Lined Swale (LS)

LW

PAVED FLUME

Practice Description

A lined swale is a constructed channel with a permanent lining designed to carry concentrated runoff to a stable outlet. This practice applies to the following sites: 1) where grass swales are unsuitable because of conditions such as steep channel grades, prolonged flow areas, soils that are too erodible or not suitable to support vegetation or insufficient space and/or 2) where riprap-lined swales are not desired. The purpose of a lined swale is to conduct stormwater runoff without causing erosion problems in the area of channel flow.

The material that provides the permanent lining may be concrete, a specialized type of erosion control blanket, or manufactured concrete products.

Planning Considerations

A lined swale is used to convey concentrated runoff to a stable outlet in situations where a grass swale is inadequate. A lined swale can be lined with concrete, manufactured concrete products, or manufactured erosion-control products. Concrete-lined swales are the only type of lining covered in this practice. The practice *Erosion Control Blanket* should be referenced for criteria on permanent erosion control blankets. Product manufacturers and qualified design professional should be consulted for design requirements for manufactured concrete linings. Concrete-lined swales are generally used in areas where riprap-lined swales are not desired due to aesthetics, safety, or maintenance concerns. Concrete-lined swales allow easy maintenance of surrounding vegetation with normal lawn care equipment. The concrete generally provides a more

visually pleasing structure than the riprap linings. Concrete-lined swales are especially desirable in areas accessed by small children.

In areas where stormwater infiltration is a concern, riprap and manufactured products should be considered rather than the concrete lining.

Design Criteria

Capacity

Lined swales should be capable of passing the peak flow expected from a 10-year 24-hour duration storm.

Adjustments should be made for release rates from structures and other drainage facilities. Swales shall also be designed to comply with local stormwater ordinances, and should be designed for greater capacity whenever there is danger of flooding or when out-of-bank flow cannot be tolerated.

Peak rates of runoff values used to determine the capacity requirements should be calculated using accepted engineering methods. Some accepted methods are:

- Natural Resources Conservation Service, Engineering Field Manual for Conservation Practices, Chapter 2, Estimating Runoff.
- Natural Resources Conservation Service (formerly Soil Conservation Service), Technical Release 55, Urban Hydrology for Small Watersheds.
- Other comparable methods – See Appendix A: Erosion and Stormwater Runoff Calculations found in the Appendices Volume.

Slope

This practice applies only to paved flumes that are installed on slopes of 25% or less. Slopes steeper than this should be designed by a qualified design professional.

The slope in feet per 100 feet of length can be determined from a topographic map of the site or from a detailed survey of the planned lined swale location.

Cross Section

With peak flow (capacity) and slope known, the paved flume cross section can be determined by using Figures LS-l – LS-3.

Concrete

Flumes should be constructed of concrete with a minimum 28-day compressive strength of 3,000 psi. Flumes shall have a minimum concrete thickness of 4″.

Cutoff Walls

Cutoff walls shall be constructed at the beginning and end of every flume except where the flume connects with a catch basin or inlet.

Alignment

Keep paved flumes as straight as possible because they often carry supercritical flow velocities.

Inlet Section

The inlet section to the paved flume should be at least 6 feet long and have a bottom width equal to twice the bottom width of the flume itself. The bottom width should transition from twice the flume bottom width to the flume bottom width over the 6-foot length.

Outlet

Outlets of paved flumes shall be protected from erosion. The standard for *Outlet Protection* can be used to provide this protection. A method to dissipate the energy of low flows is to bury the last section of the flume in the ground. This will usually force the development of a "scour hole," which will stabilize and serve as a plunge basin. For the design of large-capacity flumes, it may be necessary to design a larger energy dissipater at the outlet.

