NATURAL RESOURCES CONSERVATION SERVICE

MISSOURI OPERATION AND MAINTENANCE

LINED WATERWAY OR OUTLET

CODE 468

OPERATION AND MAINTENANCE

Operation and maintenance shall address maintaining the lined portions, associated berms, approach channel, and outlet channel. Site should be checked every six months and after any excessive rainfall.

Any component at the site should be corrected as soon as possible to prevent major damages.

BERM

Eroded areas shall be promptly repaired and reseeded, if applicable.

Trees and woody cover generally create problems and should be controlled.

Cross sectional shape shall be corrected if substantially different than original built.

Cracking in earth berm should be corrected by determining the extent of the effected area and repairing this area with fill material.

TYPE OF LINING

Concrete

Check for any cracking in concrete surface and determine to what depth the cracking is occurring.

Look for any exposed steel reinforcement, if applicable. If present and exposed, prepare a neat cement mixture composed of cement, sand, and water. Prepare area to be patched by chipping back to solid material, wetting the area by placing wet burlap or other moisture holding materials on the area for at least one hour prior to start of patching.

Observe the condition of any contraction joints. Consult with local office staff on ways to repair effected area.

Rock Riprap

Compare size of existing rock pieces to size of those at time of installation. (Refer to as-built drawings and specifications.) If substantially smaller in size, consider replacing rock riprap with proper size in order for lined outlet to operate as designed.

Check for overall appearance of cross sectional area. Redistribute rock pieces to reestablish proper cross sectional shape and dimensions.

Synthetic Turf Reinforcement Mat

Check for eroded areas under the mat and repair by filling with topsoil and reseeding. Replace and re anchor mat as needed.

Take precautions to protect the mat material when mowing or burning vegetation.

Outlet

Inspect condition of downstream channel for clogging in cross section (across channel).

VEGETATION

The vegetation shall be maintained to prevent erosion or gullying of the associated berm and other areas near the lined waterway site. Prescribed burning and mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.

Additional Details:_____

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NATURAL RESOURCES CONSERVATION SERVICE

MISSOURI CONSTRUCTION SPECIFICATION

LINED WATERWAY OR OUTLET

(CONCRETE LINED)

CODE 468-A

GENERAL

Work shall consist of furnishing all labor, equipment, materials, and constructing the concrete lined waterway and appurtenances at locations shown on the drawings. Construction operations shall be carried out in a manner and sequence that erosion and air and water pollution are minimized and held within legal limits.

The completed job shall present a workmanlike appearance and shall conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used. Contractor shall be assured that all state laws concerning buried utilities have been met.

A land disturbance permit from the Missouri Department of Natural Resources may be needed if the disturbed area is greater than one (1) acre in size.

MATERIALS

Materials and fabrication shall be as specified herein or on the drawings.

Concrete and reinforcement steel shall conform to Missouri Construction Specification (750) Reinforced Concrete.

EXCAVATION, FILL, BACKFILL, AND FINISH GRADING

Foundation area shall be cleared of trees, stumps, roots, sod, and loose rock.

Cross section area shall be excavated to the neat lines and grades as shown on the drawings. Overexcavated areas shall be backfilled with moist soil compacted to the density of the surrounding material.

Suitable excavated material may be used as fill and backfill.

Finish grading shall consist of smoothing and grading to form a smooth uniform surface between the existing ground and the top of the concrete lining. When completed the entire disturbed area shall be ready for seeding.

CONSTRUCTION

Concrete lining shall be placed to the thickness, shapes, lines, and grades shown on the drawings and Missouri NRCS Construction Specification (750) Reinforced Concrete. Abrupt deviations from line or grade shall not be permitted. Except for sections of the lined waterway designed with steel reinforcement that are to be poured in one contiguous unit, the lining shall be formed and placed in alternate sections, not to exceed fifteen (15) feet. Expansion joint filler shall be placed between each section.

Steel reinforcement will be placed at locations shown on the drawings, if applicable.
Earth surface shall be firm and damp where concrete is to be placed.
Unless otherwise noted on the plans, concrete shall have a wood float finish and be immediately coated with concrete curing compound.

Additional Details:_____

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NATURAL RESOURCES CONSERVATION SERVICE

MISSOURI CONSTRUCTION SPECIFICATION

LINED WATERWAY OR OUTLET

(RIPRAP LINED)

CODE 468-B

GENERAL

Work shall consist of furnishing all labor, equipment, materials, and constructing the concrete lined waterway and appurtenances at locations shown on the drawings. Construction operations shall be carried out in a manner and sequence that erosion and air and water pollution are minimized and held within legal limits.

