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Sedimient And Erosion Control

An Inventory of Current Practices
April 20, 1990

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Sediment and Erosion Control
An Inventory of Current Practices
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Work Assignment 1-19, Task 2

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I INTRODUCTION

This report was prepared to inventory sediment and erosion control practices currently in use nationwide. The inventory represents completion of the first of a six task project designed to develop guidance, including model permit language, for development of NPDES permits for the storm water discharges of construction sites, and for the evaluation of municipal storm water management and sediment and erosion control programs with regard to effective control of construction site discharges to municipal separate storm sewer systems. The sediment and erosion control practice inventory will be combined with information generated under the remaining tasks to assist EPA Regions and NPDES approved State in writing NPDES permits for the storm water discharges of the construction industry, and in evaluating the NPDES permit applications of municipal separate storm sewer systems for effective control of construction site storm water discharges.

The sediment and erosion control practice inventory was developed based upon interviews with the State and local Soil Conservation District agencies of representative metropolitan areas from each of the nine geographic/climatic regions established in 40 CFR, Part 122.42. In addition to interviews, local manuals of practice, regulations, handbooks and other data were evaluated to develop the inventory. The inventory is organized into two categories, 1) vegetative and 2) structural sediment and erosion control practices. Each practice is defined and illustrated, and a discussion is provided regarding the purpose, applicability, effectiveness, advantages, disadvantages, and cost of each practice.

During the course of the inventory development, it became evident that a high degree of variability exists among state sediment and erosion control laws, and many states have not yet passed legislation controlling construction site soil erosion. Among the states with legislation, sediment and erosion control programs which implement the laws varied greatly in requirements, standards and enforcement. The most developed programs were found in the eastern United States. The Maryland legislation and regulatory program was frequently found to be used as a guide for developing programs in other states, such as New York and Florida. In general, implementation of sediment and erosion control programs was limited in midwestern and western

II FACTORS INFLUENCING EROSION AND SEDIMENTATION

A number of east coast jurisdictions have sediment and erosion control manuals which address factors influencing erosion and sedimentation. The following is reproduced from the "1983 Maryland Standards and Specifications for Soil Erosion and Sediment Control",(Reference 1). The same discussion can be found in numerous manuals from Florida to New York.

The erosion potential of a site is principally determined by five factors; the erodibility of the soil, vegetative cover, topography, climate and season. Although the factors are interrelated as determinants of erosion potential, they are discussed separately for ease of understanding.

A. Soil Erodibility

The vulnerability of a soil to erosion is known as erodibility. The soil structure, texture, and percentage of organic matter influence its erodibility.

The most erodible soils generally contain high proportions of silt and very fine sand. The presence of clay or organic matter tends to decrease soil erodibility. Clays are sticky and tend to bind soil particles together. Organic matter helps to maintain stable soil structure (aggregates).

B. Vegetative Cover

There are several ways in which vegetation protects soil from the erosive forces of raindrop impact and runoff scour. Vegetation (top growth) shields the soil surface from raindrop impact while the root mass holds soil particles in place. Grass buffer strips can be used to filter sediment from the surface runoff. Grasses also slow the velocity of runoff, and help maintain the infiltration capacity of a soil. The establishment and maintenance of vegetation are the most important factors in minimizing erosion during development.

areas of the country (with the notable exception of the state of Washington), although in several instances, new programs were under consideration.

The inventory of sediment and erosion control practices provided in Section IV is of standard practices currently being implemented in the jurisdictions contacted during this investigation which had active sediment control programs. The inventory does not refer to the state or local regulations from which the practice was derived, although local regulations and standards directly influence the effectiveness of sediment control practices in the field. Cost estimates provided in the inventory were obtained from the "Means Site Work Cost Data", 9th Edition, R.S. Means Company, 1990, or local (Washington D.C. area) agency bond price lists. Cost estimates are approximate and should be used for relative comparison purposes only. Washington, D.C. unit costs were used to add conservativeness to the estimates based upon the assumption that materials costs in this area are generally higher than other areas of the country. Standard details are provided for illustrative purposes only and should not be considered for use in design of sediment control plans.

In addition to the inventory, this report addresses factors which influence erosion and sedimentation, effective planning of erosion control measures at construction sites, and general criteria common to many sediment and erosion control programs encountered during this investigation.

III PLANNING CONSIDERATIONS

The planning of sediment and erosion control practices for a construction site must begin with consideration of regional water quality concerns. Construction site soil erosion impacts local and regional water quality, and has regional planning implications. For example, uncontrolled soil erosion at a new shopping mall site in Northern Virginia could degrade water quality in the Chesapeake Bay and impact use of the Bay's myriad natural resources. Sediments leaving a new subdivision project in the Ohio Valley could result in the the need for intensive and costly dredging of the lower Mississippi River to control flooding impacts. Soil erosion and sedimentation, as with any water resources related issue, is a regional problem that transends local, county, and state boundaries.

Regional planning agencies evaluate the quality and nature of water resources within their jurisdiction. Often, the sensitivity of each resource to increased sediment loads is quantified, and goals are established to control, minimize or correct existing problems. In certain areas and subwatersheds of a given water resource, unusual limits might be adopted in response to a unique or highly sensitive resource. Once these goals or limits are set, the implications of each land disturbance can be determined, and an effective erosion control approach can be developed. In many instances, existing water quality data resources such as 208 basin studies, can provide information on the sensitivity of a particular water resource. Once the sensitivity of the receiving stream is known, a comprehensive development plan must be developed that minimizes the risk of environmental damage due to erosion and sedimentation. Site plans should be designed to minimize grading requirements, save existing vegetation, protect critical areas such and steep slopes, and erodible soils, and generally "fit the site". Construction should be planned to occur in phases in order to minimize the amount of disturbed land exposed at any one time, thus limiting the overall erosion potential of the site. Once an effective, phased development plan has been prepared, individual erosion control practices can be selected and implemented on site. These individual practices are inventoried and described in the following section.

C. Topography

Slope length and steepness are key influences on both the volume and velocity of surface runoff. Long slopes deliver more runoff to the base of slopes and steep slopes increase runoff velocity; both conditions enhance the potential for erosion to occur.

D. Climate

Erosion potential is also affected by the climate of the area. Rainfall characteristics, such as frequency, intensity, and duration directly influence the amount of runoff that is generated. As the frequency of rainfall increases, water has less chance to drain through the soil between storms. The soil will remain saturated for longer periods of time and stormwater runoff volume may be potentially greater. Therefore, where rainfall events are frequent, intense, or lengthy, erosion risks are high.

E. Season

Seasonal variation in temperature and rainfall defines periods of high erosion potential during the year. A high erosion potential may exist in the spring when the surface soil first thaws and the ground underneath remains frozen. A low intensity rainfall may cause substantial erosion as infiltration is impossible because of the frozen subsoil. The erosion potential is also high during the summer months because of more frequent, high intensity rainfall.

protection and dune stabilization. These vegetative practices are described in the following sections.

IV INVENTORY OF SEDIMENT CONTROL TECHNOLOGIES

A. Vegetative Practices

The establishment and maintenance of vegetation are the most important factors in minimizing erosion during development. A vegetation cover greatly reduces an area's erosion potential in three primary ways; 1) by absorbing the kinetic energy of raindrops which would otherwise impact soil and loosen it, 2) by intercepting water so it can infiltrate into the ground instead of running off carrying surface soil and 3) by slowing the velocity of runoff promoting deposition of water born sediment. (2)

Preserving existing vegetation where possible, and revegetating open areas as soon as practical after grading or construction are very cost effective methods controlling erosion. Seeding open areas is fairly inexpensive, and savings in reduced maintenance and reduced need for structural practices can be significant.

Vegetation, as discussed here, refers to covering or maintaining an existing cover over the soil. The cover may be grass, trees, vines, shrubs, bark, mulch or straw. Grasses are the most common type of vegetative cover. Many types of grasses germinate and grow quickly providing erosion protection within 15 days. Grasses may be placed with straw or other anchoring medium which provide temporary erosion control until the grasses are established. Straw, mulch and other anchoring techniques may be used for soil stabilization during non-growing seasons. Maintaining existing trees and shrubs is an effective way to prevent erosion. The planting of new trees provides only limited erosion control by reducing raindrop impact. Tree roots grow slowly requiring extensive time before providing significant anchoring of the soil.

In each application of a vegetative practice, the soil fertility should be considered. The use of fertilizers and lime as well as the neutralizing of harmful chemicals will greatly enhance the growth of vegetation. The primary types of vegetative practices are: temporary seeding, permanent seeding, "mulching only" stabilization, sod stabilization, vegetative buffer strips, tree

2. Permanent Seeding

- Definition: Planting vegetation such as grasses and legumes on critical areas.

- Purpose: To stabilize the soil; to reduce damages from sediment and runoff to downstream areas; improve wildlife habitat; enhance natural beauty.

- Conditions Where Practices Apply: Graded or cleared areas subject to erosion and where a permanent, long-lived vegetative cover is needed.

- Effectiveness: Permanent seeding has been found to be 99% effective in controlling erosion on construction sites. (3) Therefore, it is obvious that areas on-site should be permanently seeded as soon as possible. To achieve this high efficiency rate, permanent seeding must be properly established and maintained.

- Advantages: As with all seeding measures, permanent seeding is inexpensive and highly effective.

- Disadvantages: To be effective, mulching of some sort is required for the permanent seeding to germinate and establish itself. If the soil to be seeded is under nutriented, (which is common on construction sites because the top soil has often been lost during grading), fertilizer and or topsoil must be added to the area prior to seeding. Finally, when using the most common mulch, straw, a mulch anchoring of some type (i.e., thermal tack coot, netting, etc.) is generally required to hold the mulch in place. Obviously these added components of permanent seeding can increase the cost of this practice considerably.

- Costs: The cost for seed is approximately $1.00 per square yard. Added to this is the cost of mulching the area which usually consists of spreading straw and adds another $1.25 per square yard to the above price. Finally, a mulch anchor of some type must be selected and applied adding further to the cost of this practice.

- Geographical Considerations: Permanent seeding is an effective erosion control measure can be used in each of the 9 regions. However, in the northern areas its use is limited by the shorter growing season.

1. Temporary Seeding

- Definition: Planting short-term vegetation on critical areas.

- Purpose: To temporarily stabilize the soil; to reduce damages from sediment and runoff to downstream areas; improve wildlife habitat; enhance natural beauty.

- Conditions Where Practice Applies: Graded or cleared areas which are subject to erosion for a period of 14 days or more.

- Effectiveness: It has been determined that seeding practices are the single most important factor in reducing erosion on construction sites. (2) Once established, properly vegetated areas will nearly duplicate site conditions before disturbance. In fact, temporary seeding practices have been found to be approximately 95% effective in reducing erosion on-site. (3)

- Advantages: As mentioned above, temporary seeding is highly effective in minimizing erosion once properly established. Also, temporary seeding practices are very inexpensive.

- Disadvantages: To be effective, mulching of some sort is required for the temporary seeding to germinate and establish itself. If the soil to be seeded is under nutriented, and on construction sites it usually is because the top soil has been graded away, then fertilizer and or topsoil must be added to the area prior to seeding. Finally, when using the most common mulch, straw, a mulch anchoring of some type (i.e., thermal tack coat, netting, etc.) is generally required to hold the mulch in place. Obviously these added components of temporary seeding can increase the cost of this practice considerably.

- Costs: The cost for seed is approximately $1.00 per square yard. Added to this is the cost of mulching the area which usually consists of spreading straw and adds another $1.25/sy to the above price. Finally, a mulch anchor of some type must be selected and applied adding further to the cost of this practice.

- Geographical Considerations: Temporary seeding is an effective erosion control measure can be used in each of the 9 regions. However, in the northern areas its use is limited by the shorter growing season.

STANDARD AND SPECIFICATIONS FOR MULCHING

Definition

Applying plant residues or other suitable materials to the soil surface.

Purpose

To conserve moisture and modify surface soil temperature fluctuations; prevent surface compaction or crusting; reduce runoff and erosion; control weeds; and help establish plant cover.

Conditions Where Practice Applies

On soils subject to erosion on which low residue producing crops, such as grapes, berries and small fruits are grown; on critical areas; and on soils that have a low infiltration rate.

Design Criteria

1. SITE PREPARATION

A. Prior to mulching, install the necessary temporary or permanent erosion control (structural) practices and drainage systems within or adjacent to area to be mulched.

B. Slope, grade and smooth the site if conventional equipment is to be used in applying and anchoring the mulch.

C. Remove all undesirable stones and other debris depending on anticipated land use.

D. Compacted or crusted soil surface should be loosened to at least two inches by disking or other suitable method.

2. MULCHING MATERIALS

A. Select from attached Table 3.8 on page 3.32 the type of mulch and application rate that will best meet the needs and availability of material.

B. If needed, select the anchoring method from Table 3.9 on page 3.35 that will best meet the need.

C. The best combination is straw (small grain) mulch applied at 2 ton/acre (90 lbs/1,000 sq. ft.) and anchored with wood fiber mulch (hydromulch) at 500 - 750 lbs./acre (11 - 17 lbs./1,000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.

3. **Mulching Only Stabilization**

- Definition: Apply plant residues or other suitable materials not produced on the site to the soil surface.

- Purpose: To conserve moisture; prevent surface compaction or crusting; reduce runoff and erosion; control weeds, and help establish plant cover.

- Conditions Where Practices Applies: Where protection of the soil surface is desired and temporary and permanent seeding is not feasible, mulching only stabilization should be used.

- Effectiveness: Although generally not as effective as seeding practices, (mulching ranges in effectiveness from 75 to 98%) (3), mulching does provide adequate erosion control on construction sites. To maintain optimum effectiveness, mulches must be anchored to resist wind displacement.

- Advantages: Mulching controls erosion as soon as it is placed, unlike seeding practices that take time to grow before stabilization occurs. Also mulching can be used effectively on poor soils where grasses could not survive. Finally, the cost of mulching only is relatively inexpensive.

- Disadvantages: The most common type of mulch, straw, needs an anchoring method to be held in place on site. These anchoring methods ranging from chemical coatings to netting add to the cost of mulching.

- Costs: Straw, the most common mulch costs approximately $1.25 per square yard. Note that the cost of an appropriate mulch anchor must be added.

- Geographical Considerations: Mulching is an effective erosion control measure which can be used in each region.

Table 3.8
Guide to Mulch Materials, Rates & Uses

Mulch Material	Quality Standards	Application Rates per 1000 sq. ft.	per acre	Depth of Application	Remarks
Sawdust, Green or Composted	Free from objectionable coarse material	83-500 cu. ft.	—	1-7"	Most effective as a mulch around ornamentals, small fruits, & other nursery stock. *Special application rates:* fruit trees 5-7"; blueberries 6"; vegetables and flowers 2-3"; blackberries and raspberry 4-7"; strawberries 3". Most resistant to wind blowing. Requires 30-35 lbs. N/ton to prevent N deficiency while decaying mulch. One cu. ft. weighs 24 lbs.
Wood chips or Shavings	Green or air-dried. Free of objectionable coarse material	500-900 lbs.	10-20 tons	2-7"	Has about the same use and application as sawdust, but requires less N/ton (10-12 lbs.). Resistant to wind blowing. Decomposes slowly.
Wood Excelsior	Green or air-dried burred wood fibers .024" x .031" x 4"	90 lbs. (1 bale)	2 tons	—	Effective for erosion control. Tie-down usually not required. Decomposes slowly. Subject to some wind blowing. Packaged in 80-90 lb. bales.
Cellulose (Partly digested wood fibers)	Made from natural wood usually with green dye & dispersing agent added. Max. 15% moisture packed.	50 lbs.	2000 lbs.	--	When used for erosion control on critical areas double application rate. Apply with hydromulcher. No tie-down required.
Compost or Manure	Well shredded, free of excessive coarse material.	400-600 lbs.	8-10 tons	--	Use strawy manure where erosion control is needed. May create problem with weeds. Excellent moisture conserver. Resistant to wind blowing.
Cornstalks, Shredded or Chopped	Air-dried, shredded into 8" to 12" lengths.	150-300 lbs.	4-6 tons	--	Effective for erosion control, relatively slow to decompose. Excellent for mulch on crop fields. Some value-cover crop. Resistant to wind blowing.

Table 3.8 (Cont'd.)
Guide to Mulch Materials, Rates & Uses

Mulch Material	Quality Standards	Application Rates per 1000 sq. ft.	Application Rates per acre	Depth of Application	Remarks
Gravel, Crushed Stone or Slag	Washed; Size 2B or 3A.	9 cu. yds	4-6 tons	3"	Excellent mulch for short slopes & around woody plants & ornamentals. Use 2B where subject to foot traffic. (Approx. 2000 lbs./cu.yd.)
Hay or Straw	Air-dried; free of undesirable seeds & coarse materials.	75-100 lbs., 2-3 bales	1.5 - 2.5 T 90-120 bales	Lightly cover 75 to 90% of surface	Use straw where mulch effect to be maintained for more than 3 months. Subject to wind blowing unless kept moist or tied down. Most common, widely used mulching material. Good for erosion control.
Peat Moss	Dried, compressed free of coarse materials.	200-400 cu. ft.	—	2" - 4"	Most effective as a mulch around ornamentals. Subject to wind blowing unless kept wet. Pkgd. in 100 lb. bales (6 cu.ft.). Excellent moisture holding capacity.
Mats and Netting Twisted Kraft Paper Yarn	Plain weave, warp 7 per in., filling 4 per in. selvage edge with polypropylene filament	45" x 250 yds.	Roll 100 lbs.	312-1/2 sq. yds.	Use to hold seed and aid in germination without mulch. Tie down according to manufacturing specifications.
Twisted Kraft Paper Yarn	Fungicide treated warp 1.1 pairs per in. filling 2.5 in.	45" x 250 yds.	Roll 80 lbs.	312-1/2 sq. yds.	Use over bare soil or sod to prevent erosion and hold seed. Good for waterways, critical slopes, & critical ditch bottoms. Tie down with staples as per manufacturing specifications.
Jute, Twisted Yarn	Undyed, unbleached plain weave Warp 78 ends/yd. Weft 41 ends/yd.	48" x 50 yds. or 48" x 75 yds.	Roll 60 lbs. 90 lbs.	60 sq. yds. 100 sq.yds.	Use without additional mulch. Tie down as per manufacturing specification. Effective for erosion control on critical areas.

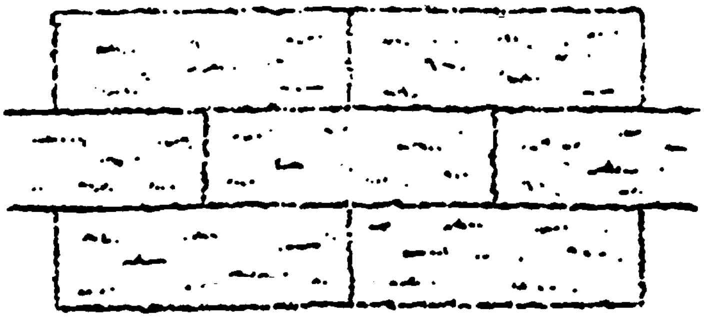
Table 3.8 (Cont'd.)
Guide to Mulch Materials, Rates & Uses

Mulch Material	Quality Standards	Application Rates per 1000 sq. ft.	per acre	Depth of Application	Remarks
Excelsior Wood Fiber Mats	Interlocking web of excelsior fibers with mulch net backing on 1 side only	36" x 30 yds.	Roll	16-1/2 sq. yds.	Use without additional mulch. Tie down as per manufacturing specifications.
Glass Fiber	1/4" thick, 7/16" dia., holes on 1" centers	72" x 30 yds.	Roll 56 lbs.	100 sq.yds.	Use without additional mulch. Tie down with T bars as per manufacturing specifications.
Plastic	2-4 mils	Variable up to 50 feet wide			Use black for weed control; use white for seeding establishment without organic mulch. Release plastic after seeding is established. Effective moisture conservation and weed control for small fruits

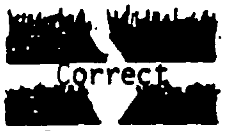
Table 3.9
Mulch Anchoring Guide

Anchoring Method or Material	Kind of Mulch to be Applied	How to Apply
A. Manual 1. Peg and Twine	Hay or straw, pine straw	After mulching, divide areas into blocks approx. 1 sq. yd. in size. Drive 4-6 pegs per block to within 2" to 3" of soil surface. Secure mulch to surface by stretching twine between pegs in criss-cross pattern on each block. Secure twine around each peg with 2 or more turns. Drive pegs flush with soil where mowing & maintenance is planned.
2. Mulch netting	Hay or straw, shredded sugar cane, pine straw, compost, wood shavings, 'tanbark'	Staple with light-weight paper, jute, wood fiber, or plastic nettings to soil surface according to manufacturer's recommendations.
3. Soil and stones	Plastic	Plow a single furrow along edge of area to be covered with plastic, fold about 6" of plastic into the furrow and plow furrow slice back over plastic. Use stones to hold plastic down in other places as needed.
4. Silt	Hay or straw	Cut mulch into soil surface with square-edged spade. Make cuts in contour rows spaced 18" apart.
B. Mechanical 1. Asphalt spray (emulsion)	Compost, wood chips, wood shavings, hay or straw	Apply with suitable spray equipment using the following rates: asphalt emulsion 0.04 gallons per sq. yd.; liquid asphalt (rapid, medium, or slow setting) 0.10 gallons per sq. yd.
2. Wood cellulose fiber	Hay or straw	Apply with hydroseeder immediately after mulching. Use 750 lbs. wood fiber per acre.
3. Pick Chain	Hay or straw, manure compost, pine straw	Use on slopes steeper than 3:1. Pull across slopes with suitable power equipment.
4. Mulch Anchoring Tool or disk (smooth or notched)	Hay or straw, manure pine straw	Apply mulch and pull a mulch anchoring tool over mulch. When a disk (smooth) is used, set in straight position and pull across slope with suitable power equipment. Mulch material should be "tucked" into soil surface about 3".
5. Chemical	Hay or straw	Apply Terra Tack AR (45 lbs.) or Aerospray 70 (60 gal./A.) according to manufacturer's instructions. Avoid application during rain. A 24 hr. curing period required & soil temp. higher than 45°F.

