joints shall be formed transversely to a depth of about 1/3 the thickness of the lining at a uniform spacing in the range of 10 to 15 feet. Provide welded wire fabric or other uniform support to the joint to prevent unequal settlement.

9. Filter or Bedding Materials

Filters or bedding shall be used where appropriate to prevent piping. Drains shall be used to reduce uplift pressure and to collect water.

Filter or bedding material shall consist of clean sand, gravel, and/or crushed rock that ranges in size from concrete sand (ASTM C 33) to gravel or crushed rock no larger than 3/8 inch. Material shall be uniformly graded.

10. Geotextile

Nonwoven geotextiles shall be used where appropriate as a separator between rock, flagstone, or concrete linings and soil to prevent migration of soil particles from the subgrade through the lining material.

Place nonwoven geotextile filter fabric on sides and below drainfill material as shown on the plans. Fabric placement for rock riprap shall be as indicated on the plans.

Place filter fabric over and outside of the entire area of the bedding material when using concrete blocks for waterway lining. No bedding material or soil shall be placed between the filter fabric and concrete blocks. The fabric shall be loosely laid (not stretched) such that it will conform to any minor surface irregularities. No cuts or punctures in the fabric will be permitted. Fabric edges should extend at least 12 inches past the edges of the bedding material. Use a minimum lap of 24 inches if the filter fabric is installed in more than one piece. The fabric shall not be left exposed for more than 48 hours. The length of the fabric shall be placed parallel to the direction of water flow unless otherwise indicated on the plans.

Place excess fabric in a trench along all edges of bedding material and backfill or anchor with soil. The fabric shall be anchored to a minimum depth of 12 inches into the trench.

The geotextile shall be shipped/transported in rolls wrapped with a cover for protection from moisture, dust, dirt, debris, and ultraviolet light. The cover shall be maintained undisturbed to the maximum extent possible before placement. Each roll of geotextile shall be labeled or tagged to clearly identify the brand, class, and the individual production run in accordance with ASTM D 4873.

Geotextiles shall be designed according to American Association of State Highway Transportation Officials (AASHTO) M 288, Section 7.3.

Requirements for nonwoven geotextiles are as follows:

Property	Test Method	Class I	Class II	Class III	Class IV ^{2/}
Tensile Strength - pounds ^{1/}	ASTM D 4632 grab test method	180 minimum	120 minimum	90 minimum	115 minimum
Elongation - % at breaking load ^{1/}	ASTM D 4632 Grab test method	≥ 50	≥ 50	≥ 50	≥ 50
Puncture - pounds ^{1/}	ASTM D 4833	80 minimum	60 minimum	40 minimum	40 minimum
Ultraviolet Light Resistance	ASTM D 4355 150 hours exposure	70% tensile strength retained			
Apparent Opening Size (AOS)	ASTM D 4751	As specified #40 maximum ^{3/}			
Permittivity - $\frac{1}{\text{seconds}}$	ASTM D 4491	0.70 minimum	0.70 minimum	0.70 minimum	0.10 minimum

^{1/} Minimum average roll value (weakest principal direction)

^{2/} Heat-bonded or resin-bonded geotextile may be used for Classes III and IV. They are particularly well-suited to Class IV. Needle-punched geotextiles are required for all other classes.

^{3/} U.S. standard sieve size

11. Rock Riprap

Individual rock fragments shall be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. Except as otherwise specified, the rock fragments shall be angular to subrounded. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Rock riprap shall be free from dirt, clay, sand, rock fines, and other material not meeting the required gradation limits.

A rock source may be rejected if the rock from that source deteriorates in 3 to 5 years under similar use and exposure conditions expected for the rock to be installed under this specification.

Deterioration is defined as the loss of more than one-quarter of the original rock volume, or severe cracking that would cause a block to split. Measurements of deterioration are taken from linear or surface area particle counts to determine the percentage of deteriorated blocks. Deterioration of more than 25 percent of the pieces shall be cause for rejection of rock from the source.

12. Vegetation

A protective cover of vegetation shall be established on all exposed surfaces or earthfill and excavated areas. Seedbed preparation, seeding, fertilizing, mulching, or other vegetation shall be as specified in Section 14, "Construction Details."

13. Measurement

The measurement will be as shown on the plans or as specified in Section 14, "Construction Details."

14. Construction Details