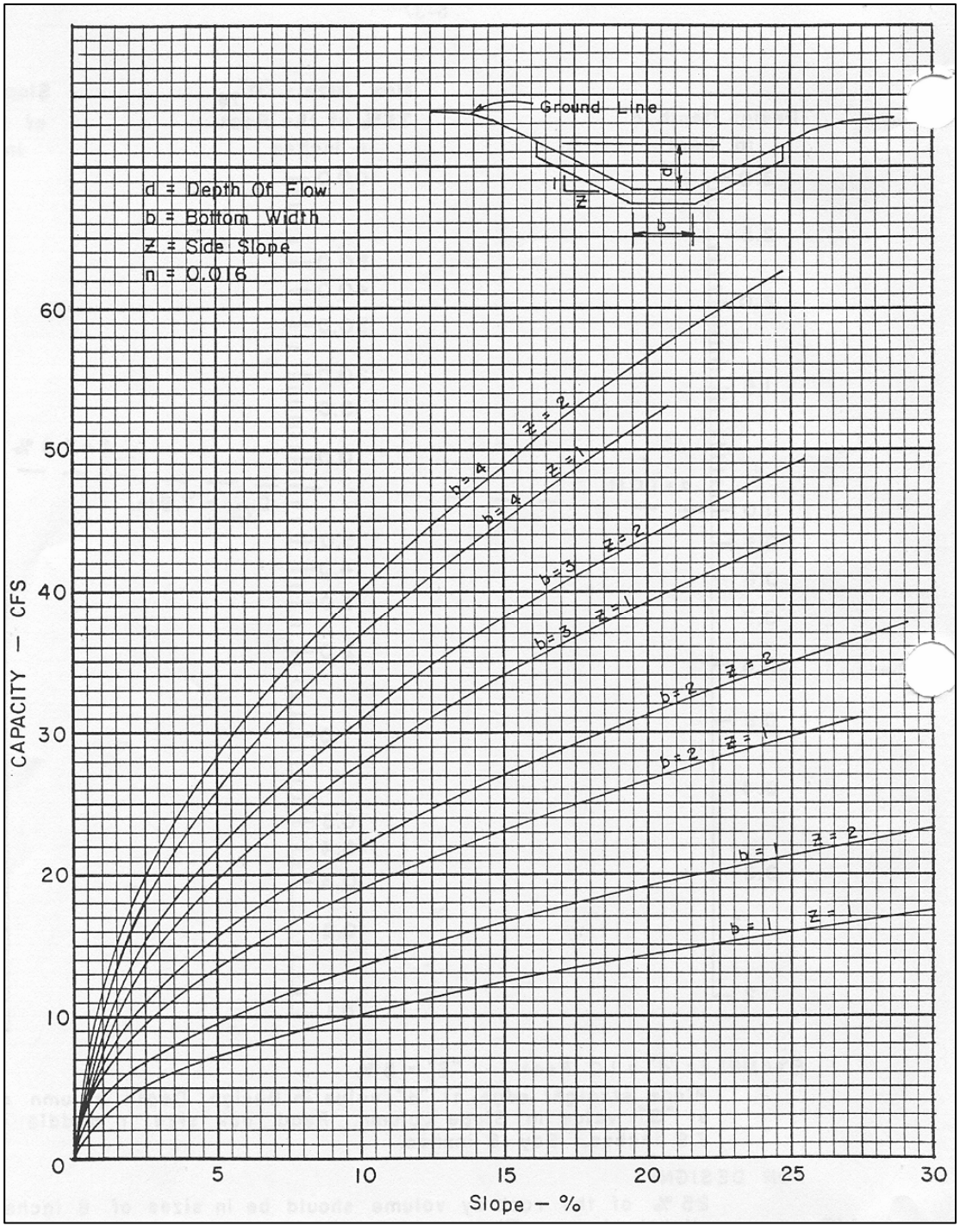


Figure LS-1 Capacity Graph for Concrete Flumes
Depth of Flow = 0.50 Foot

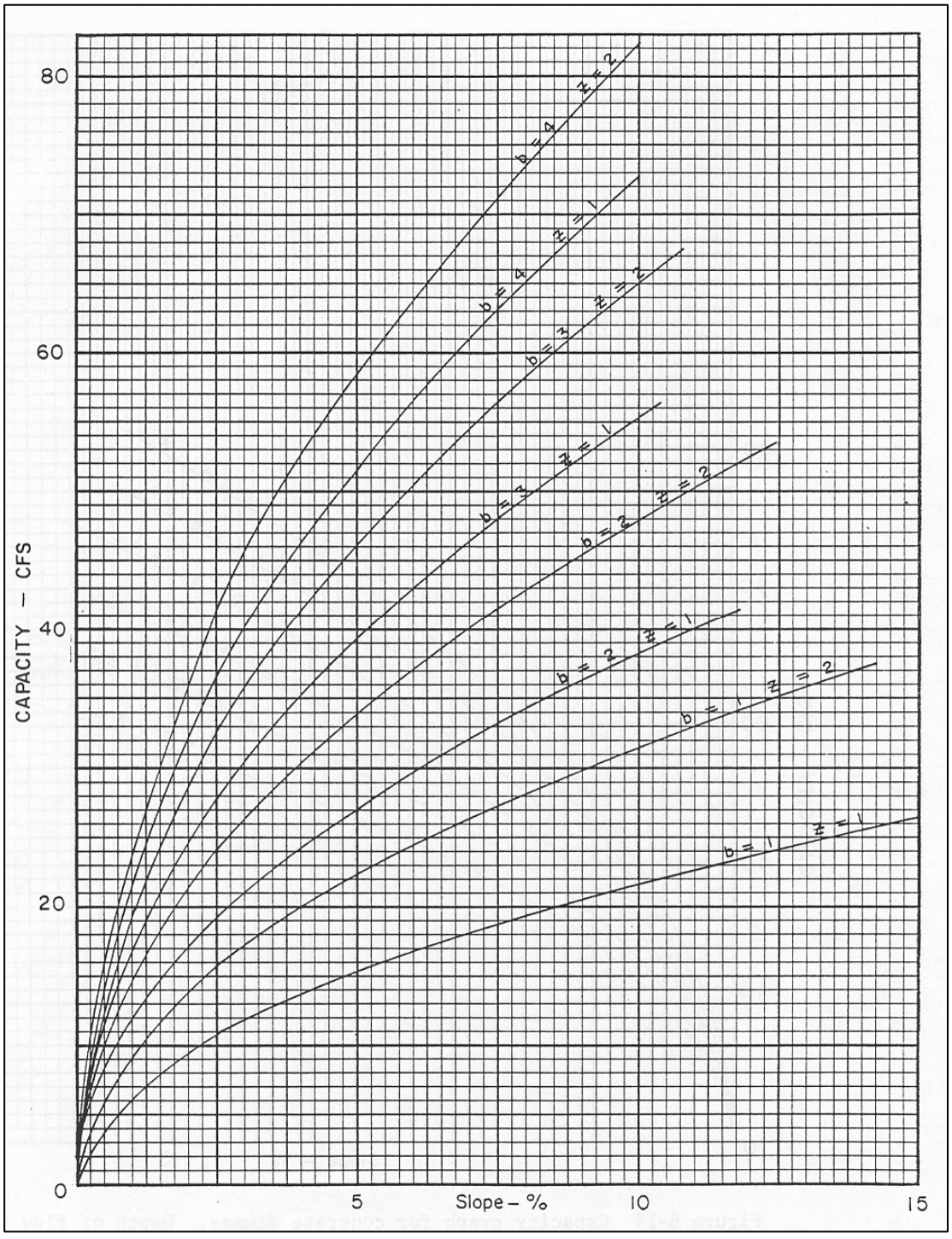


Figure LS-2 Capacity Graph for Concrete Flumes
Depth of Flow = 0.75 Foot

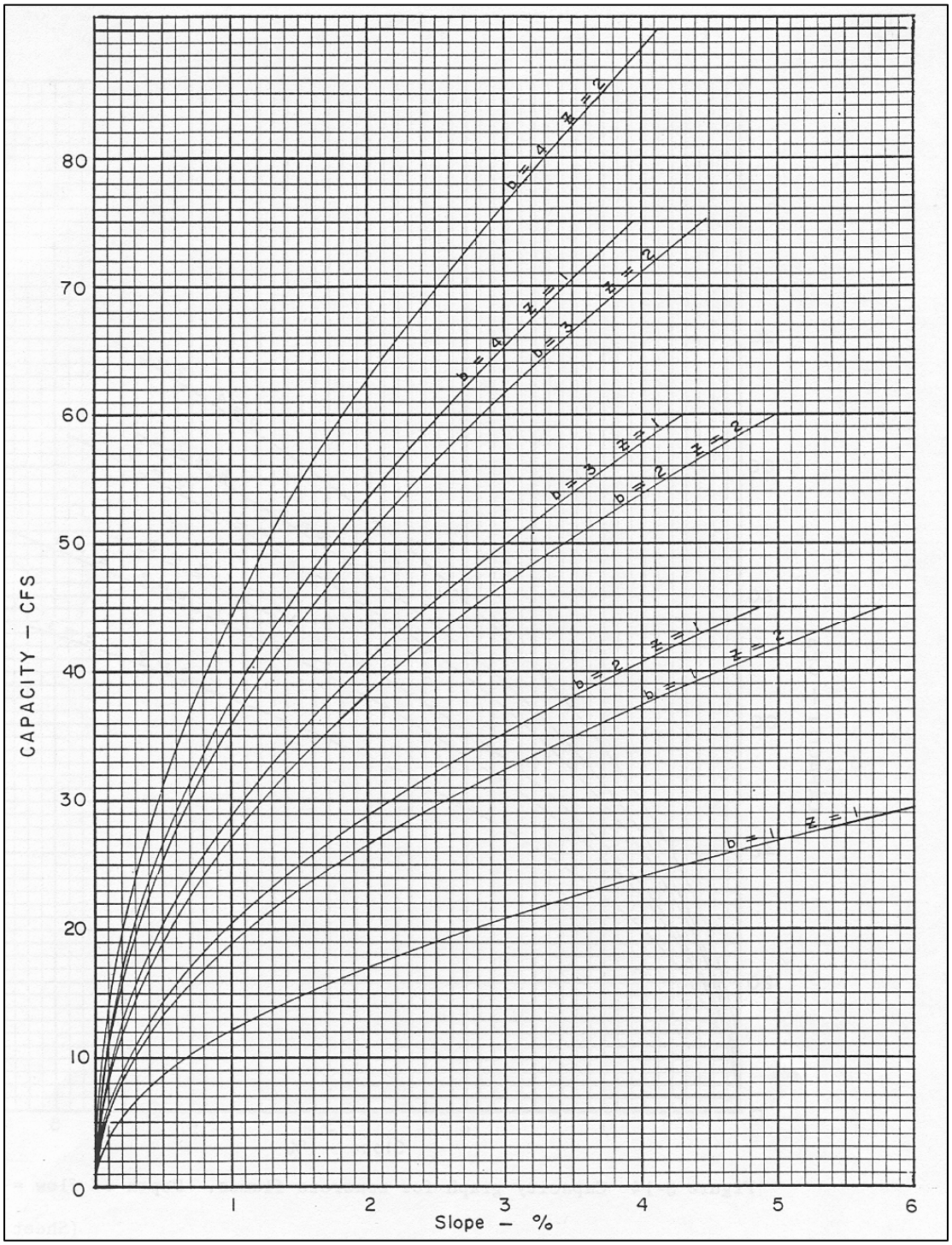


Figure LS-3 Capacity Graph for Concrete Flumes
Depth of Flow = 1.00 Foot

Construction

Prior to start of construction, lined swales should be designed by a qualified design professional, and specifications should be available to field personnel.

Plans and specifications should be referred to by field personnel throughout the construction process.

Note: Concrete-lined channel is the only lining method that is covered in this edition of the manual. Numerous permanent erosion control blankets and rock products are available with similar applications, and their unique installation procedures should be obtained from the manufacturer of the product being used. In addition, Riprap-Lined Swale is covered in this manual.

Site Preparation

Determine exact location of underground utilities (See Appendix C: MS One-Call and 811 Color Coding).

Remove brush, trees, and other debris from the channel and spoil areas, and dispose of properly.

Grade or excavate cross section to the lines and grades shown in design for the concrete subgrade.

Remove soft sections and unsuitable material and replace with suitable material. The subgrade should be thoroughly compacted and shaped to a smooth, uniform surface.

Material Placement

Place forms to meet the specific plan design for the project, and place concrete of the designed mix into the forms according to construction specifications.

Construction and expansion joints should be used where swale length exceeds 10 feet. Construction joints should be spaced at 10-foot intervals and expansion points at intervals not to exceed 20 feet.

The subgrade should be moist at the time the concrete is placed.