SODDING

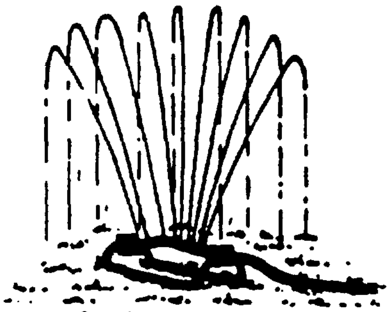


Lay sod in a staggered pattern. Butt the strips tightly against each other. Do not leave spaces and do not overlap. A sharpened mason's trowel is a handy tool for tucking down the ends and trimming pieces.



Butting - angled ends caused by the automatic sod cutter must be matched correctly.

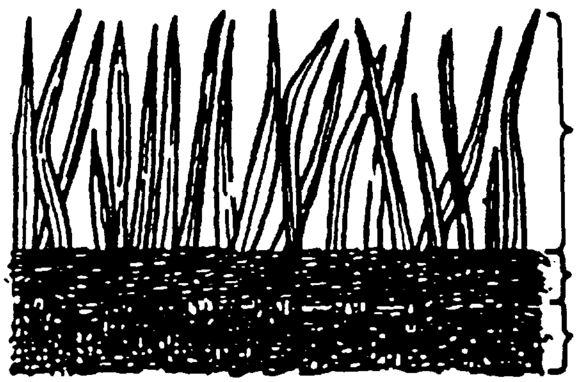
ROLL sod immediately to achieve firm contact with the soil.



WATER to a depth of 4" as needed. Water well as soon as the sod is laid.

MOW when the sod is established - in 2-3 weeks. Set the mower high (2"-3").

APPEARANCE OF GOOD SOD



Shoots or grass blades. Grass should be green and healthy, mowed at a 2"-3" cutting height.

Thatch - grass clippings and dead leaves, up to 1/2" thick.

Root Zone - soil and roots. Should be 1/2"-3/4" thick, with dense root mat for strength.

Source: Va SWCC

Plate 1.67a

4. **Sod Stabilization**

- Definition: Stabilizing sediment producing areas by establishing long-term stands of grass with sod.

- Purpose: To stabilize the soil; reduce damage from sedi ;ent and runoff to downstream areas; enhance natural beauty.

- Conditions Where Practices Applies: On exposed soils where a quick vegetative cover is desired; on sites which can be maintained with ground equipment (2:1 or flatter slopes).

- Effectiveness: When installed and maintained properly, sodding at 99% efficiency serves as the most effective vegetation practice available. (3) This extremely high efficiency in controlling erosion is achieved because sodding establishes an instantaneous permanent grass vegetation on previously disturbed surfaces. Careful maintenance of sodded areas must be practiced to assure optimum efficiency.

- Advantages: As mentioned above, sodding is the most effective sediment control technology available.

- Disadvantages: Installation purchase costs of sodding are relatively high thus making sodding undesirable for large areas. Also, extensive maintenance including watering and fertilizing may be required.

- Costs: Generally sodding costs $4.00 per square yard to install plus any additional costs associated with maintenance such as fertilizing and watering as needed.

- Geographical Considerations: Sod is very sensitive to the climate of a region and is especially draught susceptible. Sod can be established anywhere but many require intensive maintenance practices such as watering and fertilizing. As with any type of vegetative practice, sodding is only viable during the growing season in northern climates.

5. **Vegetative Buffer Strip** (4)

- Definition: Planting of vegetation at the top and bottom of a slope along the contour.
- Purpose: To slow runoff velocity; filter sediment from runoff; reduce the volume of runoff on slopes.
- Conditions Where Practice Applies: Graded or cleared slopes which are subject to erosion for extended periods of time.
- Effectiveness: Buffer strips have proven to be very effective in removing sediments from construction site runoff, with efficiencies ranging from 75% and 99% depending on the type and quality of ground cover. (3)
- Advantages: Buffer strips are easy and inexpensive to install and once established, require little maintenance.
- Disadvantages: Vegetative buffer strips may require large strips of land that can limit movement of construction equipment on site. Also, buffer strips are ineffective until vegetation has been completely established.
- Costs: The cost of installing a vegetative buffer strip is approximately.
- Geographical Considerations: Buffer strips can be installed whenever growing conditions allow full vegetation of the area.

6. Protection of Trees in Urbanizing Areas

- Definition: Protection of desirable trees from mechanical and other injury while the land is being developed.

- Purpose: To employ the necessary protective measures to insure the survival of desirable trees for shade, beautification and vegetative cover.

- Conditions Where Practices Applies: On areas now occupied by single specimen trees or groups of trees.

- Effectiveness: Mature trees have extensive roof systems that help to hold soil in place thus reducing erosion. Also, shade trees help to keep soil from drying rapidly and becoming susceptible to erosion. To effectively save an existing tree, no disturbances of any kind should be allowed within the drip line of the tree.

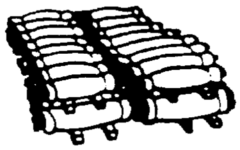
- Advantages: Saving existing mature trees on site beautifies the area and saves money by limiting the number of new trees required to be planted. Mature trees also increase property values and satisfy consumer aesthetic needs.

- Disadvantages: For sites with diverse topography it is often difficult and expensive to save existing trees and grade the site satisfactorily for the planned development.

- Costs: Costs associated with tree saving techniques can vary greatly. Expensive structural practices such as retaining walls and tree wells may be required for sites with varied topography. Ideally, the only cost associated with tree saving would be installing fences,(for example, snow fence at $2.50 per linear foot) along the drip line to keep construction activities away from the tree.

- Geographical Considerations: Tree protection can be implemented an any construction project where trees are present.

Care of Seedlings Until Planted



Seedlings should be planted immediately. If it is necessary to store moss-packed seedlings for more than 2 weeks, one pint of water per pkg. should be added. If clay-treated, do not add water to pkg. Packages must be separated to provide ventilation to prevent "heating". Separate packages with wood strips and store out of the wind in a shaded, cool (not freezing) location.

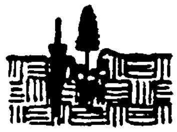
Care of Seedlings During Planting

When planting, roots must be kept moist until trees are in the ground. Do not carry seedlings in your hand exposed to the air and sun. Keep moss-packed seedlings in a container packed with wet moss or filled with thick muddy water. Cover clay-treated seedlings with wet burlap only.

Hand Planting

Insert bar at angle shown and push forward to upright position.

Remove bar and place seedling at correct depth.



Insert bar two inches toward planter from seedling.

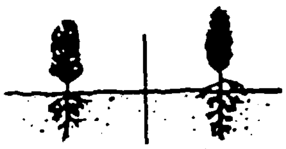
Pull bar toward planter firming soil at bottom of roots.

Push bar forward from planter firming soil at top of roots.

Fill in last hole by stamping with heel.

Firm soil around seedling with feet.

Test planting by pulling lightly on seedling.

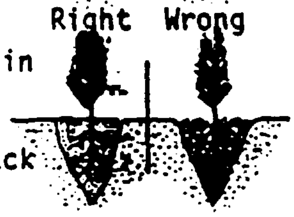


Don't expose roots to air during freeze or plant in frozen ground.

Plant seedlings upright - not at an angle.

Do not bend roots so that they grow upwards out of the ground.

Always plant in soil - never loose leaves or debris. Pack soil tightly.

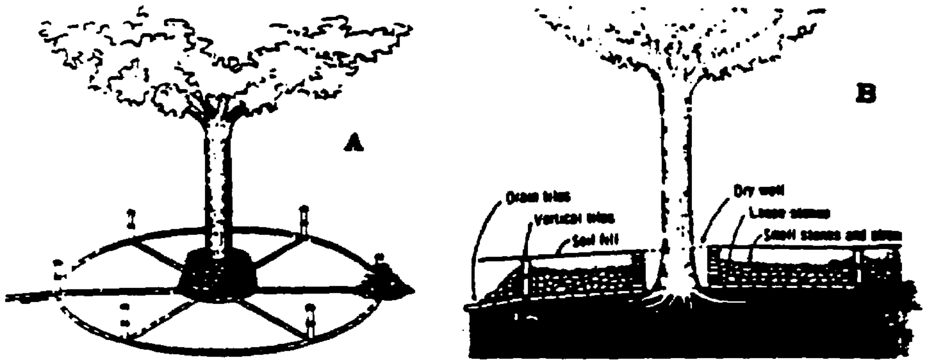


PLANTING BARE-ROOTED SEEDLINGS

Source: Virginia Division of Forestry

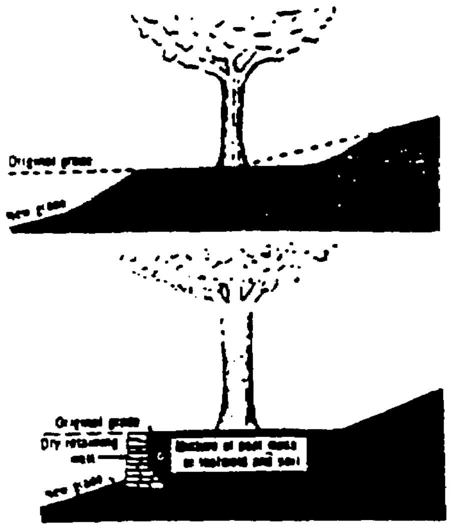
Plate 1.80d

Figure 1



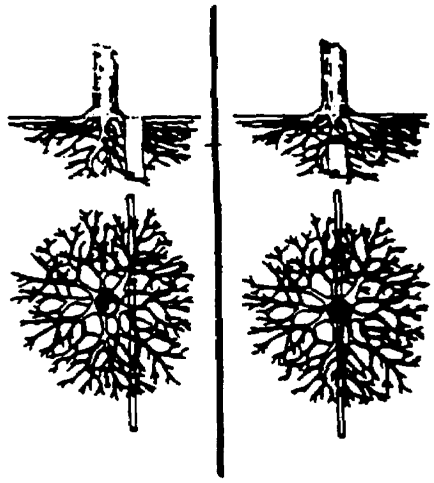
A tile system protects a tree from a raised grade. *A*, The tile is laid out on the original grade, leading from a dry well around the tree trunk. *B*, The tile system is covered with small stones to allow air to circulate over the root area.

Figure 2



A retaining wall protects a tree from a lowered grade.

Figure 3



Tunnel beneath root systems. Drawings at left show trenching that would probably kill the tree. Drawings at right show how tunneling under the tree will preserve many of the important, feeder roots.

Figure 3.5
Combination of Sand Fence and Vegetation for Dune Building

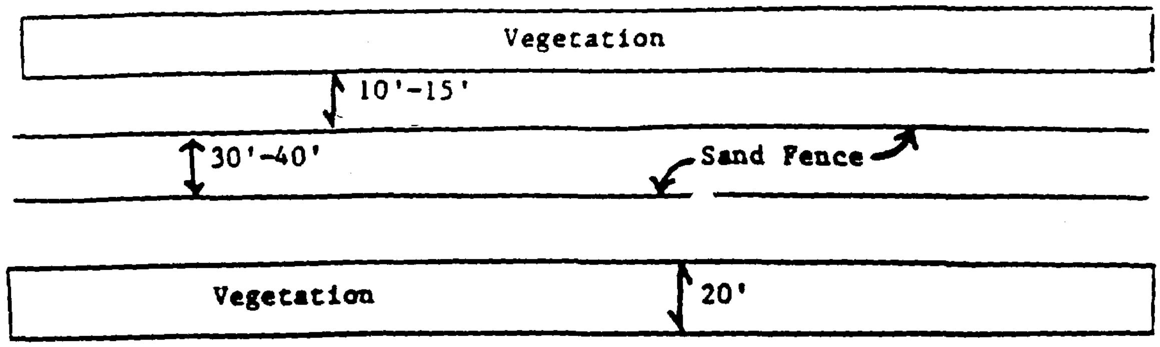
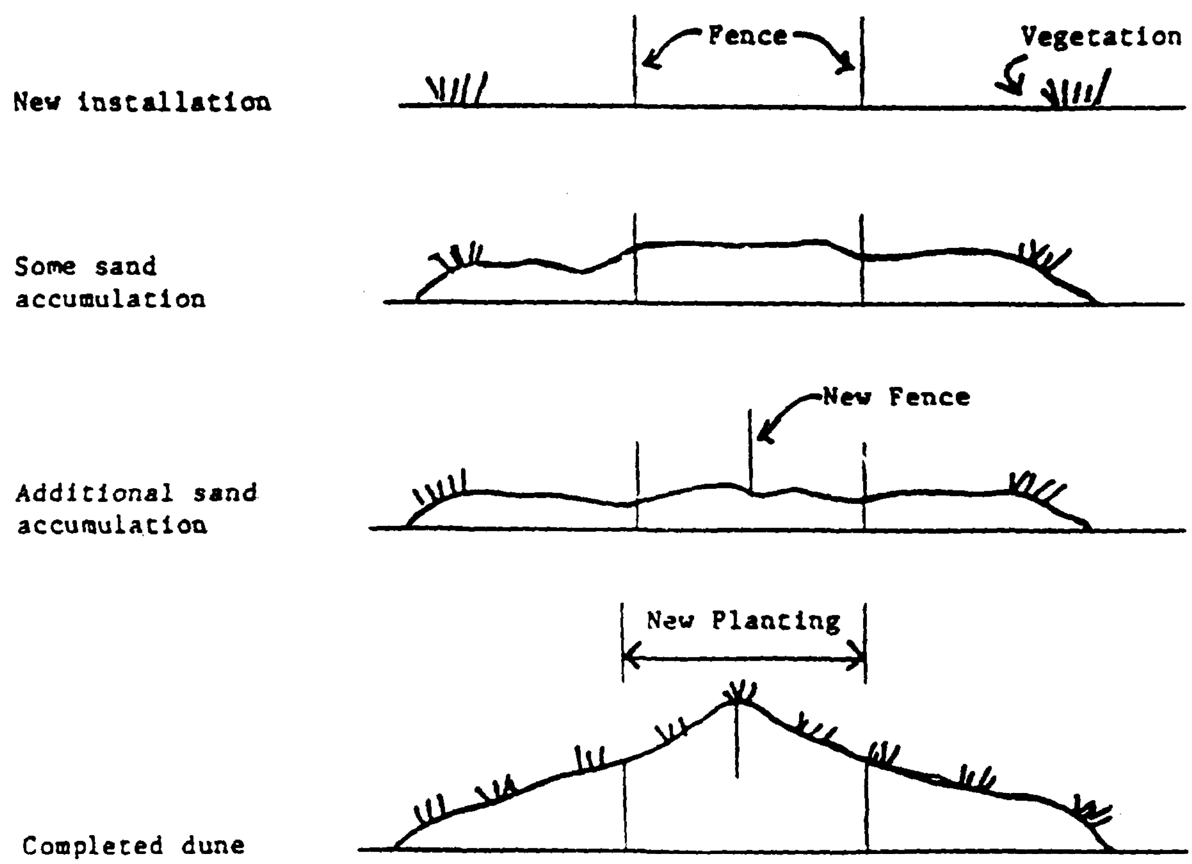


Figure 3.6
Typical Cross-Section Created by a Combination of Sand Fence and Vegetation



7. **Dune Stabilization (2)**

- Definition: Controlling surface movement of sand dunes or shifting sand by vegetative means.

- Purpose: To stabilize frontal dunes and reduce soil blowing and the encroachment of shifting sands on valuable property; provide a barrier against tide water.

- Conditions Where Practices Applies: On seashore areas where blowing sands, tide and storm water may cause damage.

- Effectiveness: A well-established dune buffer will minimize potentially severe wind erosion on beachfront developments.

- Advantages: Dunes control and stabilize beach erosion which often times saves valuable real estate. Also dunes create a permanent habitat for wildlife.

- Disadvantages: Man made dunes are still quite difficult to construct and often times do not develop as planned. Dune systems are very fragile and difficult to maintain once created.

- Costs: To construct a dune, fencing (for example, snow fence at $2.50 per linear foot) is placed along the beach to trap blowing sand and begin deposition along the dune line. An additional cost is associated with planting and fertilizing dune grasses along the dune once it has been created.

- Geographical Considerations: Obviously, only coastal regions would have a need for dune stabilization with an emphasis on developing coastal communities and barrier islands.

IV INVENTORY OF SEDIMENT CONTROL TECHNOLOGIES

(Continued)

B. Structural Practices

Structural practices involve the construction of devices to divert flow, trap flow or limit runoff. Structural practices are classified as either temporary or permanent. Temporary structural practices are used during construction to prevent offsite sedimentation or to divert clean water from a construction area. Permanent structural practices are used to convey surface water runoff to a safe outlet. Permanent structural practices remain in place after completion of construction. Structural practices should be the first items constructed before grading begins. Earthen structures should be vegetatively stabilized before they are considered operational. (1)

Even though the specific conditions of each site determine precisely what measures are necessary to control sedimentation, some general principles apply to the selection and placement of sediment control measures. It is important to prevent clean water from crossing disturbed areas where sediment can be removed. This can be accomplished by diverting runoff from undisturbed upslope areas. Earth dikes, temporary swales, perimeter dike/swales, or diversions that outlet in stable areas can be used in this capacity. Another inportant objective is to remove sediment from site runoff before the runoff leaves the site. The method of sediment removal depends upon how the runoff drains from the site. Concentrated flow must be diverted to a trapping device so that suspended sediment can be deposited. Dikes or swales that outlet into sediment traps or basins can accomplish this. A storm drain system may be used to convey concentrated sediment laden water only if the system empties into a trap or basin. Otherwise, all storm drain inlets must be protected so that sediment laden water cannot enter the drainage system before being treated to remove the sediment. Surface runoff draining in sheet flow must be filtered before the water leaves the site. Straw bale dikes, silt fences, or brush barriers can be used to filter sheet flow.

8. **Dust Control** (5)

- Definition: Controlling dust blowing and movement on construction sites and roads.

- Purpose: To prevent blowing and movement of dust from exposed soil surfaces, reduce on and off-site damage, health hazards, and improve traffic safety.

- Conditions Where Practices Applies: This practice is applicable to areas subject to dust blowing and movement where on and off-site damage is likely without treatment.

- Effectiveness: When used properly, chemical treatments to soil on construction sites can minimize wind erosion.

- Advantages: Dust control chemical soil treatments help to eliminate wind erosion on disturbed areas and improves health and safety aspects of the construction site.

- Disadvantages: Chemical dust control can also be dangerous if applied improperly due to the large amounts of chemicals exposed on the site surface.

- Costs: Dust control costs vary due to availability and type of chemical chosen.

- Geographical Considerations: Chemical dust control is best utilized in dry, arid climates such as in regions 5, 6, 8 and 9. It is not recommended for cold or wet climate conditions.

1. Earth Dike

- Definition: A temporary berm or ridge of compacted soil, located in such a manner as to channel water to a desired location.

- Purpose: The purpose of an earth dike is to direct runoff to a sediment trapping device, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used for diverting clean water away from disturbed areas.

- Conditions Where Practice Applies: Earth dikes are often constructed across disturbed areas and around construction sites such as graded parking lots and subdivisions. The dikes should remain in place until the disturbed areas are permanently stabilized.

- Effectiveness: An earth dike itself does not control erosion or remove sediment from runoff, rather it directs runoff to an erosion control device such as a sediment trap or directs runoff away from an erodable area.

- Advantages: Earth dikes can handle flows from large drainage areas and are easy to install. Also, once stabilized, earth dikes require little maintenance.

- Disadvantages: Often times earth dikes create more disturbed area on site and become barriers to construction equipment. Earth dikes must be stabilized immediately which adds cost and maintenance concerns.

- Costs: The cost associated with earth dike construction is roughly $4.50 per linear foot which covers the earthwork involved in preparing the dike. Also added to this cost is approximately $1.00 per linear foot for stabilization practices. It should be noted that for most construction projects, the cost of earth dike construction is insignificant compared to the overall earthwork project costs.

- Geographical Considerations: Earth dikes can be constructed on any construction site, but need to be properly stabilized which may be affected by area climate.

No matter which practices are selected and implemented, they must be properly maintained in order to remain functional. Sediment accumulated associated with these differ nt practices must be removed and disposed of in a manner that minimizes erosion and sedimentation.

Descriptions of the various structural practices in use currently follows.

2. **Straw Bale Dike**

- Definition: A temporary barrier of straw or similar material used to intercept sediment laden runoff from small drainage areas of disturbed soil.