The completed job shall present a workmanlike appearance and shall conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used. Contractor shall be assured that all state laws concerning buried utilities have been met.

A land disturbance permit from the Missouri Department of Natural Resources may be needed if the disturbed area is greater than one (1) acre in size.

MATERIALS

Individual rock fragments should be dense, sound, and free from defects conducive to accelerated weathering. Rock fragments should be angular to subrounded in shape. The rock should have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5 .

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 20 percent when sodium sulphate is used or 25 percent when magnesium sulfate is used.

The rock shall conform to the specified grading limits. Flat slabs of concrete or rock shall not be used.

SUBGRADE PREPARATION

Foundation area shall be cleared of trees, stumps, roots, and sod. Cross section area shall be excavated to the neat lines and grades as shown on the drawings. Overexcavated areas shall be backfilled with moist soil compacted to the density of the surrounding material.

No abrupt deviations from design grade or horizontal alignment shall be permitted.

EQUIPMENT-PLACED ROCK RIPRAP

Rock shall be placed by equipment on the surfaces and to the depths specified. Riprap shall be placed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials.

Riprap in place shall be reasonably homogeneous with larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spoils filling the voids between the larger rocks. Riprap shall be placed so it does not reduce the design section more than 10 percent. It is recommended that rock placement begin at the outlet section and progress upstream.

FILTER OR BEDDING LAYER

When the drawings specify filter layers or bedding beneath riprap, the filter or bedding material shall be spread uniformly on the prepared subgrade surfaces to the depth specified. The surface of such layers shall be finished reasonably free of mounds, dips, or windrows. The filter or bedding materials shall be hard, durable material conforming to the grading limits shown on the drawings or in the specifications.

Geotextile conforming to Missouri Construction Specification 753 Geotextile may be used when shown on the drawings.

Additional Details:_____

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NATURAL RESOURCES CONSERVATION SERVICE

MISSOURI CONSTRUCTION SPECIFICATION

LINED WATERWAY OR OUTLET

(SYNTHETIC TURF REINFORCEMENT MAT LINED)

CODE 468-C

GENERAL

Work shall consist of furnishing all labor, equipment, materials, and constructing the concrete lined waterway and appurtenances at locations shown on the drawings. Construction operations shall be carried out in a manner and sequence that erosion and air and water pollution are minimized and held within legal limits.

The completed job shall present a workmanlike appearance and shall conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used. Contractor shall be assured that all state laws concerning buried utilities have been met.

A land disturbance permit from the Missouri Department of Natural Resources may be needed if the disturbed area is greater than one (1) acre in size.

MATERIALS

The synthetic turf reinforcement mat (TRM) shall be a long term and non-degradable rolled erosion control product composed of UV stabilized, non-degradable synthetic fibers, filaments, nettings and/or wire mesh processed into a three dimensional reinforcement matrix. The TRM shall provide sufficient thickness, strength and void space to permit soil filling and/or retention and the sprouting and rooting of vegetation within the matrix. The TRM shall meet or exceed the physical properties listed in Table 1 for the Type of TRM specified on the drawings.

TRM material shall be stored in a clean dry location, out of direct sunlight and with the manufacturer's protective cover undisturbed.

SUBGRADE PREPARATION

Foundation area shall be cleared of trees, stumps, roots, and sod. Cross section area shall be excavated to the neat lines and grades as shown on the drawings. Overexcavated areas shall be backfilled with moist soil compacted to the density of the surrounding material.

No abrupt deviations from design grade or horizontal alignment shall be permitted.

MATERIAL ANCHORING

Unroll and install the TRM with the long dimension parallel to the primary direction of water flow. Install the TRM in header, footer and erosion stop trenches as detailed on the drawings.

Anchor the TRM using steel staples formed in "U" shapes. The staples shall be a minimum 11 gauge steel wire with a minimum leg length of 6 inches. The spacing of the staples shall be as detailed on the drawings. All splices and joints shall be oriented, lapped (or sewn), and anchored as detailed on the drawings. The upstream end or edge shall overlap on top of the downstream

end or edge. Alternate anchoring and splicing methods and patterns as recommended by the manufacture may be used unless otherwise stated on the drawings.