Place concrete for the lined channel to the thickness shown on the plans and finish it in a workmanlike manner.

Coat the concrete with an approved curing compound as soon as finish work is complete and the free water has disappeared from the surface.

Provisions should be made to protect the freshly poured concrete from extreme temperatures to ensure proper curing.

Stabilization

Stabilize channel inlet and outlet points according to the design plan.

Stabilize adjacent disturbed areas after construction is completed with a vegetation treatment (see *Permanent Seeding* or *Temporary Seeding Practices*) and mulching. Provide topsoil, lime, and fertilizer as needed to grow grass on areas disturbed by construction. Many design plans specify a row of sod at the edges of the concrete channel.

If not specified in a plan, select lime, fertilizer, variety and mulching components from related practices – *Permanent Seeding* or *Temporary Seeding*, *Mulching, Erosion Control Blankets,* or *Sodding*.

Construction Verification

Check finished grades and cross sections throughout the length of the channel. Verify channel cross-section dimensions at several locations to avoid flow constrictions.

Common Problems

Consult with a qualified design professional if any of the following occur:

Variations in topography on site indicate practice will not function as intended; changes in plan may be needed.

Design specifications cannot be met; substitution may be required. Unapproved substitutions could result in failure of the practice.

Maintenance

Inspect lined channel at regular intervals and after storm events. Check for erosion adjacent to the channel, at inlets and outlets, and underneath the lined channel.

Give special attention to the channel inlet and outlet, and repair eroded areas promptly.

Inspect for erosion in the entire swale, and repair with appropriate vegetative treatment (permanent or temporary seeding and mulching).

References

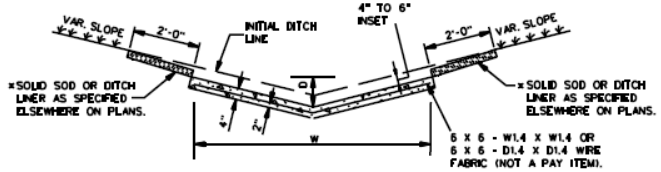
BMPs from Volume 1

Chapter 4

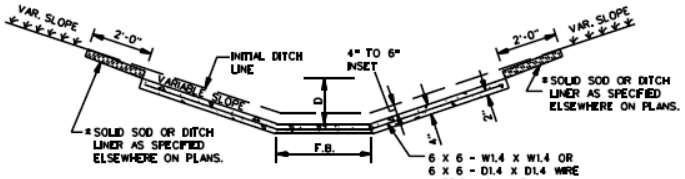
Erosion Control Blanket (ECB)	4-33
Permanent Seeding (PS)	4-53
Sodding (SOD)	4-93
Temporary Seeding (TS)	4-103
Outlet Protection (OP)	4-199

MDOT Drawing DT-1

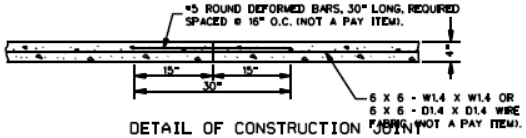
Details of Typical Ditch Treatments	4-198



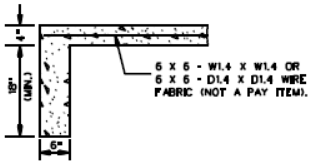
"V" TYPE SECTION



FLAT BOTTOM SECTION



DETAIL OF CONSTRUCTION JOINT



DETAIL OF TOE WALL

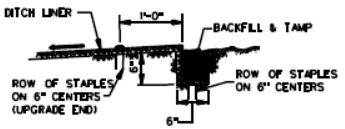
NOTE: TOE WALL REQUIRED UPSTREAM AND DOWNSTREAM.