- Purpose: The purpose of a straw bale dike is to reduce runoff velocity and effect deposition of the transported sediment load. Straw bale dikes are to be used for no more than three (3) months because they tend to rot and fall apart over time.

- Conditions Where Practice Applies: The straw bale dike is used where there are no concentrations of water in a channel or other drainage way above the barrier, and erosion would occur in the form of sheet erosion.

- Effectiveness: When installed and maintained properly, straw bale dikes remove approximately 67% (6) of the sediment transported in construction site runoff. This optimum efficiency can only be achieved through careful maintenance with special attention to replacing rotted or broken bales.

- Advantages: Straw bale pikes can be constructed from readily available materials and can be placed to control site runoff without major site disturbances.

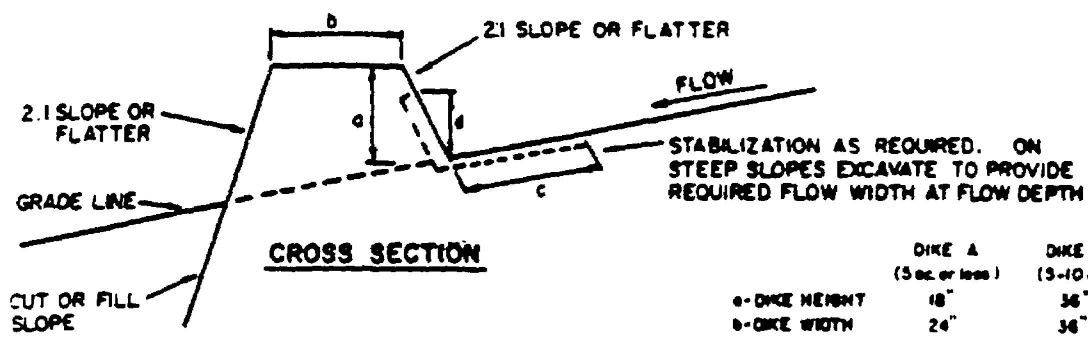
- Disadvantages: Installation of straw bale dikes is very manpower intensive. Also, straw bales lose their effectiveness rapidly due to rotting, thus constant maintenance is required.

- Costs: Installation of straw bale dikes on a construction site costs approximately $5.00 per linear foot.

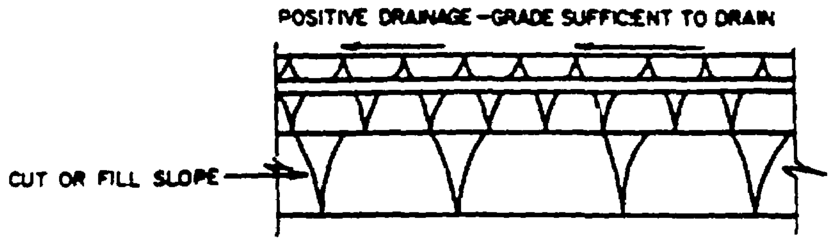
- Geographical Considerations: Straw is a readily available throughout the country, thus straw bale dikes can be used nationwide. However, use of straw bale dikes may be limited in northern areas where long term freezing occurs.

EARTH DIKE

not to scale

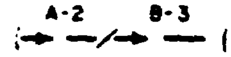


	DIKE A (5 ac. or less)	DIKE B (5-10 ac.)
a-DIKE HEIGHT	18"	36"
b-DIKE WIDTH	24"	36"
c-FLOW WIDTH	4'	6'
d-FLOW DEPTH	6"	15"



STANDARD SYMBOL

A-2 B-3



CONSTRUCTION SPECIFICATIONS

1. ALL DIKES SHALL BE COMPACTED BY EARTH-MOVING EQUIPMENT.
2. ALL DIKES SHALL HAVE POSITIVE DRAINAGE TO AN OUTLET.
3. TOP WIDTH MAY BE WIDER AND SIDE SLOPES MAY BE FLATTER IF DESIRED TO FACILITATE CROSSING BY CONSTRUCTION TRAFFIC.
4. FIELD LOCATION SHOULD BE ADJUSTED AS NEEDED TO UTILIZE A STABILIZED SAFE OUTLET.
5. EARTH DIKES SHALL HAVE AN OUTLET THAT FUNCTIONS WITH A MINIMUM OF EROSION. RUNOFF SHALL BE CONVEYED TO A SEDIMENT TRAPPING DEVICE SUCH AS A SEDIMENT TRAP OR SEDIMENT BASIN WHERE EITHER THE DIKE CHANNEL OR THE DRAINAGE AREA ABOVE THE DIKE ARE NOT ADEQUATELY STABILIZED.
6. STABILIZATION SHALL BE: (A) IN ACCORDANCE WITH STANDARD SPECIFICATIONS FOR SEED AND STRAW MULCH OR STRAW MULCH IF NOT IN SEEDING SEASON, (B) FLOW CHANNEL AS PER THE CHART BELOW.

FLOW CHANNEL STABILIZATION

TYPE OF TREATMENT	CHANNEL GRADE	DIKE A	DIKE B
1	.5-3.0%	SEED AND STRAW MULCH	SEED AND STRAW MULCH
2	3.1-5.0%	SEED AND STRAW MULCH	SEED USING JUTE, OR EXCELSIOR; SOD; 2" STONE
3	5.1-8.0%	SEED WITH JUTE, OR SOD; 2" STONE	LINED RIP-RAP 4-8"
4	8.1-20%	LINED RIP-RAP 4-8"	ENGINEERING DESIGN

A. STONE TO BE 2 INCH STONE, OR RECYCLED CONCRETE EQUIVALENT, IN A LAYER AT LEAST 3 INCHES IN THICKNESS AND BE PRESSED INTO THE SOIL WITH CONSTRUCTION EQUIPMENT.

B. RIP-RAP TO BE 4-8 INCHES IN A LAYER AT LEAST 8 INCHES THICKNESS AND PRESSED INTO THE SOIL.

C. APPROVED EQUIVALENTS CAN BE SUBSTITUTED FOR ANY OF THE ABOVE MATERIALS.

7. PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	EARTH DIKE	STANDARD DRAWING ED-1

3. **Silt Fence**

- Definition: A temporary barrier of geotextile fabric (filter cloth) used to intercept sediment laden runoff from small drainage areas of disturbed soil.

- Purpose: The purpose of a silt fence is to reduce runoff velocity and effect deposition of transported sediment load. Limits imposed by ultraviolet stability of the fabric will dictate the maximum period the silt fence may be used.

- Conditions Where Practice Applies: Silt fence is placed along disturbed areas to control sheet erosion, where there are no expected concentrations of runoff flow.

- Effectiveness: When installed and maintained properly, silt fence removes 97% of the sediment transported in construction site runoff. (6) Care must be taken in maintaining silt fence with an emphasis on removal of excessive sedimentation.

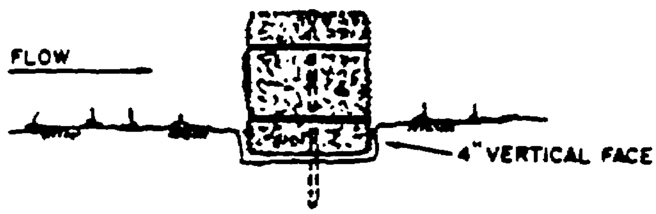
- Advantages: Installation of silt fence requires minimal ground disturbance and is highly effective in controlling sedimentation off site. Silt fence is also easily adaptable to varied site features and can be moved easily.

- Disadvantages: Silt fence can only be used in areas of sheet flow and requires intensive maintenance. Additionally, some silt fence fabric may be susceptible to ultraviolet deterioration, thus limiting its usefulness.

- Costs: Silt fence can be installed on a construction site for approximately $6.00 per linear foot.

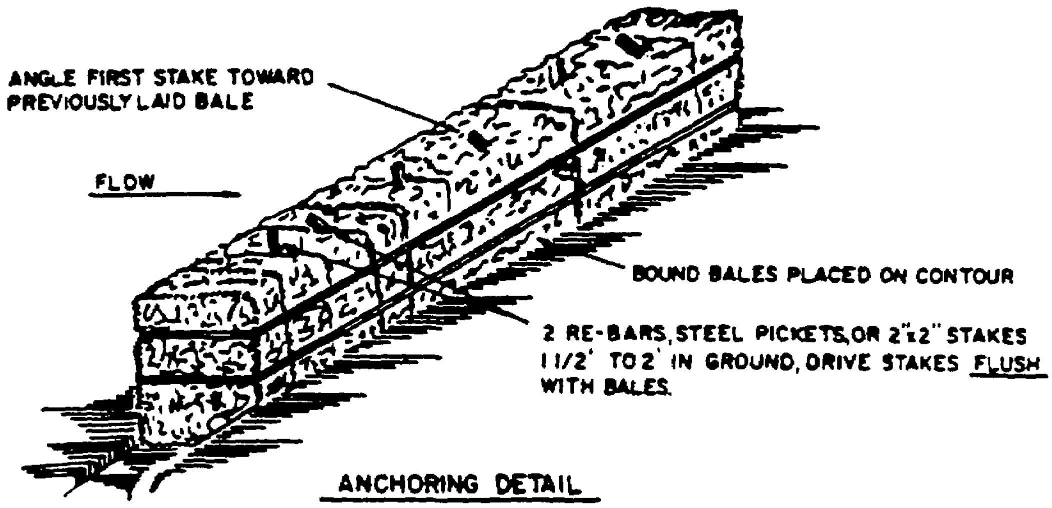
- Geographical Considerations: Silt fence can be used throughout the country as site conditions permit and whenever the silt fencing material can be obtained readily.

STRAW BALE DIKE



BEDDING DETAIL

STANDARD SYMBOL



ANCHORING DETAIL

CONSTRUCTION SPECIFICATIONS

1. BALES SHALL BE PLACED AT THE TOE OF A SLOPE OR ON THE CONTOUR AND IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF (4) INCHES, AND PLACED SO THE BINDINGS ARE HORIZONTAL.
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE-BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
4. INSPECTION SHALL BE FREQUENT AND REPAIR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
5. BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	STRAW BALE DIKE	STANDARD DRAWING SBD-1

4. **Brush Barrier** (6)

- Definition: A temporary sediment barrier composed of tree limbs, weeds, vines, root mat, soil, rock and other cleared materials placed at the toe of a slope.

- Purpose: The purpose of a brush barrier is to intercept and detain sediment and decre se flow velocities.

- Conditions Where Practice Applies: Brush barriers can be utilized on graded or cleared slopes which are subject to sheet and rill erosion.

- Effectiveness: Brush barriers serve as an effective means of utilizing waste vegetation that is normally burned on site. However, these barriers have limited erosion control potential.

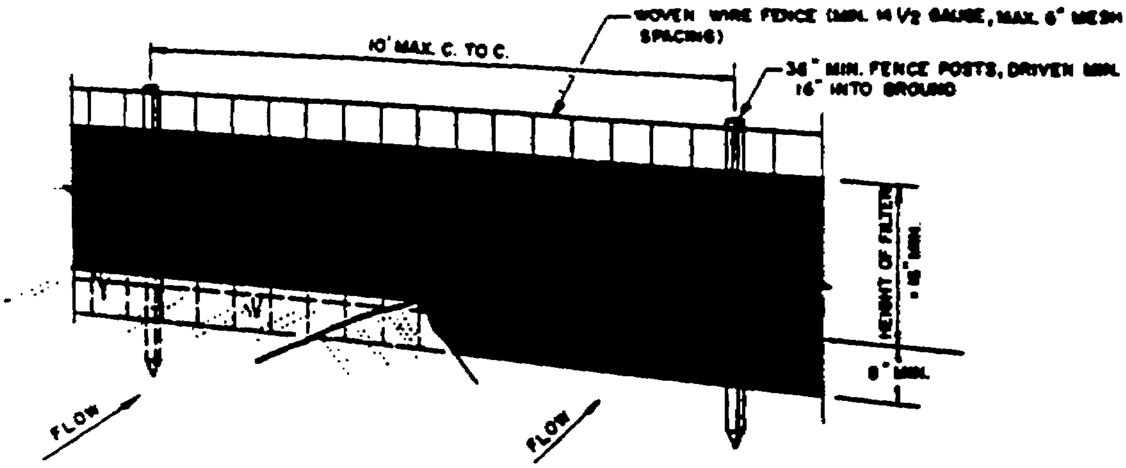
- Advantages: Brush barriers are possibly the easiest of all erosion techniques to construct and have almost no cost associated with them.

- Disadvantages: Brush barriers often contain large amounts of top soil which adds to the site erosion potential. Also, brush barriers are rather unsightly.

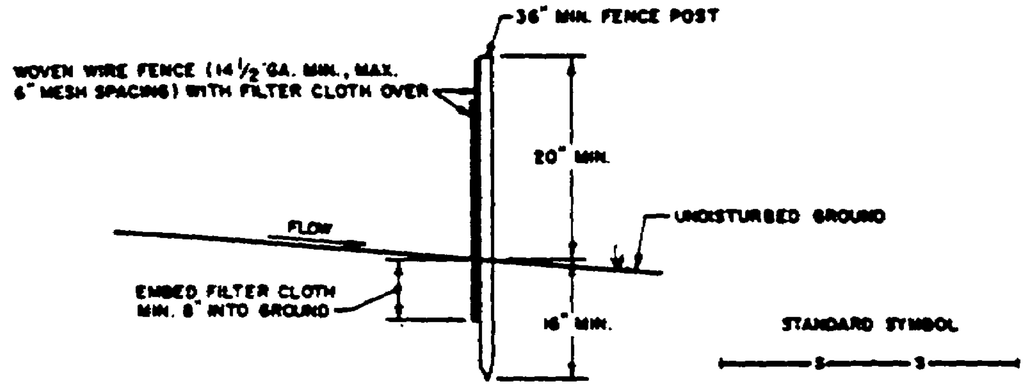
- Costs: The costs of creating brush barriers is included in the cost of clearing and grubbing a construction site and is very minimal.

- Geographical Considerations: Brush barriers may be used in all geographic and climatic regions of the United States where cleared materials can form on effective barrier.

SILT FENCE



PERSPECTIVE VIEW



SECTION

CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVER-LAPPED BY SIX INCHES AND FOLDED.
4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS: STEEL EITHER T OR U TYPE OR 2" HARDWOOD

FENCE: WOVEN WIRE, 14½ GA. 6" MAX. MESH OPENING

FILTER CLOTH: FILTER X, MIRAFI 100X, STABILINKA T140N OR APPROVED EQUAL

PREFABRICATED UNIT: GEOFAB, ENVIROFENCE, OR APPROVED EQUAL.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	SILT FENCE	STANDARD DRAWING SF-1

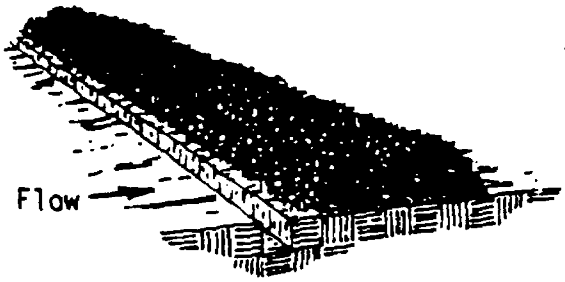
5. Drainage Swale

- Definition: A drainage way with a lining of grass, riprap, asphalt, concrete, or other material.
- Purpose: Drainage swales convey runoff without causing erosion.
- Conditions Where Practice Applies: Drainage swales are placed to divert off site flows away from a disturbed area or to direct on site sediment laden water to a trapping device.
- Effectiveness: Drainage swales will effectively convey runoff and avoid erosion only if the proper type of geometry and lining is used. Care should be taken to assure that runoff leaving the swale is at non erosive velocities.
- Advantages: Drainage swales can transport large volumes of concentrated flows with little maintenance once established.
- Disadvantages: Constructing the proper swale to handle the desired runoff flows often requires engineering design work which can be costly. Also, depending upon the liner chosen, swales can be expensive to construct.
- Costs: Drainage swale construction costs can vary greatly due to different geometries and liners chosen. Usually, earthwork costs associated with swale construction are rather minimal unless a very large swale is being built. Therefore, swale liner types usually dictate the overall cost of drainage swales. A few selected liner types and their associated costs are listed below:

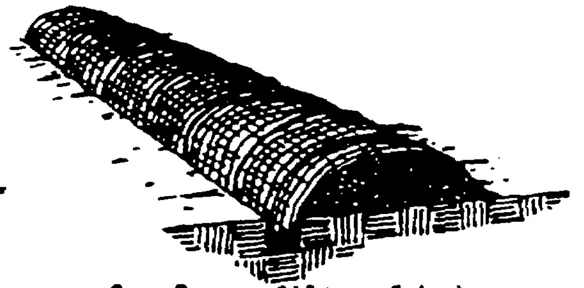
grass - $3.00 per square yard
sod - $4.00 per square yard
riprap - $45 per square yard
asphalt - $35 per square yard
concrete - $65 per square yard

Note that no matter which liner type is used the entire swale must be stabilized (i.e., seeded and mulched at a cost of about $1.25 per square yard.)

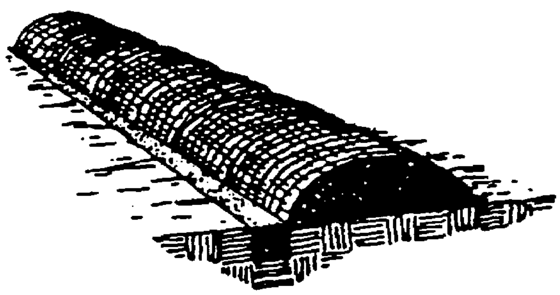
- Geographical Considerations: Drainage swales can be constructed at any construction site with soils for a suitable embankment.



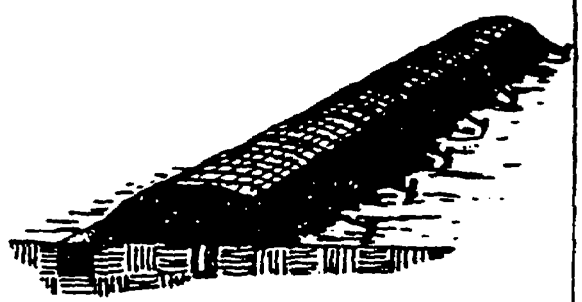
1. Excavate a 4" x 4" trench along the uphill edge of the brush barrier.



2. Drape filter fabric over the brush barrier and into the trench. Fabric should be secured in the trench with stakes set approximately 36" o.c.



3. Backfill and compact the excavated soil.



4. Set stakes along the downhill edge of the brush barrier, and anchor by tying twine from the fabric to the stakes.

CONSTRUCTION OF A BRUSH BARRIER
COVERED BY FILTER FABRIC

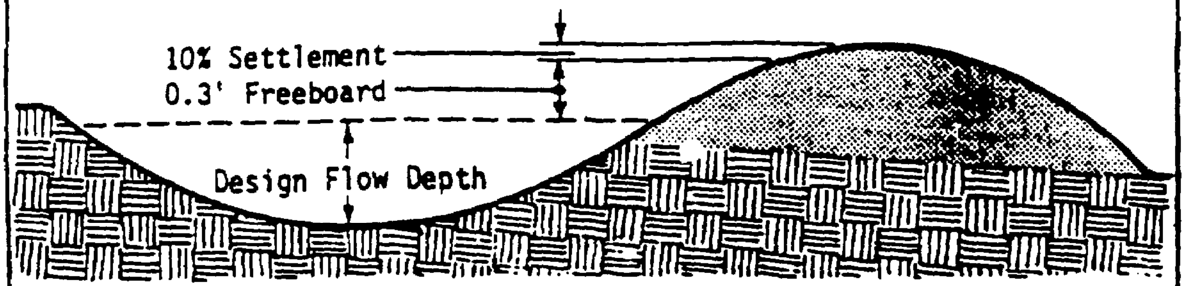
Source: Adapted from Installation of Straw and Fabric Filter Barriers for Sediment Control, Sherwood and Wyant

Plate 1.07a

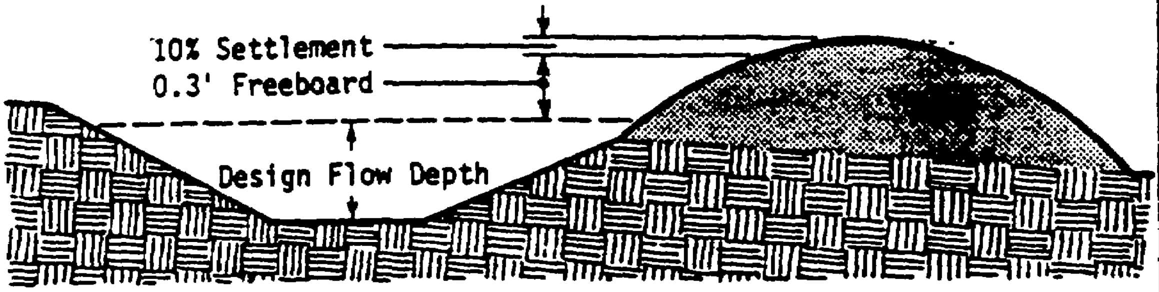
Maintenance

1. Brush barriers shall be inspected after each rainfall and necessary repairs shall be made promptly.

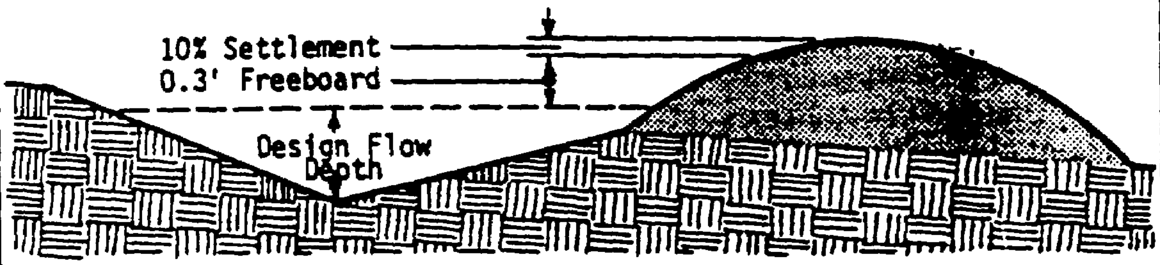
2. Sediment deposits must be removed when they reach approximately one-half the height of the barrier.