INSTALLATION - NON SOIL FILLED MATRIX

The manufacturer of the TRM must recommend that not filling the TRM matrix is an approved installation method for the product.

The TRM shall be installed within 48 hours of completing the seeding of the prepared soil surface.

The TRM shall be installed on the prepared surface at the locations and in accordance with the details shown on the drawings. Unless otherwise specifically recommended by the manufacturer no equipment shall be allowed to travel on the TRM.

INSTALLATION - SOIL FILLED MATRIX

The manufacturer of the TRM must recommend that soil filling of the TRM matrix is an approved installation method for the product.

Complete final grading of soil surface to the lines and grades shown on the drawings less the thickness of the TRM and the soil cover to be placed on top of it. The TRM shall be installed on the prepared surface at the locations and in accordance with the details shown on the drawings.

After installation of the TRM, the matrix (voids) of the TRM shall be filled and covered with friable topsoil material to the depths shown on the drawings. Unless otherwise specifically recommended by the manufacturer no equipment shall be allowed to travel on the TRM and the soil shall be applied and graded by manual means.

The soil filled and covered TRM shall be seeded according to the requirements of the seeding specification.

VEGETATION

Refer to the JS AGRON-25 job sheet or equivalent for seeding and mulching recommendations.

TABLE 1 – Minimum Physical Requirements for TRM

TRM Type	Minimum Unit Weight (oz/sy) ASTM D5261	Minimum Tensile Strength (psi) ASTM D6818	Minimum Thickness (in) ASTM D6525	Minimum UV Stability (%) ASTM D4355	Minimum Vegetated Shear Stress Rating (psi) ASTM D6460
Type 1	8	120	0.25	80	6
Type 2	12	160	0.50	80	8

Additional Details:_____

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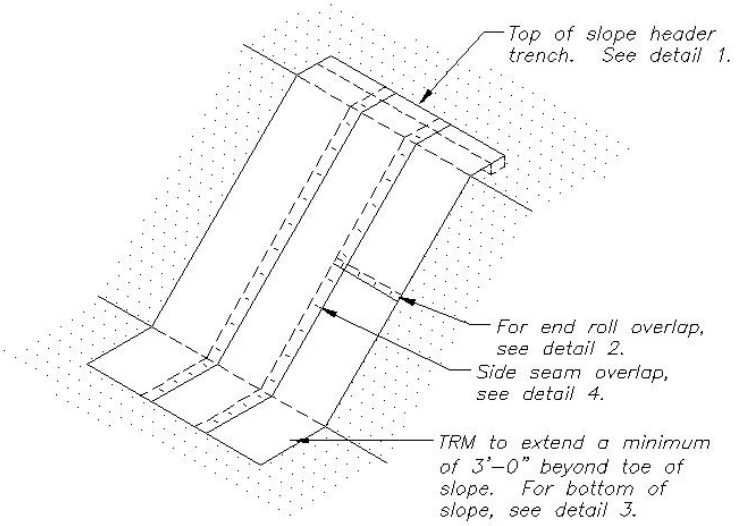
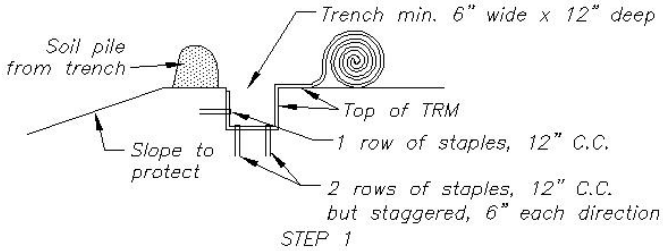
TURF REINFORCEMENT MAT FOR SLOPE

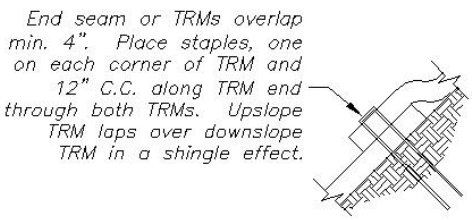


SLOPE DETAIL
No Scale

NOTES:
1. Staple patterns are dependent on site conditions. See sheet 721–5, Staple Pattern Guide for details.
2. An erosion check shall be installed if distance between header trench and downstream end trench exceeds 100 feet for slopes of 5:1 or flatter or 50 feet for slopes steeper than 5:1.