CONCRETE PAVED DITCH

NOTES:

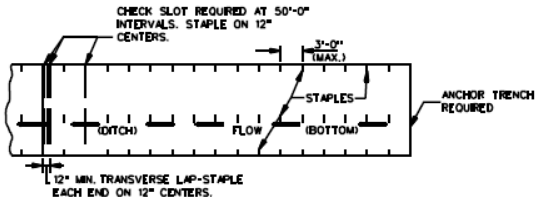
1. CONCRETE PAVED DITCHES SHALL BE GROOVED AT 20'-0" INTERVALS. THE GROOVES SHALL BE CUT TO A DEPTH OF NOT LESS THAN 1".
2. DIMENSIONS D & W ARE AS FOLLOWS:
   D(MINIMUM) = 6"
   D(NOMINAL) = 9"
   W(MINIMUM) = 24"
3. CHAIR SUPPORTS FOR THE WIRE MESH WILL NOT BE REQUIRED. HOWEVER, THE CONTRACTOR SHALL PLACE THE WIRE MESH IN A SATISFACTORY AND WORKMANLIKE MANNER TO ENSURE THAT THE FINAL POSITION IS REASONABLY NEAR THE POSITION INDICATED.

* 4. CENTER ROW OF STAPLES MAY BE OMITTED ON DITCH LINER.

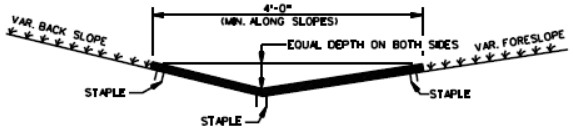


ANCHOR TRENCH DETAIL

NOTE: ANCHOR TRENCH REQUIRED AT THE BEGINNING AND ENDING OF EACH AREA TO BE COVERED, EXCEPT DOWNSTREAM END ADJOINING A STRUCTURE.



PLAN



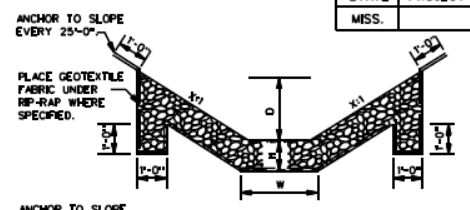
SECTION

DITCH LINER TREATMENT

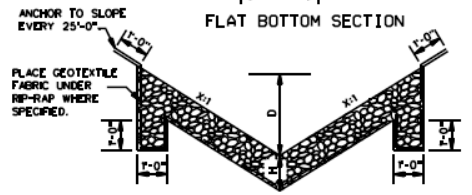
(EXCELSIOR BLANKET, JUTE MESH OR EROSION CONTROL FABRIC)

NOTE: DITCHES TREATED WITH DITCH LINER WILL BE VEGETATED PRIOR TO TREATMENT, UNLESS OTHERWISE INDICATED.

STATE	PROJECT NO.
MISS.	



FLAT BOTTOM SECTION

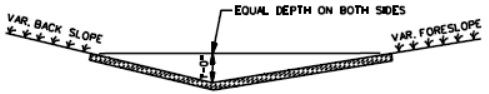


"V" TYPE SECTION
RIP-RAP TREATMENT

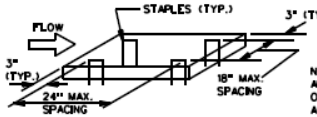
NOTES:

1. DIMENSIONS D, W AND X ARE VARIABLE AND ARE SHOWN ELSEWHERE ON THE PLANS.
2. THE RIP-RAP SIZE AND MINIMUM DEPTH "H" FOR RIP-RAP TREATMENT ARE AS FOLLOWS.

RIP-RAP SIZE & MINIMUM DEPTH "H"	
H (in)	RIP-RAP SIZE (lbs)
12"	100
18"	300



SOLID SOD TREATMENT



NOTE: SOLID SOD (STRIPS OR BLOCKS) ARE TO BE STAPLED, PINNED, PEGGED OR STAKED AT THE FOUR CORNERS OR AT THE MAXIMUM SPECIFIED SPACING.

GENERAL NOTE:

1. FOR LOCATION OF APPROPRIATE DITCH TREATMENTS, SEE PLAN SHEETS AS DENOTED BY THE FOLLOWING LEGEND OR AS DIRECTED BY THE ENGINEER:
   - DITCH LINER
   - SOLID SOD
   - CONCRETE PAVED DITCH
   - RIP-RAP

MISSISSIPPI DEPARTMENT OF TRANSPORTATION

DETAILS OF TYPICAL DITCH TREATMENTS

BY | REVISION | DATE

FILENAME: EROSION CONTROL\DT-1.DGN

DESIGN TEAM _____ CHECKED _____ DATE _____

WORKING NUMBER DT-1

SHEET NUMBER