Typical Parabolic Diversion



Typical Trapezoidal Diversion



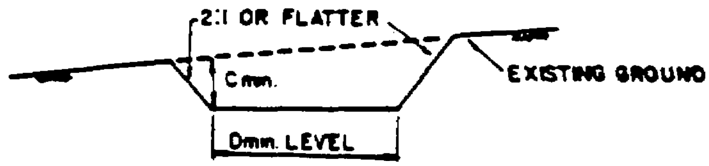
Typical Vee-Shaped Diversion

DIVERSIONS

Source: Va SWCC

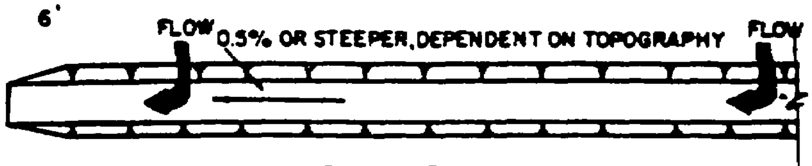
Plate 1.18a

TEMPORARY SWALE



CROSS SECTION

	SWALE A	SWALE B
C	1'	1'
D	4'	6'



OUTLET AS REQUIRED
SEE ITEM 8 BELOW

PLAN VIEW

STANDARD SYMBOL
A-2 B-3

CONSTRUCTION SPECIFICATIONS

1. ALL TEMPORARY SWALES SHALL HAVE UNINTERRUPTED POSITIVE GRADE TO AN OUTLET.
2. DIVERTED RUNOFF FROM A DISTURBED AREA SHALL BE CONVEYED TO A SEDIMENT TRAPPING DEVICE.
3. DIVERTED RUNOFF FROM AN UNDISTURBED AREA SHALL OUTLET DIRECTLY INTO AN UNDISTURBED STABILIZED AREA AT NON-EROSIVE VELOCITY.
4. ALL TREES, BRUSH, STUMPS, OBSTRUCTIONS, AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE SWALE.
5. THE SWALE SHALL BE EXCAVATED OR SHAPED TO LINE, GRADE, AND CROSS SECTION AS REQUIRED TO MEET THE CRITERIA SPECIFIED HEREIN AND BE FREE OF BANK PROJECTIONS OR OTHER IRREGULARITIES WHICH WILL IMPEDE NORMAL FLOW.
6. FILLS SHALL BE COMPACTED BY EARTH MOVING EQUIPMENT.
7. ALL EARTH REMOVED AND NOT NEEDED ON CONSTRUCTION SHALL BE PLACED SO THAT IT WILL NOT INTERFERE WITH THE FUNCTIONING OF THE SWALE.
8. STABILIZATION SHALL BE AS PER THE CHART BELOW:

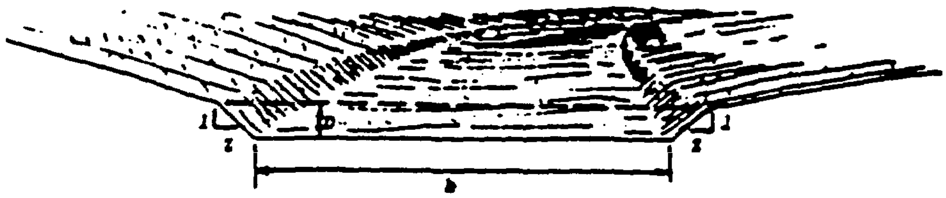
FLOW CHANNEL STABILIZATION

TYPE OF TREATMENT	CHANNEL GRADE	A (5 AC OR LESS)	B (5 AC - 10 AC)
1	0.5-3.0%	SEED AND STRAW MULCH	SEED AND STRAW MULCH
2	3.1-5.0%	SEED AND STRAW MULCH	SEED USING JUTE OR EXCELSIOR
3	5.1-8.0%	SEED WITH JUTE OR EXCELSIOR; SOD	LINED RIP-RAP 4-8" RECYCLED CONCRETE EQUIVALENT
4	8.1-20%	LINED 4-8" RIP-RAP	ENGINEERED DESIGN

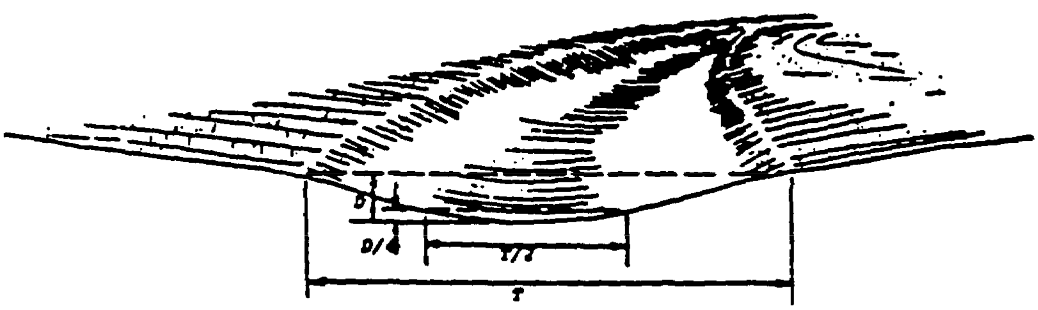
9. PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	TEMPORARY SWALE	STANDARD DRAWING TS - 1

Figure 4.45
Grassed Waterway Construction Details



TRAPEZOIDAL CROSS-SECTION



PARABOLIC CROSS-SECTION

Construction Specifications

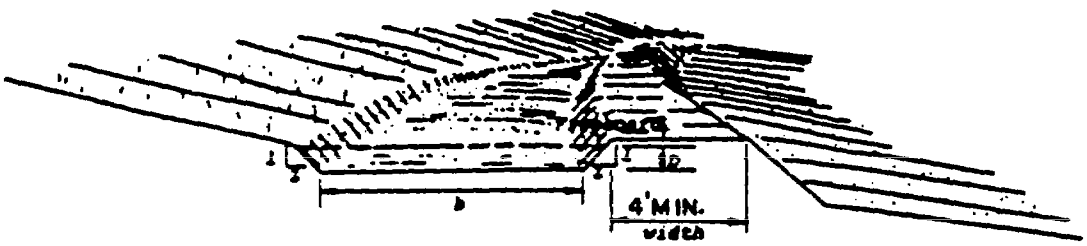
1. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the waterway.
2. The waterway shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified herein, and be free of bank projections or other irregularities which will impede normal flow.
3. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the complete waterway.
4. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the waterway.
5. Stabilization shall be done according to the appropriate Standard and Specifications for Vegetative Practices.
   - A. For design velocities of less than 3.5 ft. per sec., seeding and mulching may be used for the establishment of the vegetation. It is recommended that, when conditions permit, temporary diversions or other means should be used to prevent water from entering the waterway during the establishment of the vegetation.
   - B. For design velocities of more than 3.5 ft. per sec., the waterway shall be stabilized with sod, with seeding protected by jute or excelsior matting or with seeding and mulching including temporary diversion of the water until the vegetation is established.
   - C. Structural - Vegetative Protection
     - (1) Subsurface drain for base flow shall be constructed as shown on the Standard Drawing and as specified in the Standard and Specifications for Subsurface Drain.

Standard Symbol GW

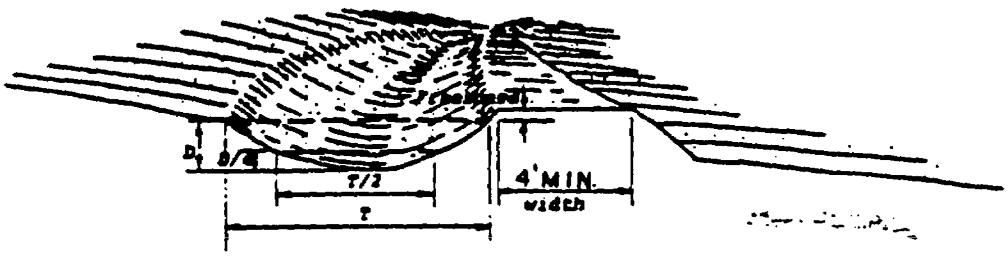
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	GRASSED WATERWAY	Standard Drawing GW-1

Figure 4.36
Diversion Detail

DIVERSION



TRAPEZOIDAL CROSS-SECTION



PARABOLIC CROSS-SECTION

Construction Specifications

1. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.
2. The diversion shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified herein, and be free of irregularities which will impede normal flow.
3. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the completed diversion.
4. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the diversion.
5. Stabilization shall be done according to the appropriate Standard and Specifications for Vegetative Practices.
   A. For design velocities of less than 3.5 ft. per sec., seeding and mulching may be used for the establishment of the vegetation. It is recommended that, when conditions permit, temporary diversions or other means be used to prevent water from entering the diversion during the establishment of the vegetation.
   B. For design velocities of more than 3.5 ft. per sec., the diversion shall be stabilized with sod, with seeding protected by jute or excelsior matting or with seeding and mulching including temporary diversion of water until the vegetation is established. See the Standard and Specifications for Protective Materials.

Standard Symbol

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	DIVERSION	Standard Drawing GW-3

6. **Check Dams** (6)

- Definition: Small temporary dams constructed across a swale or drainage ditch.

- Purpose: Check dams reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch.

- Conditions Where Practice Applies: This practice is limited to use in small open channels which drain 10 acres or less. Check dams should not be used in a live stream.

- Effectiveness: Check dams only perform their function of reducing velocities of concentrated flows and energy if they have been sized and constructed correctly and are maintained properly.

- Advantages: Check dams reduce the need for more stringent erosion control practices in the swale due to the decreased velocity and energy of runoff.

- Disadvantages: Inspections must be done frequently on check dams, usually after each storm.

- Costs: The costs for the construction of check dams varies with material used. Rock and covered straw bales, two of the most common ways of construction, cost about $100 and $50 respectively per dam. Log check dams are usually slightly less expensive than those of rock. All costs vary depending on the flow of water to be checked.

- Geographical Considerations: Check dams may be constructed in all areas where freezing of the ponded water will not occur.

Sodded Waterways

1. Care should be taken to prepare the soil adequately in accordance with this specification. The sod type shall consist of plant materials able to withstand the designed velocity. (See STORMWATER CONVEYANCE CHANNELS, Std. & Spec. 1.35).

2. Sod strips in waterways shall be laid perpendicular to the direction of flow. Care should be taken to butt ends of strips tightly.

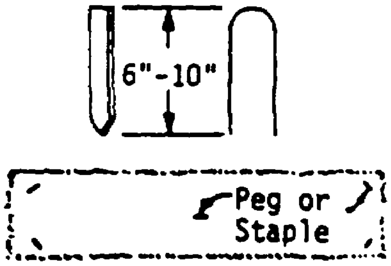
3. After rolling or tamping, sod shall be pegged or stapled to resist washout during the establishment period. Chicken wire, jute or other netting may be pegged over the sod for extra protection in critical areas.

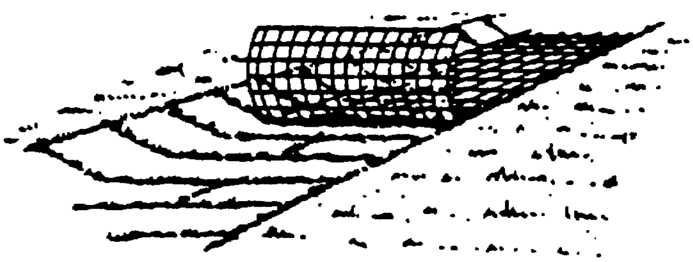
4. All other specifications for this practice shall be adhered to when sodding a waterway.

SODDED WATERWAYS

Lay sod across the direction of flow.

Use pegs or staples to fasten sod firmly - at the ends of strips and in the center, or every 3-4 feet if the strips are long. When ready to mow, drive pegs or staples flush with the ground.





In critical areas, secure sod with chicken wire or netting. Use staples.

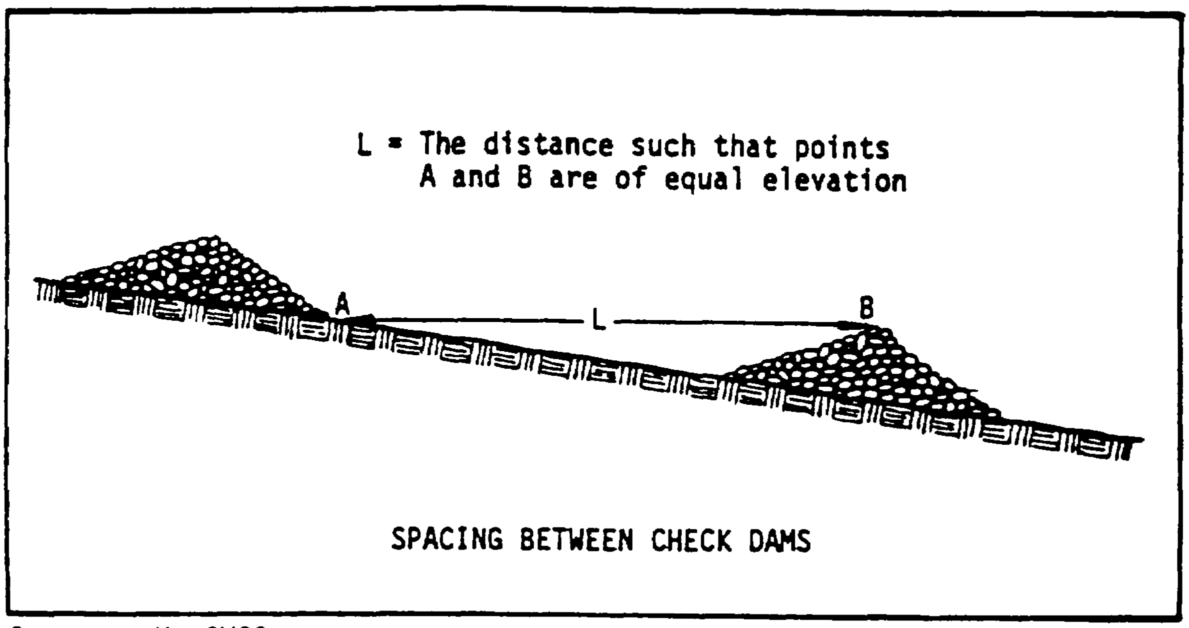
Source: Va SWCC

Plate 1.67b

Logs and/or brush should be placed on the downstream side of the dam to prevent scour during high flows.

Sediment Removal

While this practice is not intended to be used primarily for sediment trapping, some sediment will accumulate behind the check dams. Sediment should be removed from behind the check dams when it has accumulated to one half of the original height of the dam.



Source: Va SWCC

Plate 1.38c

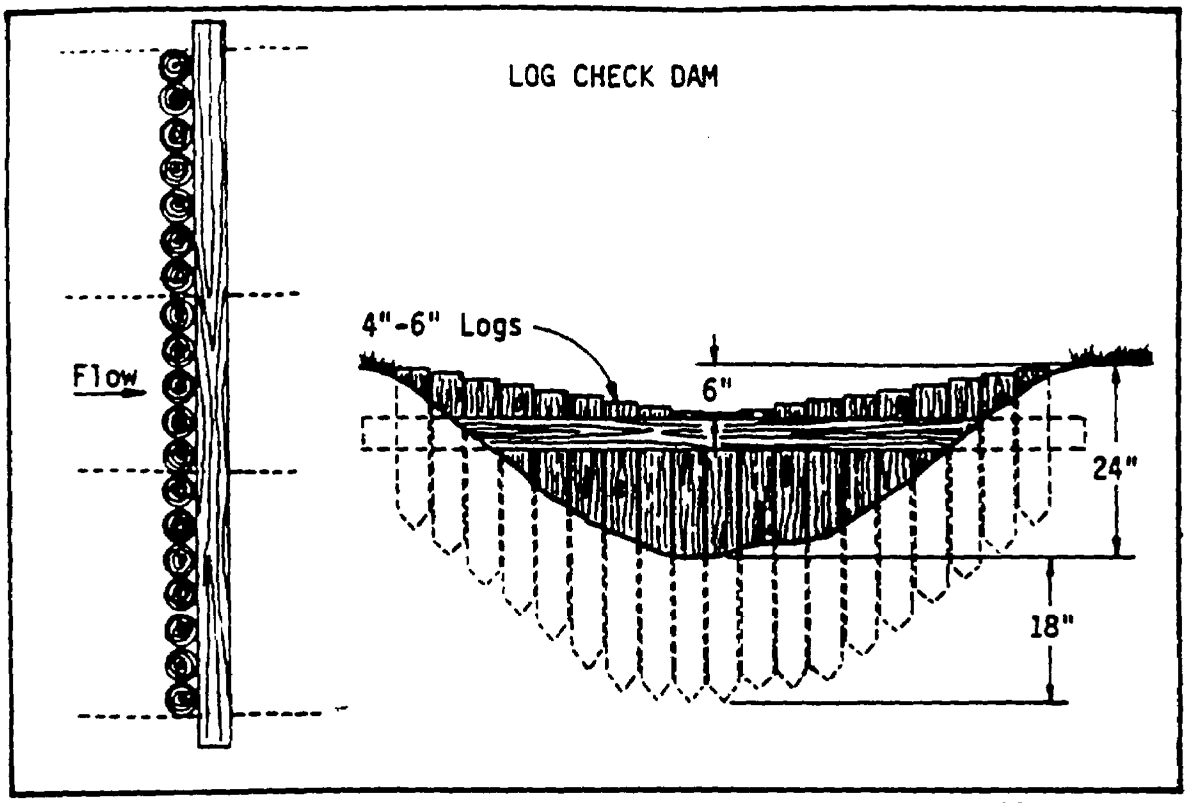
Removal

Check dams must be removed when their useful life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when it is no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed.

Maintenance

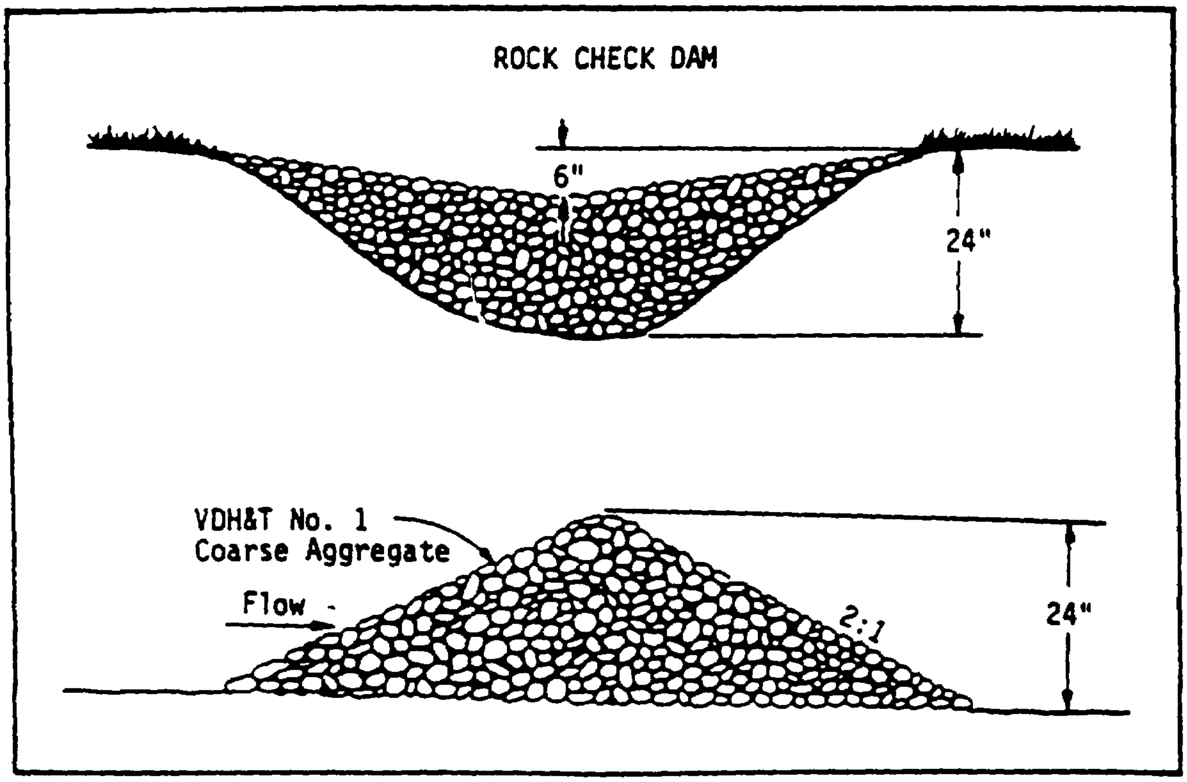
Check dams should be checked for sediment accumulation after each significant rainfall. Sediment should be removed when it reaches one half of the original height or before.