TOP OF SLOPE HEADER TRENCH – DETAIL 1
No Scale



END ROLL OVERLAP DETAIL 2
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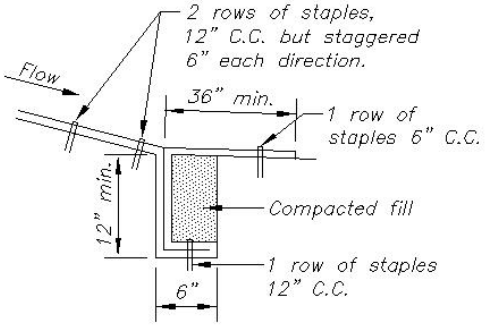
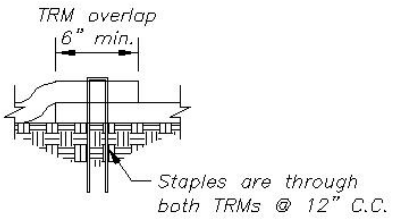
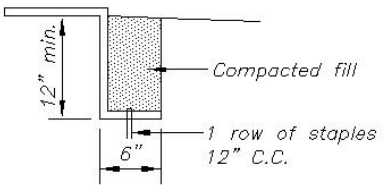


DOWNSTREAM FOOTER TRENCH AND EROSION CHECK – DETAIL 3
No Scale

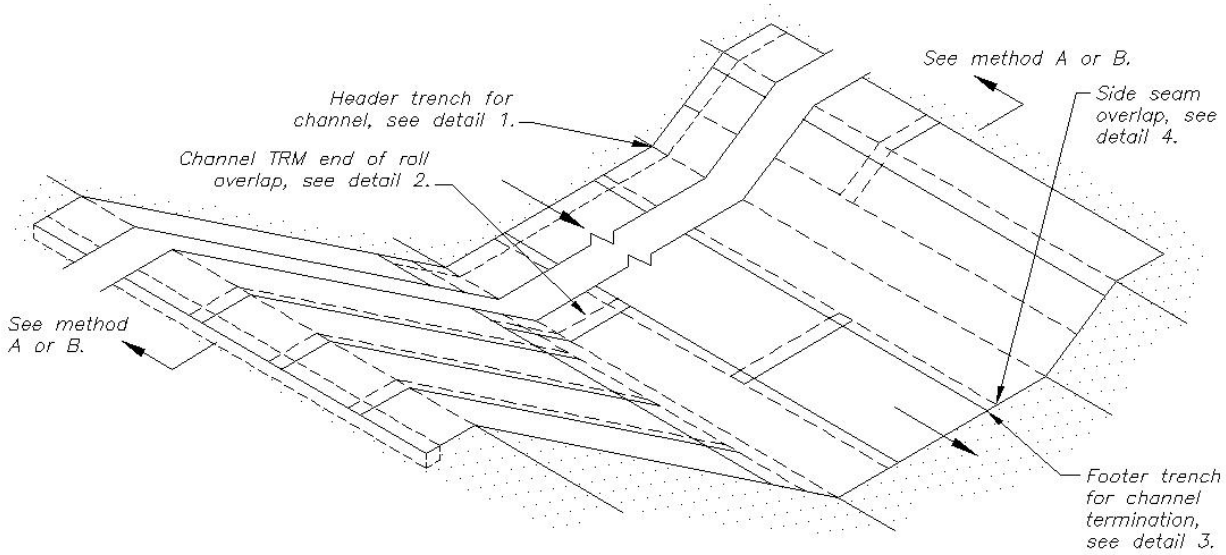


SIDE SEAM OVERLAP STAPLE – DETAIL 4
No Scale



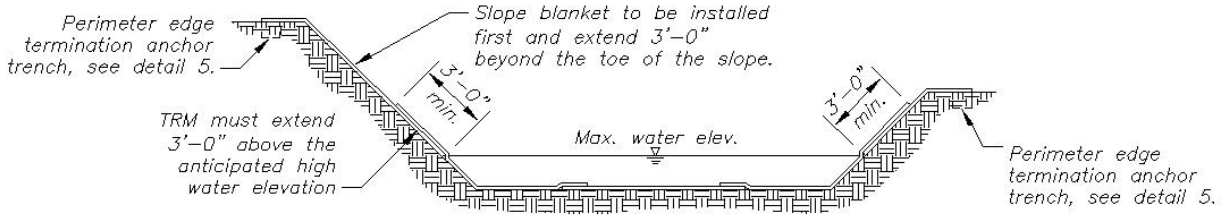
PERIMETER EDGE TERMINATION ANCHOR TRENCH – DETAIL 5
No Scale