Regular inspections should be made to insure that the center of the dam is lower than the edges. Erosion caused by high flows around the edges of the dam should be corrected immediately.



Source: Va SWCC

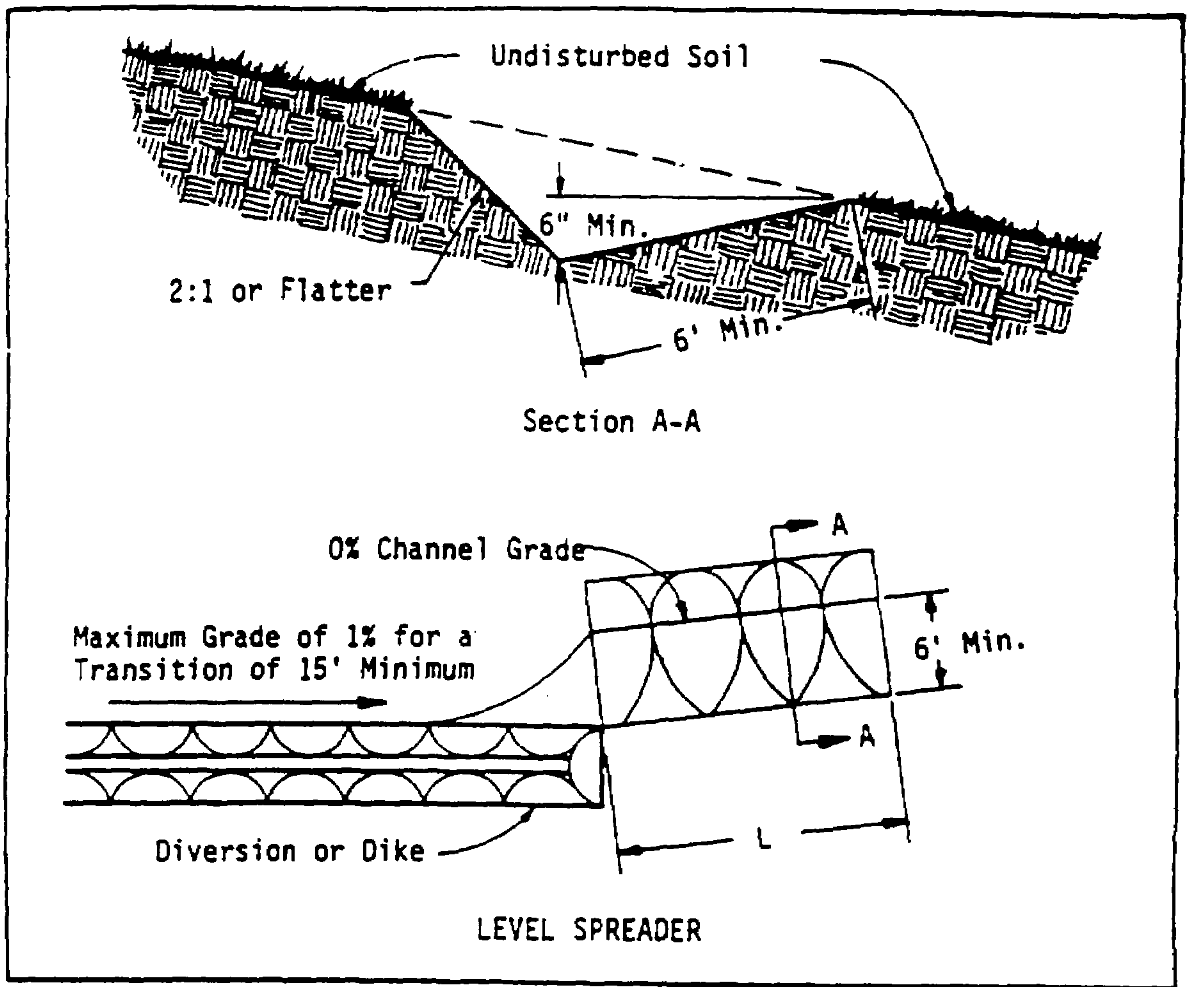
Plate 1.38a



Source: Va SWCC

Plate 1.38b

2. The grade of the level spreader shall be 0%.



Source: Va SWCC

Plate 1.40a

Outlet

The release of the stormwater will be over the level lip onto an undisturbed stabilized area. The level lip should be of uniform height and zero grade over the length of the spreader.

Construction Specifications

1. Level spreaders must be constructed on undisturbed soil (not fill material).

2. The entrance to the spreader must be shaped in such a manner as to insure that runoff enters directly onto the 0% channel.

7. **Level Spreader** (6)

- Definition: An outlet for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope.

- Purpose: Level spreaders convert concentrated runoff to sheet flow and release it onto areas stabilized by existing vegetation.

- Conditions Where Practice Applies: Level spreaders are placed at the end of dikes that carry sediment free storm runoff away from graded areas and outlet onto undisturbed areas.

- Effectiveness: A level spreader must be maintained and kept level to work properly.

- Advantages: A level spreader eliminates the need for a structural waterway below its outfall because it releases water in the form of sheet flow. This water then percolates into the ground rather than running off the site as concentrated flow and eroding soil.

- Disadvantages: Heavy volumes of water leaving the level spreader may cause concentrated flow and runoff. Maintenance and inspection of the level spreader must be performed often.

- Costs: The estimated cost for construction of a level spreader is about $4.00 per square yard. This is for a small amount of earthwork. Level spreaders construed of concrete cost about $65 per square yard.

- Geographical Considerations: All geographic regions across the county may utilize level spreaders as long as the topography of the site allows a zero percent grade for the outfall.

8. **Subsurface Drain**

- Definition: A conduit, such as tile, pipe or tubing, installed beneath the ground surface which intercepts, collects, and/or conveys drainage water.

- Purpose: To transport water from an area where it is unwanted to an area where it can b~ managed effectively.

- Conditions Where Practice Applies: Subsurface drains are used in areas having a high water table or where subsurface drainage is required. The soil shall have enough depth and permeability to permit installation of an effective system. This standard does not apply to storm drainage systems or foundation drains.

- Effectiveness: Subsurface drains are not directly a sediment control device, but do act to help reduce surface water flows which then reduces erosion potential.

- Advantages: Subsurface drains serve to reduce the risk of slump and slope failure by reducing subsurface water pressure.

- Disadvantages: Subsurface drains require soil disturbances to install and correct soil conditions to work properly which may require a complete soil analysis which could increase costs.

- Costs: The most common type of subsurface drain in use today is PVC perforated pipe which costs about $2.25 per linear foot to install.

- Geographical Considerations: Typically subsurface drainage is installed in areas of high ground water and needs to be installed below the frost line in colder climates.

9. **Pipe Slope Drain**

- Definition: A temporary structure placed from the top of a slope to the bottom of a slope.

- Purpose: The purpose of the structure is to convey surface runoff down slopes without causing erosion.

- Conditions Where Practice Applies: Pipe slope drains are used where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion. The maximum allowable drainage area should be 5 acres.

- Effectiveness: Pipe slope drains are highly effective in eliminating slope erosion because water is not allowed to flow directly on the slope.

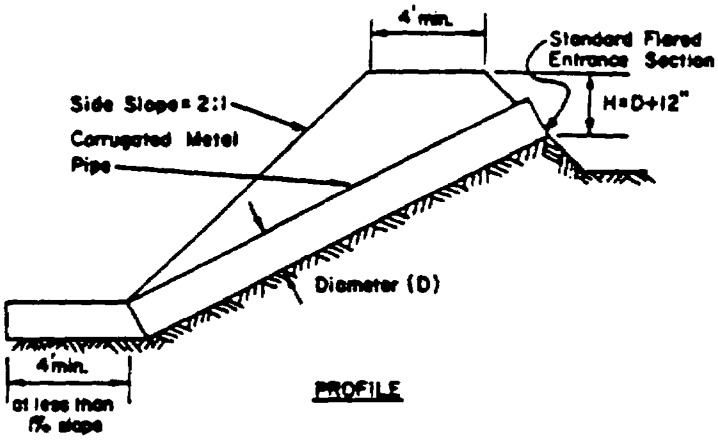
- Advantages: Pipe slope drains allow no chance of erosion down a slope because all flow is confined to an enclosed pipe. When flexible pipe is used, slope drains are easy to install and require little maintenance.

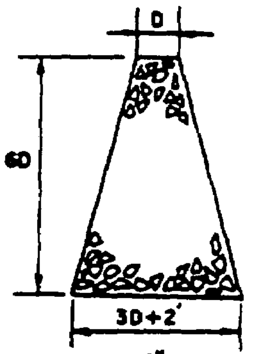
- Disadvantages: During large storms, pipe slope drains may became clogged or overcharged, forcing water around the pipe and causing extreme slope erosion. Also, dissipation of high flow velocities at the pipe outlet must be constructed to avoid downstream erosion.

- Costs: Pipe slope drain costs are generally based upon the pipe type and size, (generally, flexible PVC at $5.00 per linear foot). Also adding to this cost are any expenses associated with inlet and outlet structures.

- Geographical Considerations: Pipe slope drains can be utilized throughout the United States as site conditions dictate. Climate should have little if any affect on this erosion control practice.

PIPE SLOPE DRAIN (RIGID)





Note: Size designation is: PSD-Pipe Diam.
(ex., PSD-12 = Pipe Slope Drain with 12" diameter pipe)

CONSTRUCTION SPECIFICATIONS

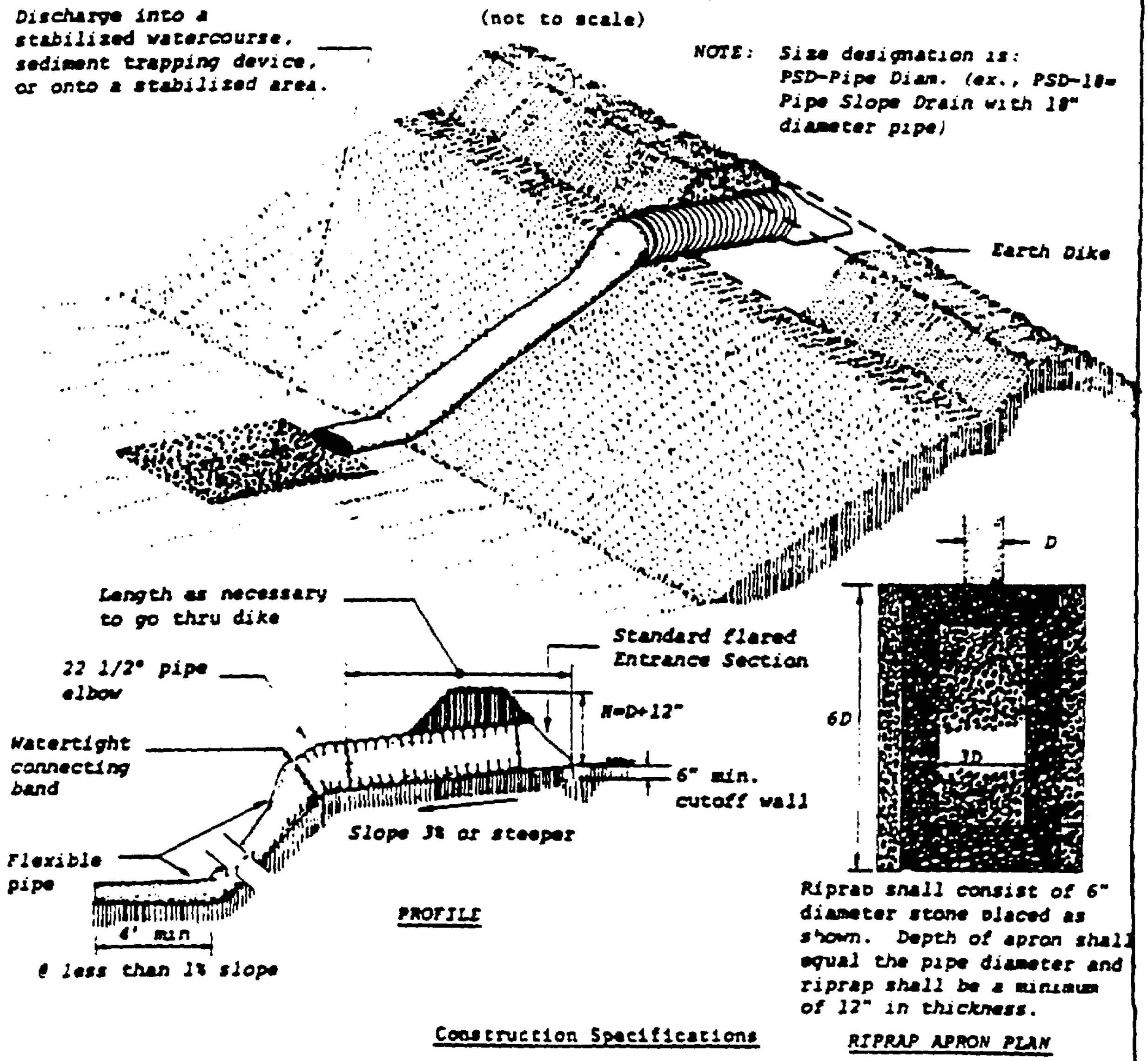
1. THE PIPE SLOPE DRAIN SHALL HAVE A SLOPE OF 3% OR STEEPER.
2. TOP OF THE EARTH DIKE OVER THE INLET PIPE AND ALL DIKES CARRYING WATER TO THE PIPE SHALL BE AT LEAST ONE FOOT HIGHER THAN THE TOP OF THE PIPE.
3. ADD 0.3 FOOT TO DIKE HEIGHT FOR SETTLEMENT.
4. SOIL AROUND AND UNDER THE SLOPE PIPE SHALL BE HAND TAMPED IN 4 INCH LIFTS.
5. THE PIPE SHALL BE CORRUGATED METAL PIPE WITH WATERTIGHT 12 INCH CONNECTING BANDS OR FLANGE CONNECTIONS.
6. RIP-RAP TO BE 4-8 INCHES IN A LAYER AT LEAST 8 INCHES THICKNESS AND PRESSED INTO THE SOIL.
7. PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT.

Maximum Drainage Area: 5 Acres

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	GRADE STABILIZATION STRUCTURE	STANDARD DRAWING GSS-2

PIPE SLOPE DRAIN (FLEXIBLE)*

(not to scale)



Construction Specifications

1. The inlet pipe shall have a slope of 3% or steeper.
2. The top of the earth dike over the inlet pipe and those dikes carrying water to the pipe shall be at least 1' higher at all points than the top of the inlet pipe.
3. The inlet pipe shall be corrugated metal pipe with watertight connecting bands.
4. The flexible tubing shall be the same diameter as the inlet pipe and shall be constructed of a durable material with hold-down grommets spaced 10' on centers.
5. The flexible tubing shall be securely fastened to the corrugated metal pipe with metal strapping or watertight connecting collars.
6. The flexible tubing shall be securely anchored to the slope by staking at the grommets provided.
7. A riprap apron shall be provided at the outlet. This shall consist of 6" diameter stone placed as shown on Standard Drawing GSS-3.
8. The soil around and under the inlet pipe and entrance section shall be hand tamped in 4" lifts to the top of the earth dike.
9. Follow-up inspection and any needed maintenance shall be performed after each storm.

Standard Symbol GSS-3 PSD-diam.

* Drainage area must not exceed 5 acres.

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE College Park, Md.	GRADE STABILIZATION STRUCTURE	Standard Drawing GSS-3

10. Temporary Storm Drain Diversion

- Definition: The re-direction of a storm drain line or outfall channel so that it may temporarily discharge into a sediment trapping device.

- Purpose: To prevent sediment laden water from entering a watercourse, public or private property through a storm drain system, or to temporarily provide underground conveyance of sediment laden water to a sediment trapping device.

- Conditions Where Practice Applies: A temporary storm drain diversion should only be used when the off-site drainage area is less than 50 percent of the on-site drainage area to that system. A special exception may be given, at the discretion of the local plan approval agency, where site conditions make this procedure impossible.

- Effectiveness: A stormdrain diversion does not directly control erosion, rather it transports sediment laden water into a control device such as a sediment trap or basin.

- Advantages: Temporary stormdrain diversions transport water without chance of erosion and do not limit on site movement of equipment. Once constructed, storm drain diversions require little maintenance.

- Disadvantages: To build and remove temporary stormdrain diversions, land area must be disturbed thus causing the potential for erosion. Also, often times storm drain diversion can be expensive and difficult to construct.

- Costs: The costs associated with temporary storm drain diversions varies greatly due to different pipe configurations, materials, and construction techniques. Specific costs can be obtained once those variables have been identified.

- Geographical Considerations: Temporary storm drain diversions can be utilized in situations where construction projects will impact existing storm drain systems.

11. Storm Drain Inlet Protection

- Definition: A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet.

- Purpose: To prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

- Conditions Where Practice Applies: Where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area.

- Effectiveness: Storm drain inlet protection is only as effective as the filter used around the inlet such a silt fence with a 98% efficiency. (4) Effectiveness decrease rapidly if the inlet protection is not properly maintained.

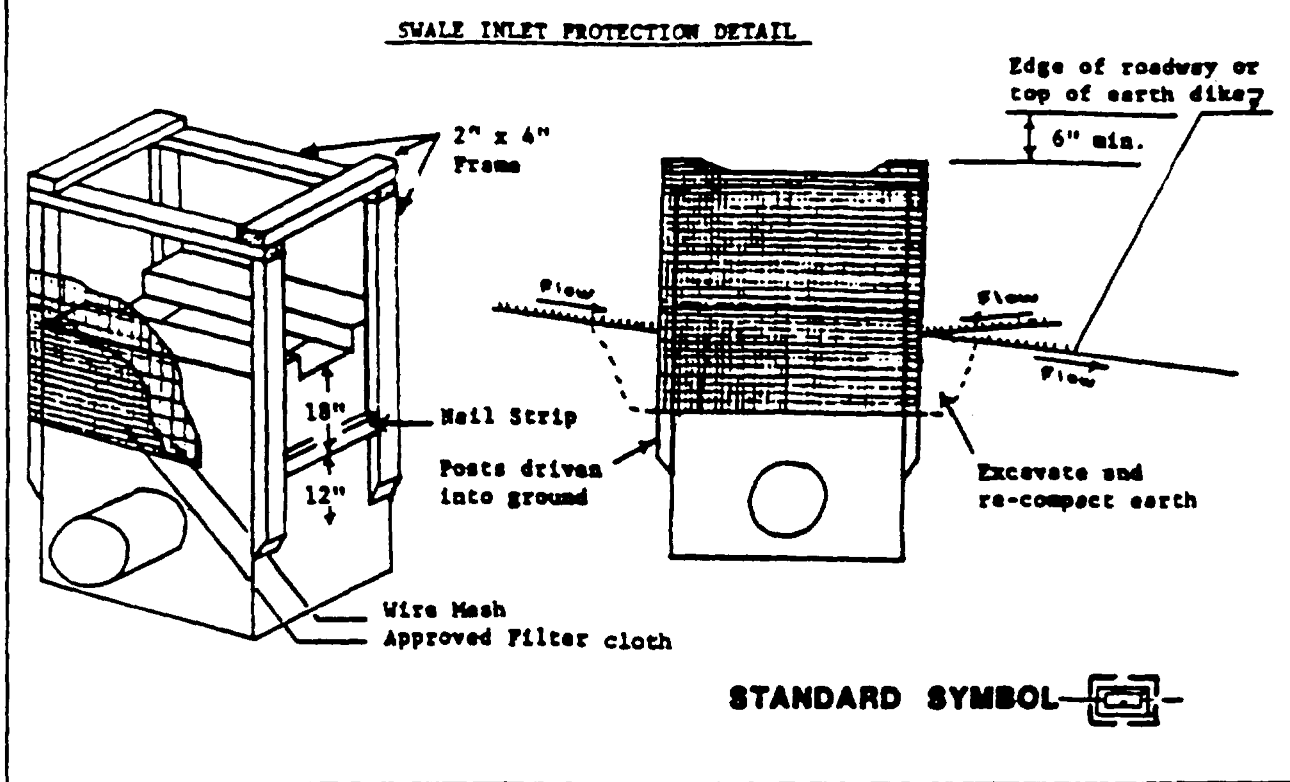
- Advantages: Storm drain inlet protection will reduce the amount of sediment leaving a construction site. Inlet protection is inexpensive and easy to construct.

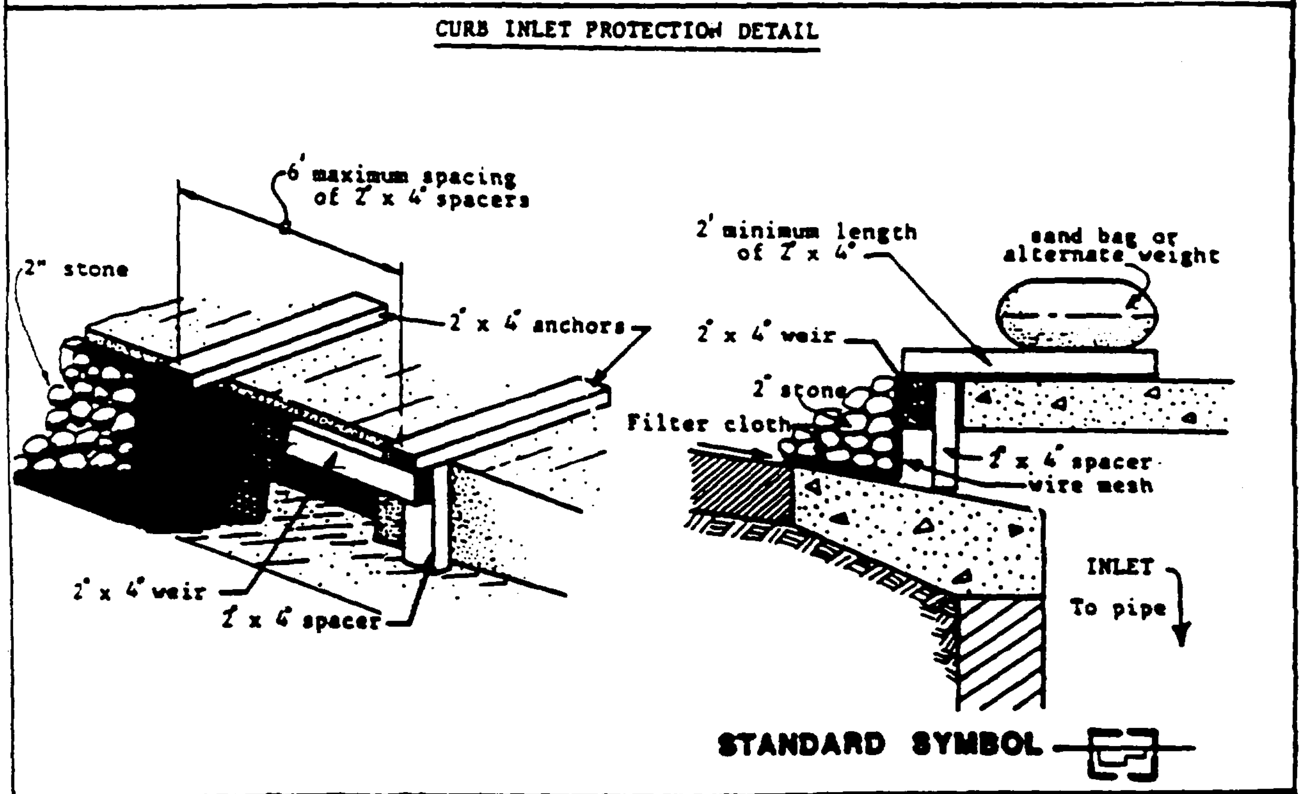
- Disadvantages: Properly maintaining inlet protection is difficult and often inlets become clogged causing erosion elsewhere.

- Costs: The cost of storm drain inlet protection varies dependent upon the size and type of inlet to be protected but generally is about $300 per inlet.

- Geographical Considerations: Inlet protection can be used whenever inlets are encountered on site.

Figure 4.34
Inlet Protection Detail





U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	INLET PROTECTION DETAIL	STANDARD DRAWING IPD—I

12. Rock Outlet Protection

- Definition: A section of rock protection placed at the outlet end of culverts, conduits or channels.

- Purpose: The purpose of the rock outlet protection is to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.

- Conditions Where Practice Applies: This practice applies where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the next downstream reach.

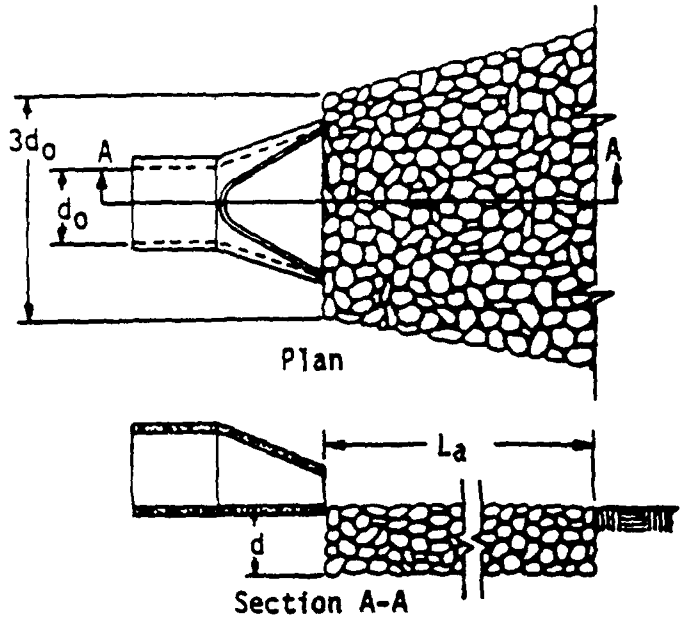
- Effectiveness: Rock outlet protection is only effective if the rock is sized and placed properly. When this is accomplished, rock outlets do much to limit erosion at pipe outlets.

- Advantages: Rock outlet protection is usually less expensive and easier to install than piping. It also serves to trap sediment and reduce flow velocities.

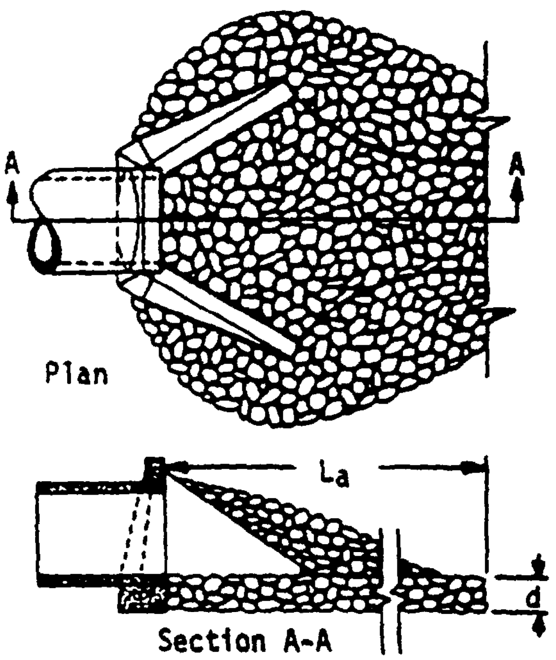
- Disadvantages: Rock outlet protection needs continual maintenance because large storms often wash away the stone and leave the area susceptible to erosion.

- Costs: Riprap is the most common form of rock outlet protection and generally can be installed for about $45 per square yard.

- Geographical Considerations: Riprap outlet protection can effectively control erosion at constructions sites throughout the United States. Only the availability, and therefore the price, will limit the use of this sediment control practice.



Pipe Outlet To Flat Area
With No Defined Channel



Pipe Outlet To Well-Defined Channel

Notes

1. Apron lining may be riprap, grouted riprap, or concrete.

2. L_a is the length of the riprap apron as calculated using Plates 1.36d and 1.36e.

3. d = 1.5 times the maximum stone diameter but not less than 6 inches.

PIPE OUTLET CONDITIONS

Source: Va SWCC

Plate 1.36a

13. **Sediment Trap**

- Definition: A temporary sediment control device formed by an excavation and/or embankment to intercept sediment laden runoff and retain sediment.

- Purpose: The purpose of a sediment trap is to intercept sediment laden runoff and trap the sediment in order to protect drainageways, properties, and rights-of-way below the sediment trap from sedimentation.

- Conditions Where Practice Applies: A sediment trap is usually installed in a drainageway, at a storm drain inlet, or other points of discharge from a disturbed area. Sediment traps should not be used to artificially break up a natural drainage area into smaller sections where a larger device (sediment basin) would be better suited. The following are types of sediment traps:

  - **Pipe Outlet Sediment Trap:** Consists of a trap formed by an embankment or excavation. The outlet for the trap is through a perforated riser and a pipe through the embankment.

  - **Grass Outlet Sediment Trap:** Consists of a trap formed by excavating the earth to create a holding area. The trap has a discharge point over natural existing grass.

  - **Storm Inlet Sediment Trap:** Consists of a basin formed by excavation on natural ground that discharges through an opening in a storm drain inlet structure. This opening can either be the inlet opening or a temporary opening made by omitting bricks or blocks in the inlet.

  - **Swale Sediment Trap:** Consists of a trap formed by over excavating a swale a drainage ditch. The outlet of the swale sediment trap is controlled by the invert of the downstream swale.

  - **Stone Outlet Sediment Trap:** Consists of a trap formed by an embankment excavation. The outlet of this trap is over a stone section placed on level ground.

  - **Riprap Outlet Sediment Trap:** Consists of a trap formed by an excavation and embankment. The outlet for this trap shall be through a partially excavated channel lined with riprap.

- Effectiveness: Effectiveness of sediment traps directly relate to the size of the trap. The current accepted standard sediment trap size is 1800 cubic feet per one acre of drainage area. Sediment traps based upon this criteria are approximately 46% effective in removing sediments from construction site runoff. (8)

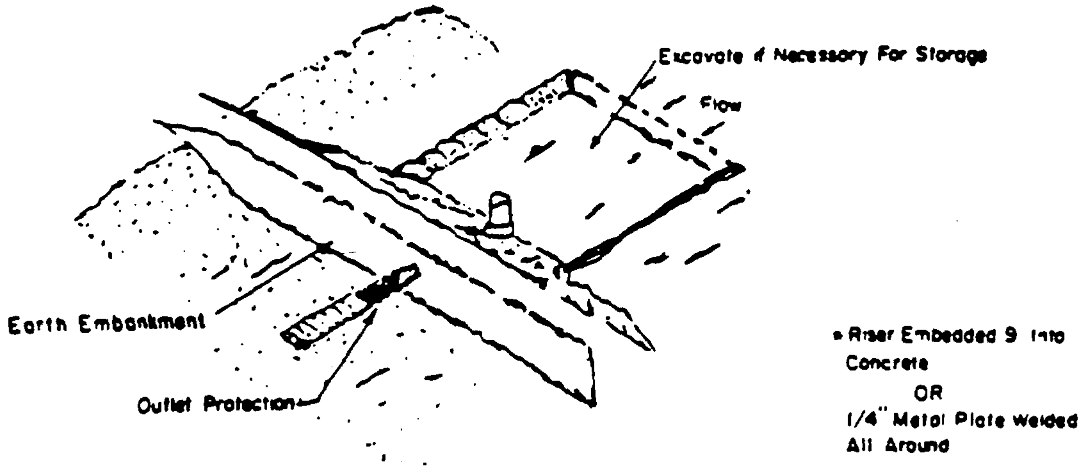
- Advantages: Sediment traps are fairly easy to construct and can effectively handle runoff from up to 5 acres. Concentrated flows can be directed into and dissipated in a sediment traps.

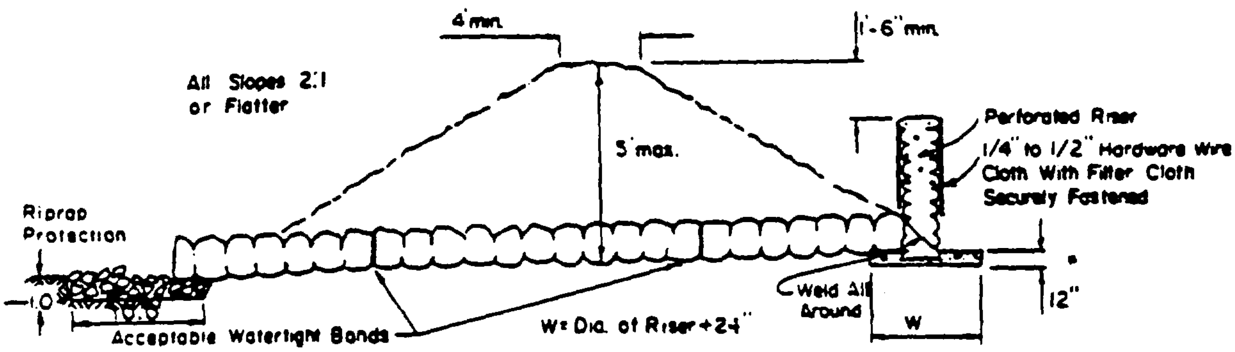
- Disadvantages: Sediment traps efficiency is less than 50% and they require extensive maintenance for removal of sediment. Traps can often occupy large areas that then must be avoided during construction.

- Costs: Many variables determine the cost of a sediment trap. Excavation, riprap, pipes structures, stone, stabilization, fencing, etc. all play a part in determining a sediment trap's final cost. Usually, traps can be installed for $500 to $7,000.

- Geographical Considerations: Sediment traps can be constructed on most any construction site with soils suitable for excavation and embankment.

PIPE OUTLET SEDIMENT TRAP ST-I





EMBANKMENT SECTION THRU RISER

SIZES OF PIPE NEEDED

Barrel Diameter __________.

Riser Diameter __________.

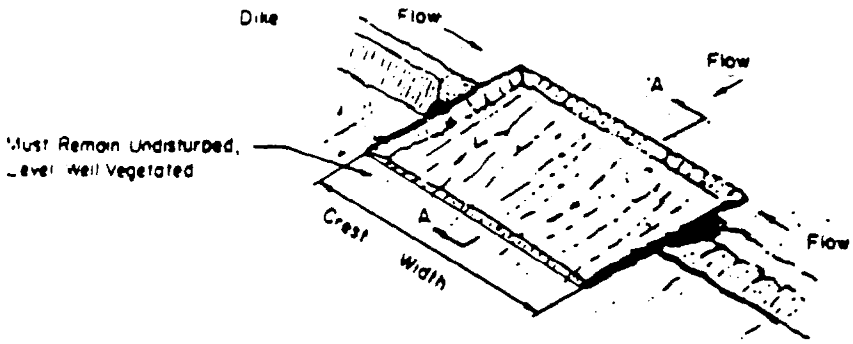
Note:

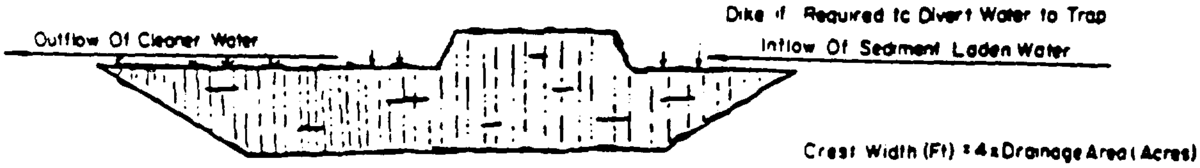
For Construction Specification see sheet 16.08

Max. Drainage Area: 5 Acres

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	PIPE OUTLET SEDIMENT TRAP	STANDARD DRAWING ST-I

GRASS OUTLET SEDIMENT TRAP ST-II





SECTION A-A

EXCAVATED GRASS OUTLET SEDIMENT TRAP

CONSTRUCTION SPECIFICATION FOR ST-II

1. Volume of sediment storage shall be 1800 cubic feet per acre of contributory drainage area.

2. Minimum crest width shall be 4 X Drainage Area.

3. Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to ½ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

4. The structure shall be inspected after each rain and repairs made as needed.

5. Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.

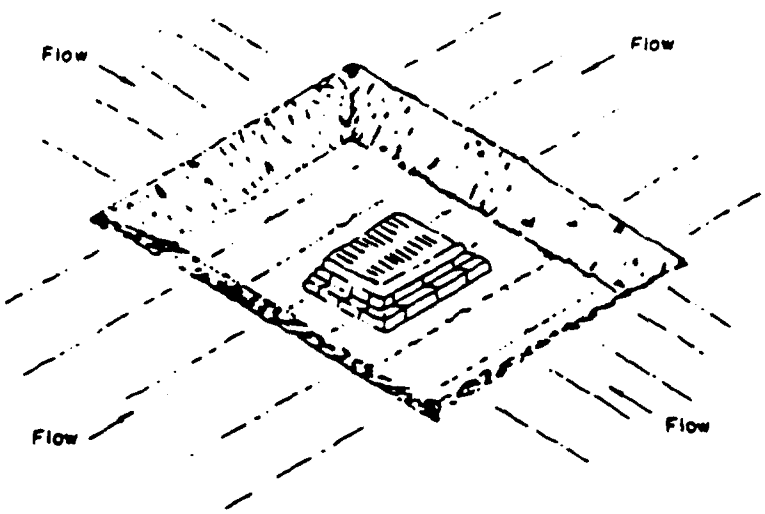
6. The sediment trap shall be removed and area stabilized when the remaining drainage area has been properly stabilized.

7. All cut slopes shall be 1:1 or flatter.

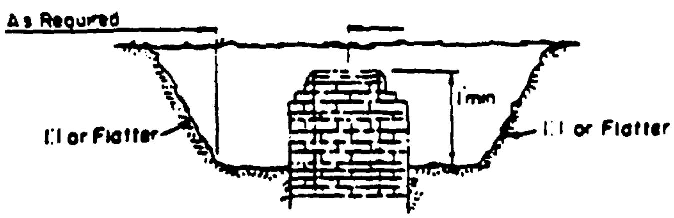
Maximum Drainage Area: 5 Acres

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	GRASS OUTLET SEDIMENT TRAP	STANDARD DRAWING ST-II

STORM INLET SEDIMENT TRAP ST-III



YARD DRAIN



CROSS SECTION

CONSTRUCTION SPECIFICATION FOR ST-III

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to ½ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

2. The volume of sediment storage shall be 1800 cubic feet per acre of contributory drainage.

3. The structure shall be inspected after each rain and repairs made as needed.

4. Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.

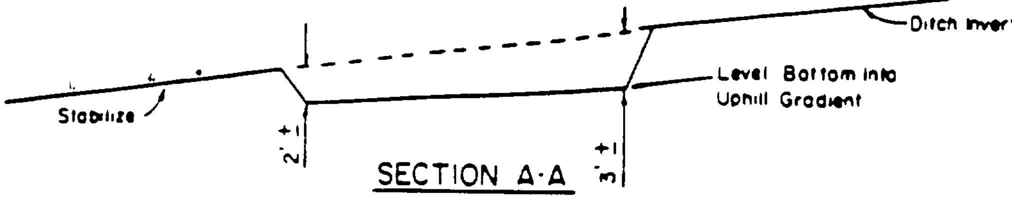
5. The sediment trap shall be removed and the area stabilized when the constructed drainage area has been properly stabilized.

6. All cut slopes shall be 1:1 or flatter.

Maximum Drainage Area: 3 Acres

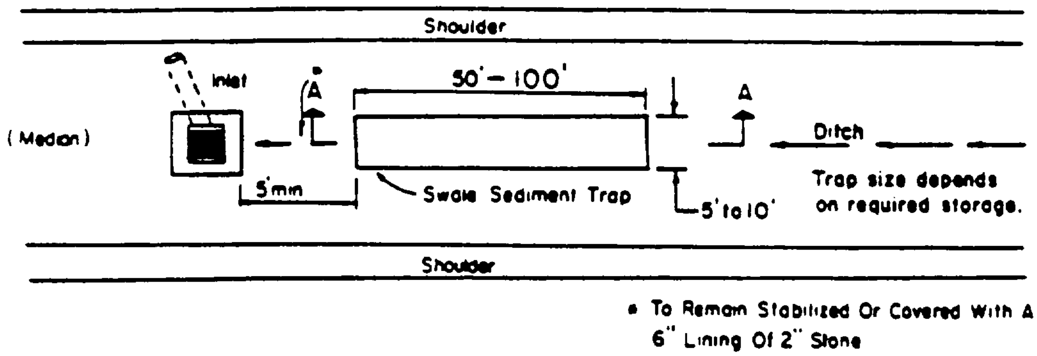
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK MARYLAND	STORM INLET SEDIMENT TRAP	STANDARD DRAWING ST - III

SWALE SEDIMENT TRAP ST-IV



SECTION A-A

SWALE SEDIMENT TRAP



CONSTRUCTION SPECIFICATION FOR ST-IV

1. The swale sediment trap shall be constructed in accordance with the dimensions provided on the design drawings or sized to provide the minimum storage necessary 1800 cubic feet of storage for each acre of drainage area.

2. Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to ½ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.

3. The structure shall be inspected after each rain and repairs made as needed.

4. Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.

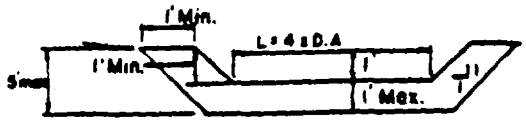
5. The sediment trap shall be removed and area stabilized when the contributory drainage area has been properly stabilized.