TURF REINFORCEMENT MAT FOR CHANNEL

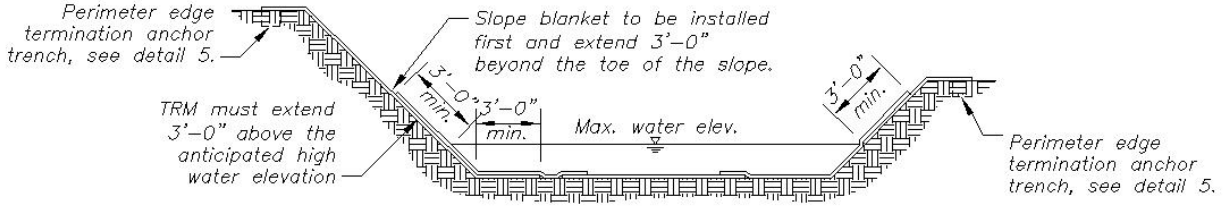


CHANNEL DETAIL
NO SCALE

NOTES:
1. Staple patterns are dependent on site conditions. See sheet 721–5, Staple Pattern Guide for details.
2. An erosion check shall be installed if distance between header trench and downstream end trench exceeds 100 feet for slopes of 5:1 or flatter or 50 feet for slopes steeper than 5:1.
3. For details 1 through 5, see sheet 721–3.



CHANNEL INSTALLATION METHOD A
NO SCALE

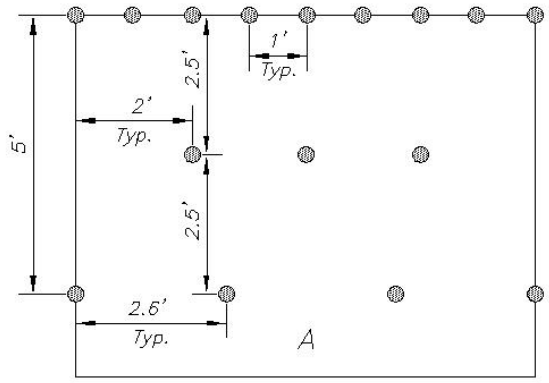


CHANNEL INSTALLATION METHOD B
NO SCALE

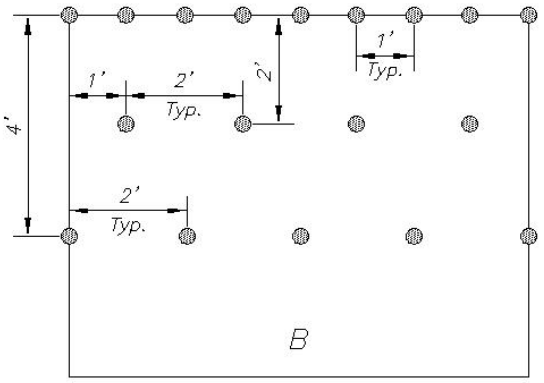
TURF REINFORCEMENT MAT (TRM) STAPLE PATTERN GUIDE

	SLOPE		CHANNEL	
	1.5:1 or Flatter	Steeper than 1.5:1	Low Flow V=8.0 fps or less	High Flow V=More than 8.0 fps
Staple Pattern	A	B	B	C

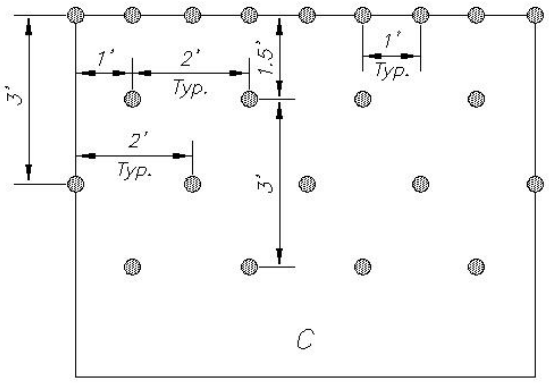
● = Staple placement



2.3–2.5 STAPLES/YD^2



3.0 STAPLES/YD^2



4.0 STAPLES/YD^2

NOTES:
1. For cohesive soil, use a 6"x1"x6" 11 gauge wire staple and for non-cohesive soil, use a 8"x2"x8" 11 gauge wire staple.
2. Equivalent stapling patterns may be used as approved by engineer.
3. For staple spacing in header, erosion check and footer trench, see sheet 721-3.