6. The swale sediment trap will be properly backfilled and the swale or ditch reconstructed.

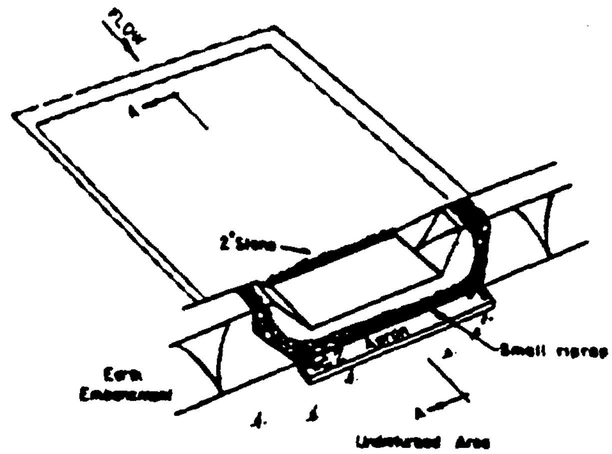
Maximum Drainage Area: 2 Acres

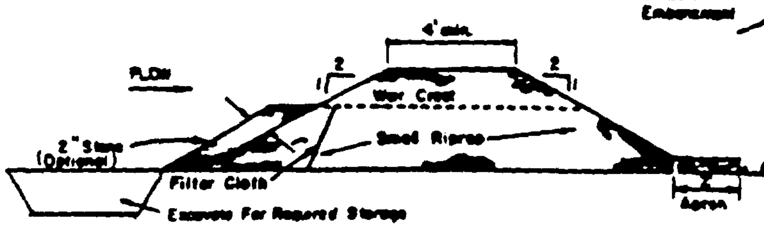
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	SWALE SEDIMENT TRAP	STANDARD DRAWING ST-IV

STONE OUTLET SEDIMENT TRAP V



PROFILE





CROSS SECTION A-A

OPTION: A one foot layer of 2" stone may be placed on the upstream side of the riprap in place of the embedded filter cloth.

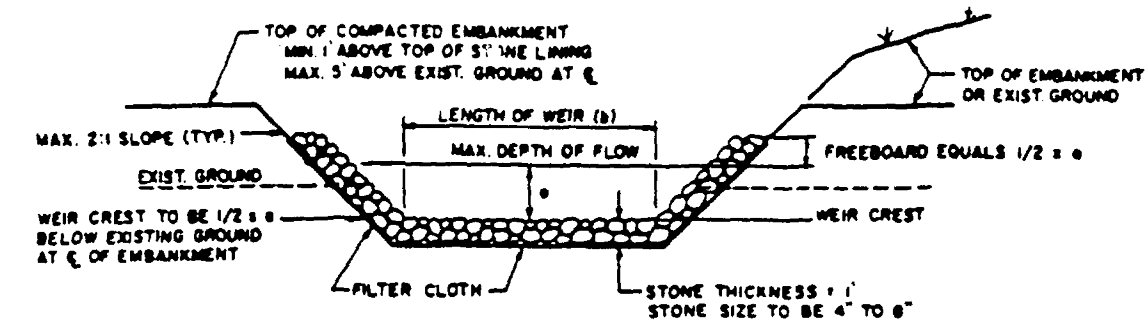
CONSTRUCTION SPECIFICATIONS FOR ST-V

1. Area under embankment shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared.
2. The fill material for the embankment shall be free of roots and other woody vegetation as well as over-sized stones, rocks, organic material or other objectionable material. The embankment shall be compacted by traversing with equipment while it is being constructed.
3. All cut and fill slopes shall be 2:1 or flatter.
4. The stone used in the outlet shall be small riprap 4"-8" along with a 1' thickness of 2" aggregate placed on the up-grade side on the small riprap OR embedded filter cloth in the riprap.
5. Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to ½ the design depth of the trap.
6. The structure shall be inspected after each rain and repairs made as needed.
7. Construction operations shall be carried out in such a manner than erosion and water pollution is minimized.
8. The structure shall be removed and the area stabilized when the drainage area has been properly stabilized.

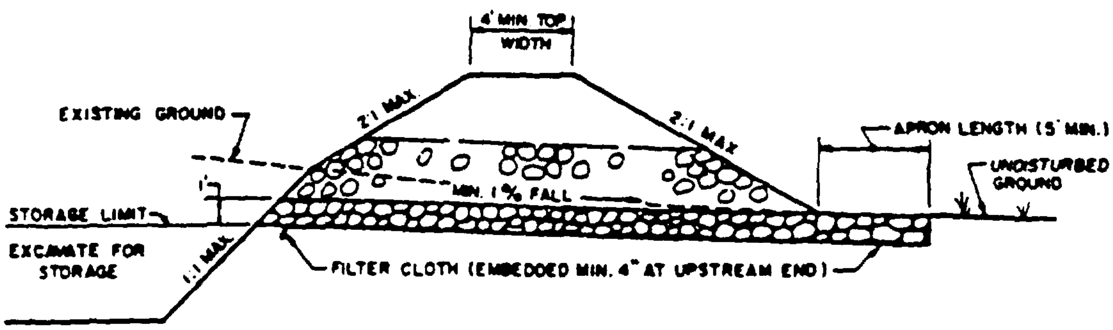
Maximum Drainage Area: 5 Acres

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	STONE OUTLET SEDIMENT TRAP	STANDARD DRAWING ST-V

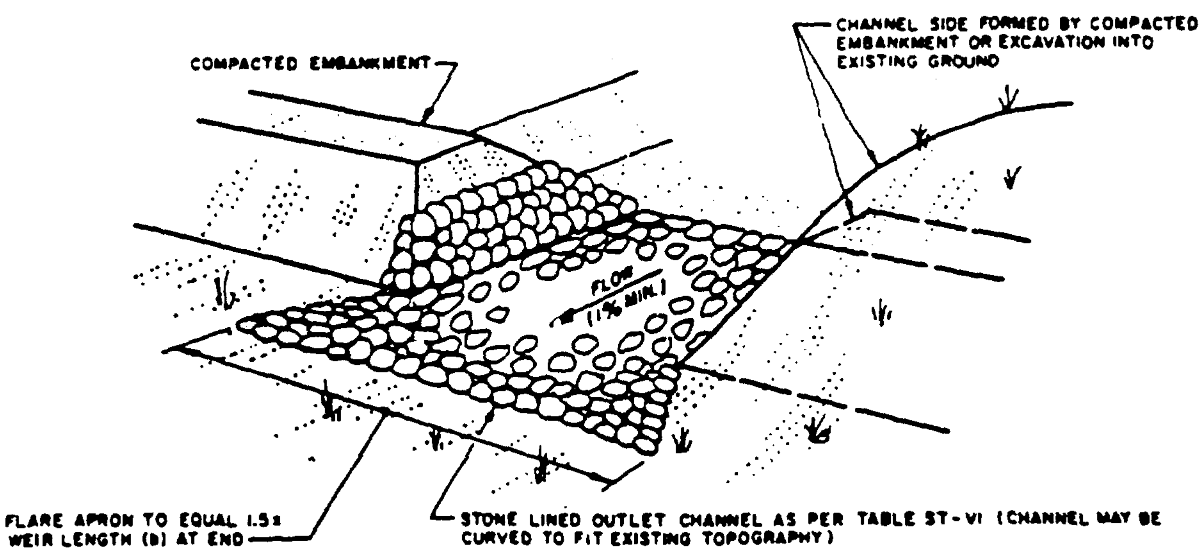
RIPRAP OUTLET SEDIMENT TRAP ST-VI



PROFILE



CROSS SECTION



PERSPECTIVE VIEW

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	RIPRAP OUTLET SEDIMENT TRAP	STANDARD DRAWING ST-VI

14. Temporary Sediment Basin

- Definition: A temporary basin with a controlled stormwater release structure, formed by constructing an embankment of compacted soil across a drainageway.

- Purpose: The purpose of the basin is to detain seuiment-laden runoff from disturbed areas long enough for the majority of the sediment to settle out.

- Conditions Where Practice Applies: A temporary sediment basin can be used below disturbed areas greater than 5 acres, where sufficient space and appropriate topography allow for the construction of a temporary impoundment.

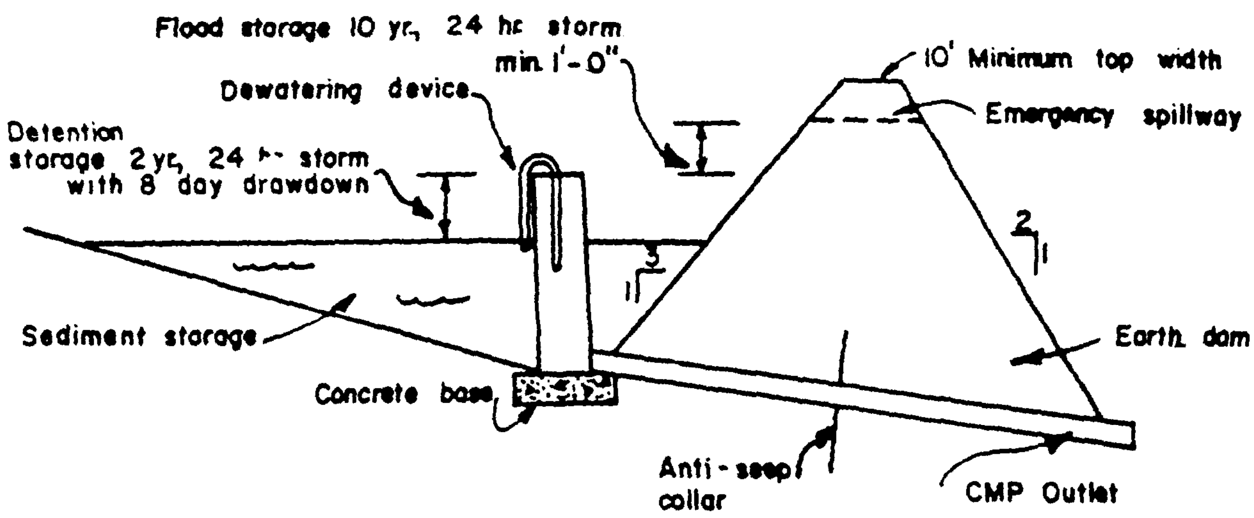
- Effectiveness: As with sediment traps, basins sized at 1800 CF/acre of drainage area are roughly 46% efficient in removing sediment from construction site runoff. (8)

- Advantages: Sediment basins can handle runoff from large, up to 100 acre, drainage areas and handle concentrates flows of sediment laden water. Basins help to control overall stormwater runoff for small storms thus protecting streams and rivers off site.

- Disadvantages: Again, like traps, sediment basin efficiencies are only about 46%. Sediment basins are large, requiring a good deal of site area and are expensive to construct.

- Costs: Sediment basins vary greatly in price based upon their size, and most basins are constructed for $5,000 to $50,000.

- Geographical Considerations: Temporary sediment basins can be constructed on any construction site as space, topography and soil conditions permit.



CROSS SECTION

' ---'--ent basin catches and stores sediment from construction
d keeps it out of streams.

15. **Sump Pit**

- Definition: A temporary pit which is constructed to trap and filter water for pumping to a suitable discharge area.

- Purpose: To remove excessive water from excavations.

- Conditions Where Practice Applies: Sump pits are constructed when water collects during the excavation phase of construction. This practice is particularly useful in urban areas during excavation for building foundations.

- Effectiveness: Generally, sump pits are not as effective as sediment traps or basins but do serve to remove some sediment from construction site runoff.

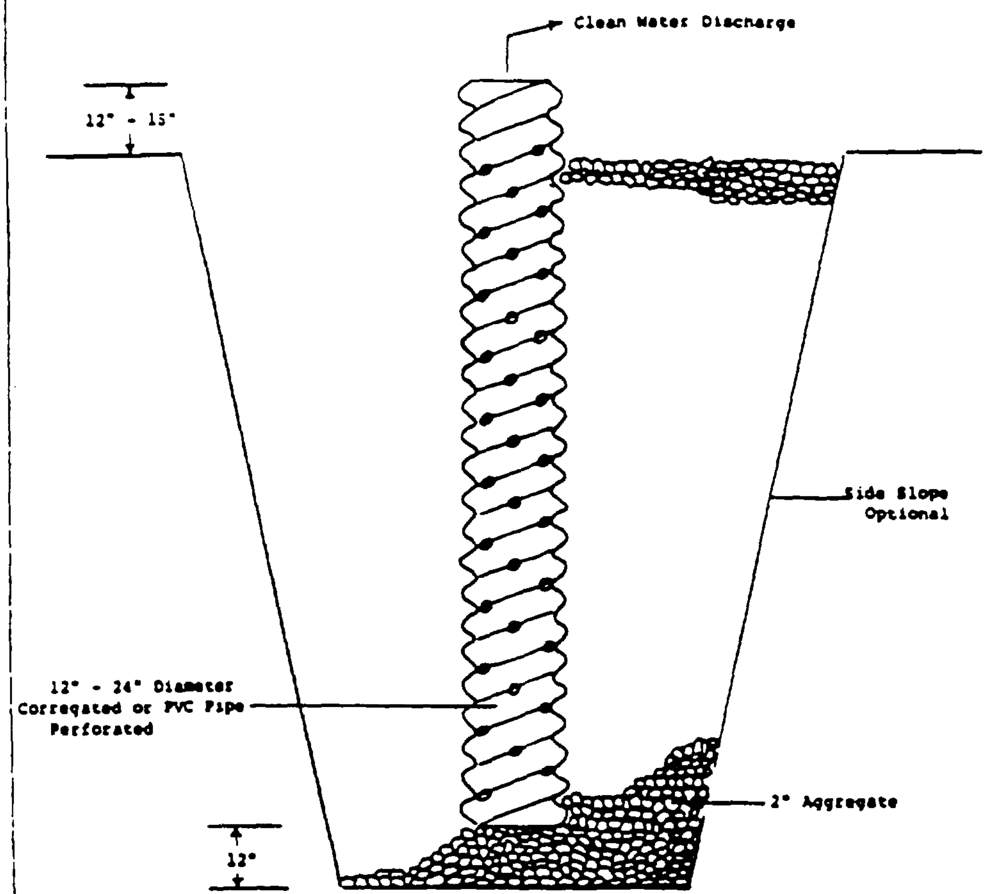
- Advantages: Sump pits can be located anywhere on site since they need no outfall. Sump pits are the only means of sediment trapping for excavation in highly urban areas.

- Disadvantages: Sump pits construction can become costly and require the control use of some type of pump to outlet water from the pit. Also without proper maintenance, sump pits can easily become clogged and ineffective.

- Costs: Costs for sump pit construction are similar to sediment trap costs ranging from $500 to $7,000. Added to this cost is the operational expenses of pumping water out of the sump pit.

- Geographical Considerations: Sump pits can be located in any region of the United States but due to the pumping requirements, use during freezing weather is rather limited.

SUMP PIT



CONSTRUCTION SPECIFICATIONS

1. Pit dimensions are optional.
2. The standpipe should be constructed by perforating a 12" - 24" diameter corregated or PVC pipe.
3. A base of 2" aggregate should be placed in the pit to a depth of 12". After installing the standpipe, the pit surrounding the standpipe should then be backfilled with 2" aggregate.
4. The standpipe should extend 12" - 18" above the lip of the pit.
5. If discharge will be pumped directly to a storm drainage system, the standpipe should be wrapped with filtercloth before installation.

   If desired, ¼" - ½" hardware cloth may be placed around the standpipe, prior to attaching the filtercloth. This will increase the rate of water seepage into the pipe.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE COLLEGE PARK, MARYLAND	SUMP PIT	STANDARD DRAWING SP - 1

16. Flotation Silt Fence (7)

- Definition: A fabric strip floating in a body of water, floating on top and anchored at the bottom.

- Purpose: To drop sediment when filling or excavating in or adjacent to a water body.

- Conditions Where Practice Applies: Can be used in water bodies adjacent to areas where sediment is deposited in the water.

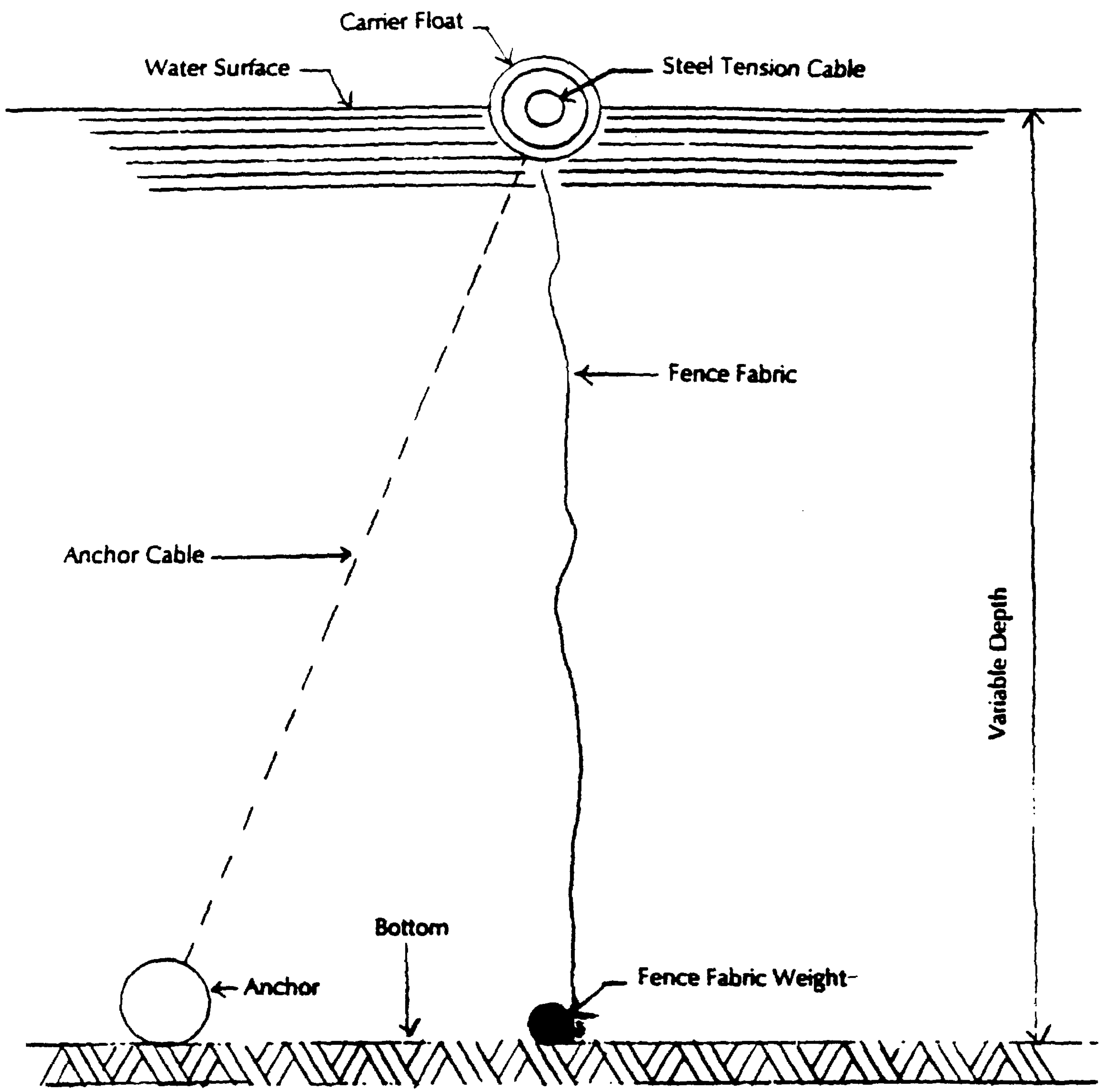
- Effectiveness: The effectiveness of a flotation silt fence in the settling out of soil particles in the water has the potential to be equal to that of the filter fabric that is used in its construction; however, the flotation fences are very difficult to maintain and thus effectiveness is reduced considerably.

- Advantages: Flotation silt fences hasten the settling out of soil particles in water bodies. Water is filtered and particles eliminated that might not otherwise have time to settle out in a sediment basin when the fence is not installed. The floating boom also stops floating objects such as trash, tree limbs or other construction debris.

- Disadvantages: Proper installation of the flotation silt fence is very difficult to achieve. Once installed, the fence must be inspected frequently to check the fabric for rips and holes and to assure dirty water is not bypassing the filter fence.

- Costs: Costs for a flotation silt fence vary directly with the size of the body of water to be filtered, with filter fabric costing about $5.00 per square yard. An anchoring device and floating boom usually increase the cost greatly.

- Geographical Considerations: A flotation silt fence may be constructed in all areas where freezing of the body of water is not likely to occur.



Temporary Flotation Silt Fence

17. **Chemical Treatment** (7)

- Definition: Application of a non-toxic chemical settling agent, such as methylene chloride, into a sediment trap or at the top end of a slope rundown.

- Purpose: Through the process of flocculation, smaller soil particles which are held in suspension are settled out.

- Conditions Where Practice Applies: Chemical settling agents are only effective in the tranquil water of a sediment trap. Introduction of the chemical agent is typically at the inlet to a sediment pond or at the top of the slope rundown.

- Effectiveness: Chemical settling agents have an extremely high efficiencies for reducing particles held in suspension if they are added in the correct manner and quantities with sufficient settling time. This is very difficult to achieve in the field and thus efficiency is greatly reduced.

- Advantages: This process eliminates soil particles held in solution which wouldn't otherwise settle out over time. Turbidity of the water is decreased, which has a beneficial impact on stream life and aesthetics.

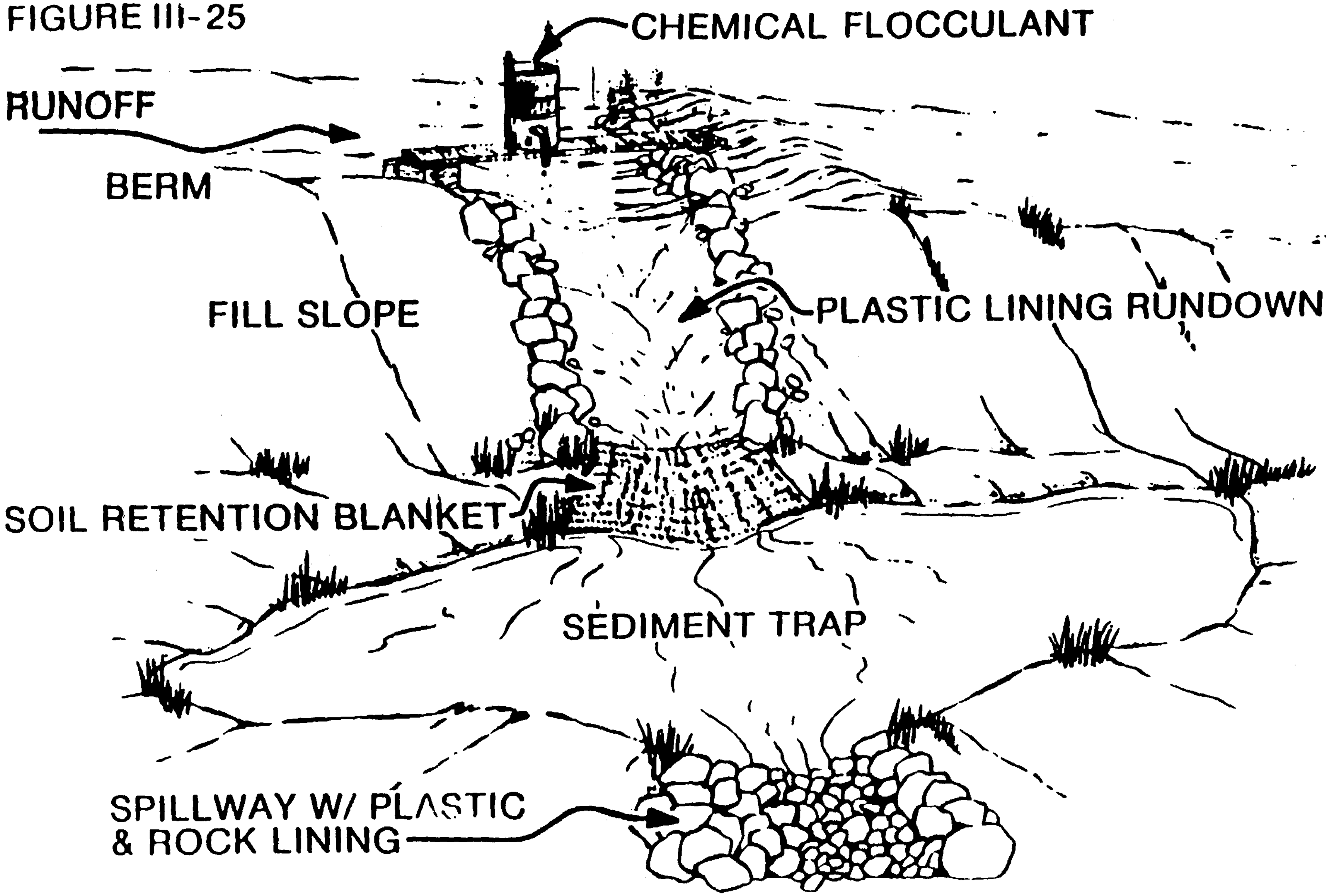
- Disadvantages: The introduction of these chemicals into the environment, although considered non-toxic, is not acceptable in many jurisdictions.

Costs: The [illegible] region by region.

- Geographical Considerations: Chemical settling agents might be used wherever they are deemed necessary to limit stream or river turbidity. However, most jurisdictions have regulations which would restrict the use of these agents.

CHEMICAL TREATMENT

FIGURE III-25



18. Stabilized Construction Entrance

- Definition: A stabilized pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area.

- Purpose: The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets.

- Conditions Where Practice Applies: A stabilized construction entrance should be used at all points of construction ingress and egress.

- Effectiveness: Stabilized construction entrances are not very effective in removing sediment from equipment leaving a construction site. Efficiency is greatly increased, though when a washing rack is included as part of a stabilized construction entrance.

- Advantages: Does remove some sediment from equipment and serves to channel construction traffic in and out of the site.

- Disadvantages: Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided.

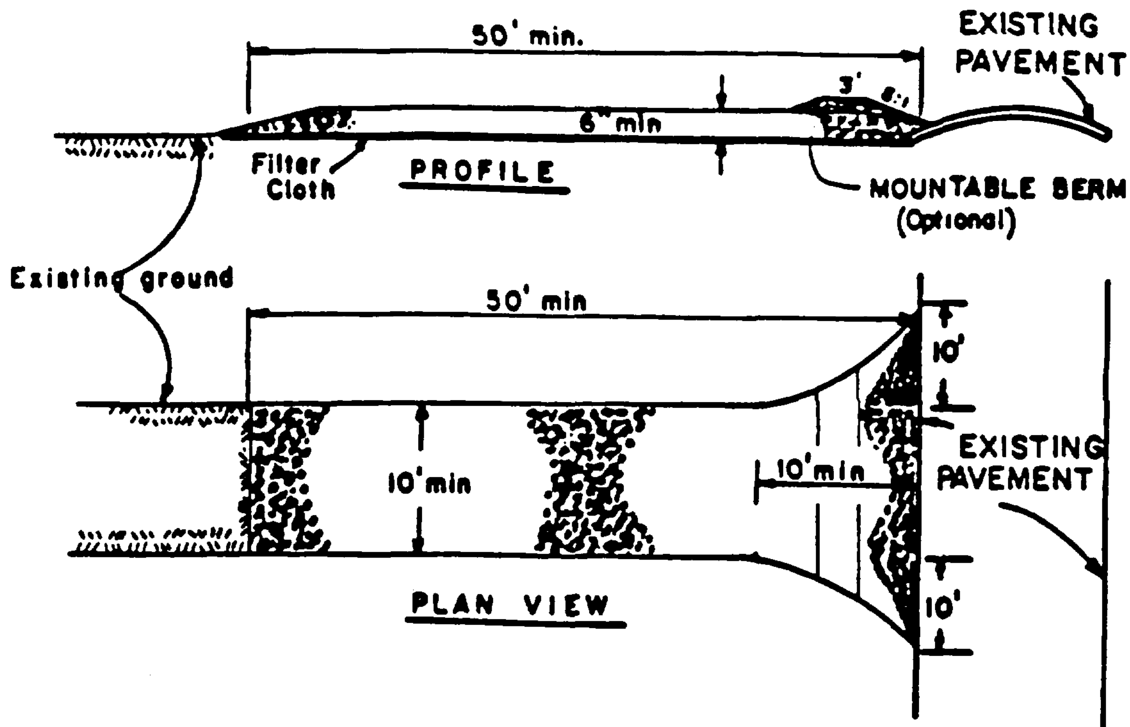
- Costs: Stabilized construction entrances cost range from $1,500 to $5,000 to install but costs increase by roughly $2,000 if a wash rack is included.

- Geographical Considerations: Stabilized construction entrances can be constructed anywhere in the country.

STABILIZED CONSTRUCTION ENTRANCE

not to scale

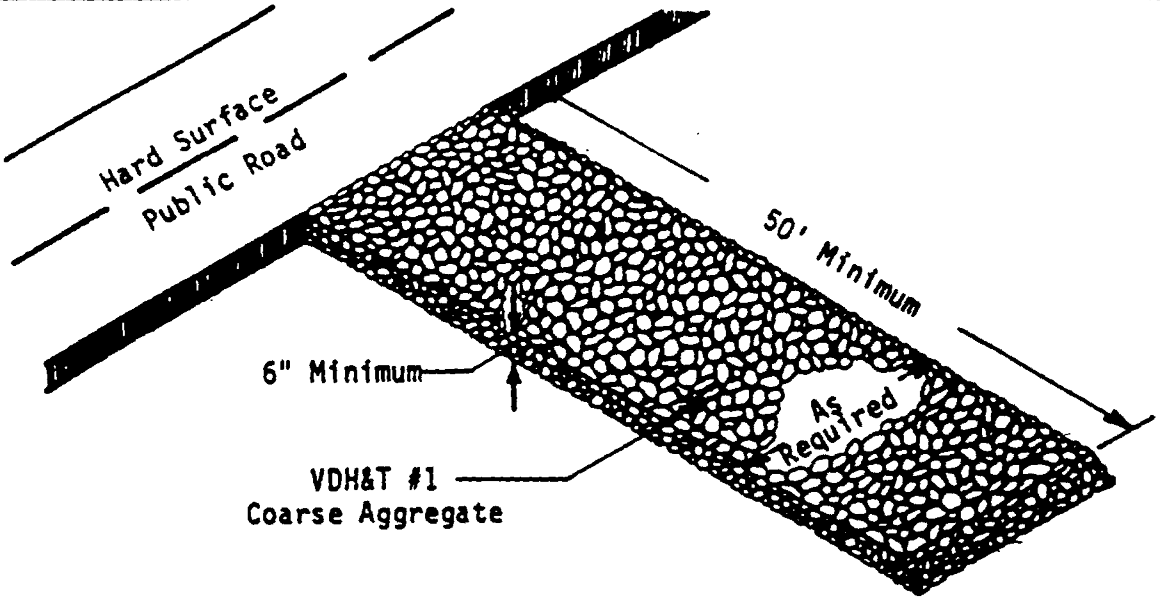
STANDARD SYMBOL 



CONSTRUCTION SPECIFICATIONS

1. Stone Size - Use 2" stone, or reclaimed or recycled concrete equivalent.
2. Length - As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum length would apply).
3. Thickness - Not less than six (6) inches.
4. Width - Ten (10) foot minimum, but not less than the full width at points where ingress or egress occurs.
5. Filter Cloth - Will be placed over the entire area prior to placing of stone. Filter will not be required on a single family residence lot.
6. Surface Water - All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.
7. Maintenance - The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.
8. Washing - Wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with stone and which drains into an approved sediment trapping device.
9. Periodic inspection and needed maintenance shall be provided after each rain.

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE College Park, Md.	STABILIZED CONSTRUCTION ENTRANCE	Standard Drawing SCE-1

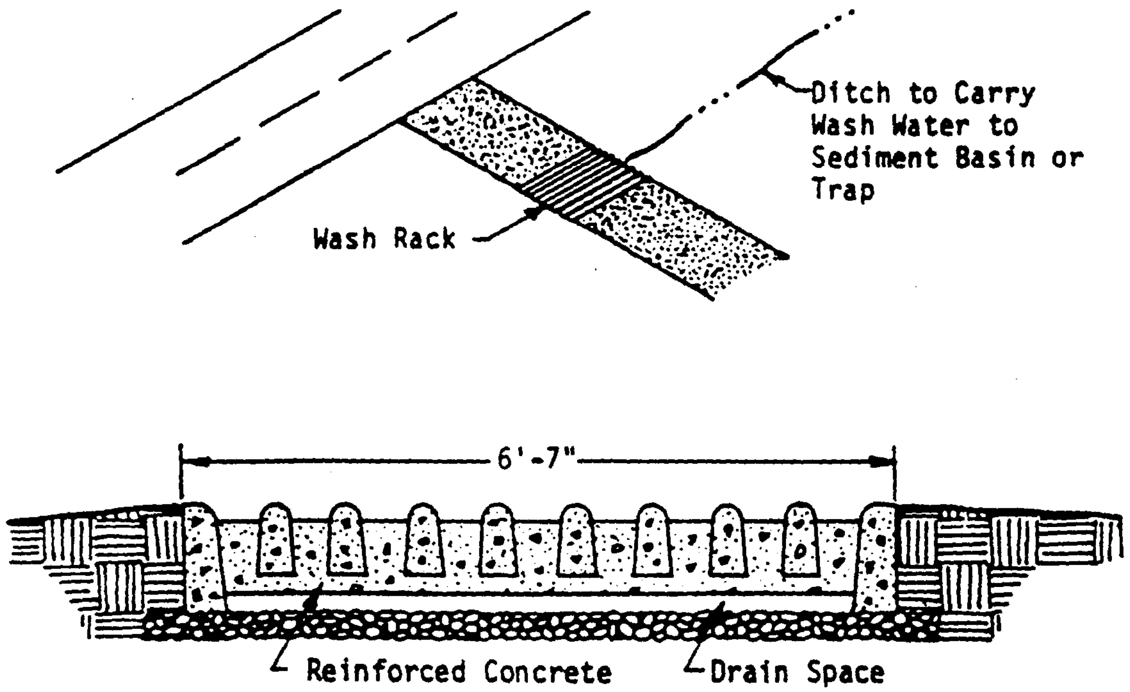


GRAVEL CONSTRUCTION ENTRANCE

Source: Va SWCC

Plate 1.01a

CONSTRUCTION ENTRANCE WITH WASH RACK



Detail of Wash Rack

Source: Smith Cattleguard Company

Plate 1.01b

19. Temporary Access Waterway Crossing

- Definition: A temporary access waterway crossing is a structure placed across a waterway to provide access for construction purposes for a period of less than one year. Temporary access crossings are not intended to be utilized to maintain traffic for the general public.

- Purpose: The purpose of the temporary access waterway crossing is to provide safe, pollution free access across a waterway for construction equipment by establishing minimum standards and specifications for the design, construction, maintenance, and removal of the structure. Temporary access waterway crossings are necessary to prevent construction equipment from damaging the waterway, blocking fish migration, and tracking sediment and other pollutants into the waterway.

- Conditions Where Practice Applies: The following standard and specifications for temporary access waterway crossings are applicable in non-tidal waterways.

- Effectiveness:

  - **Temporary Access Bridge:** A temporary access bridge is by far the most effective waterway crossing because minimal if any disturbance occur in the waterway thus very little erosion can occur.

  - **Temporary Access Culvert:** A temporary access culvert is effective in controlling erosion but will cause erosion during installation and removal.

  - **Temporary Access Ford:** A temporary access ford offers very little sediment and erosion control and is really not very effective in limiting erosion in the stream channel.

- Advantages:

  - **Temporary Access Bridge:** A temporary bridge is highly desirable because it offeres a non erosive means of stream crossing and requires little if any earth work and maintenance.

  - **Temporary Access Culvert:** A temporary culvert can be easily constructed and allows for heavy equipment loads.

  - **Temporary Access Ford:** A temporary ford is the least expensive waterway crossing and allows for maximum load limits. It also offers very low maintenance.

- Disadvantages:

  - **Temporary Access Bridge:** A temporary bridge can be quite expensive and time consuming to build and may not be able to handle large loads.

- **Temporary Access Culvert:** Temporary culverts need maintenance often and can cause erosion if the culvert becomes clogged.

- **Temporary Access Ford:** A temporary ford offers little if any erosion control and can often make erosion worse.

NOTE: Special care must be taken for all these practices when crossing an environmentally sensitive waterway such as a trout stream.

♦ Costs:

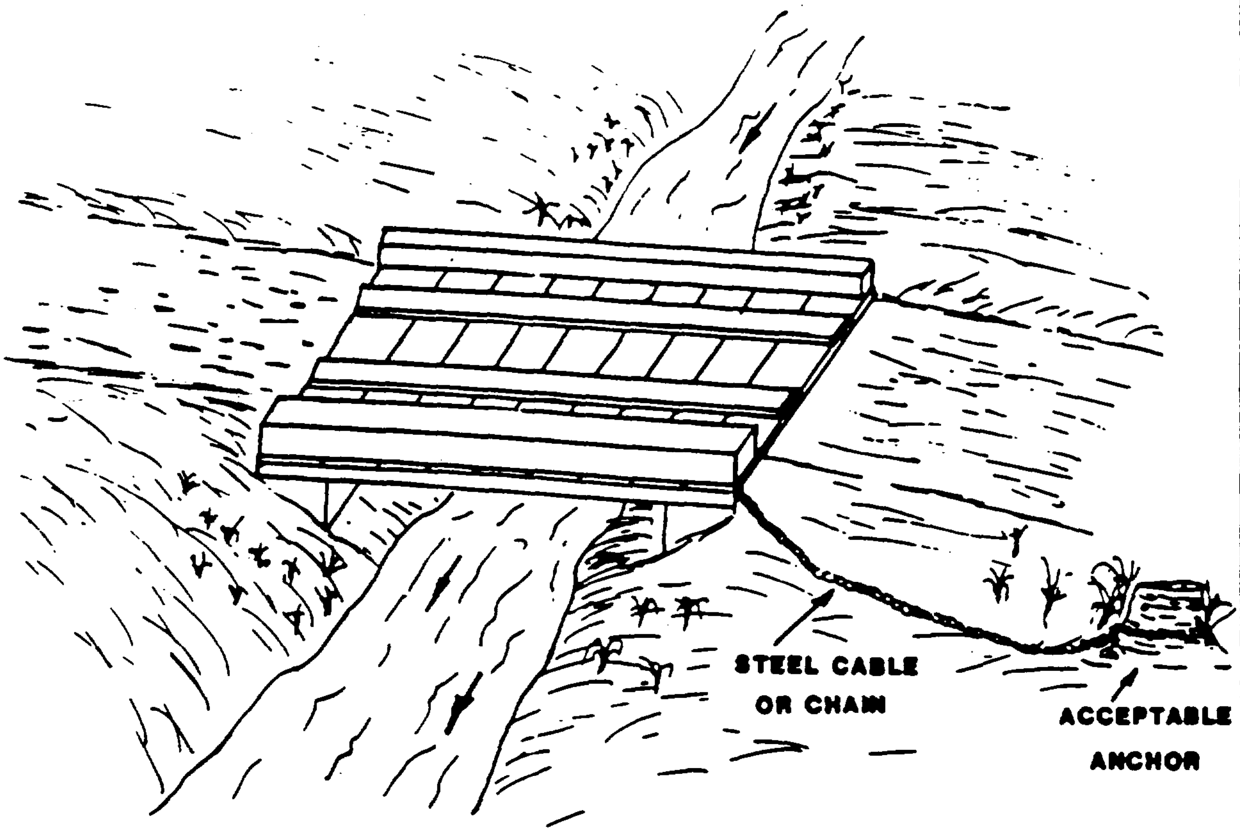
- **Temporary Access Bridge:** Bridge cost can vary greatly depending a size and type of material used.

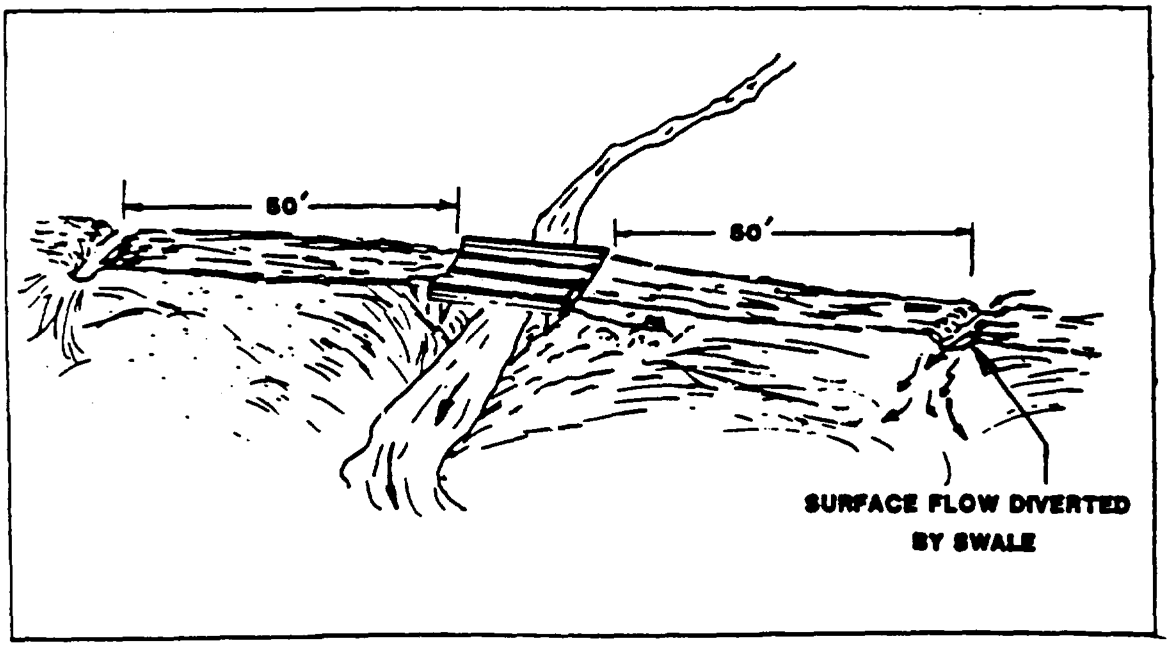
- **Temporary Access Culvert:** A temporary crossing usually ranges in price for $500 to $1,500.

- **Temporary Access Ford:** A temporary ford crossing costs are minimal, usually less than $500.

♦ Geographical Considerations: The most important thing to consider when choosing a temporary stream crossing is the impact of the crossing on the stream itself. Obviously a high quality trout stream requires much more concern than a severely polluted city waterway. The individual stream quality and flow characteristics (i.e., flooding) dictate the choice of temporary stream crossing.

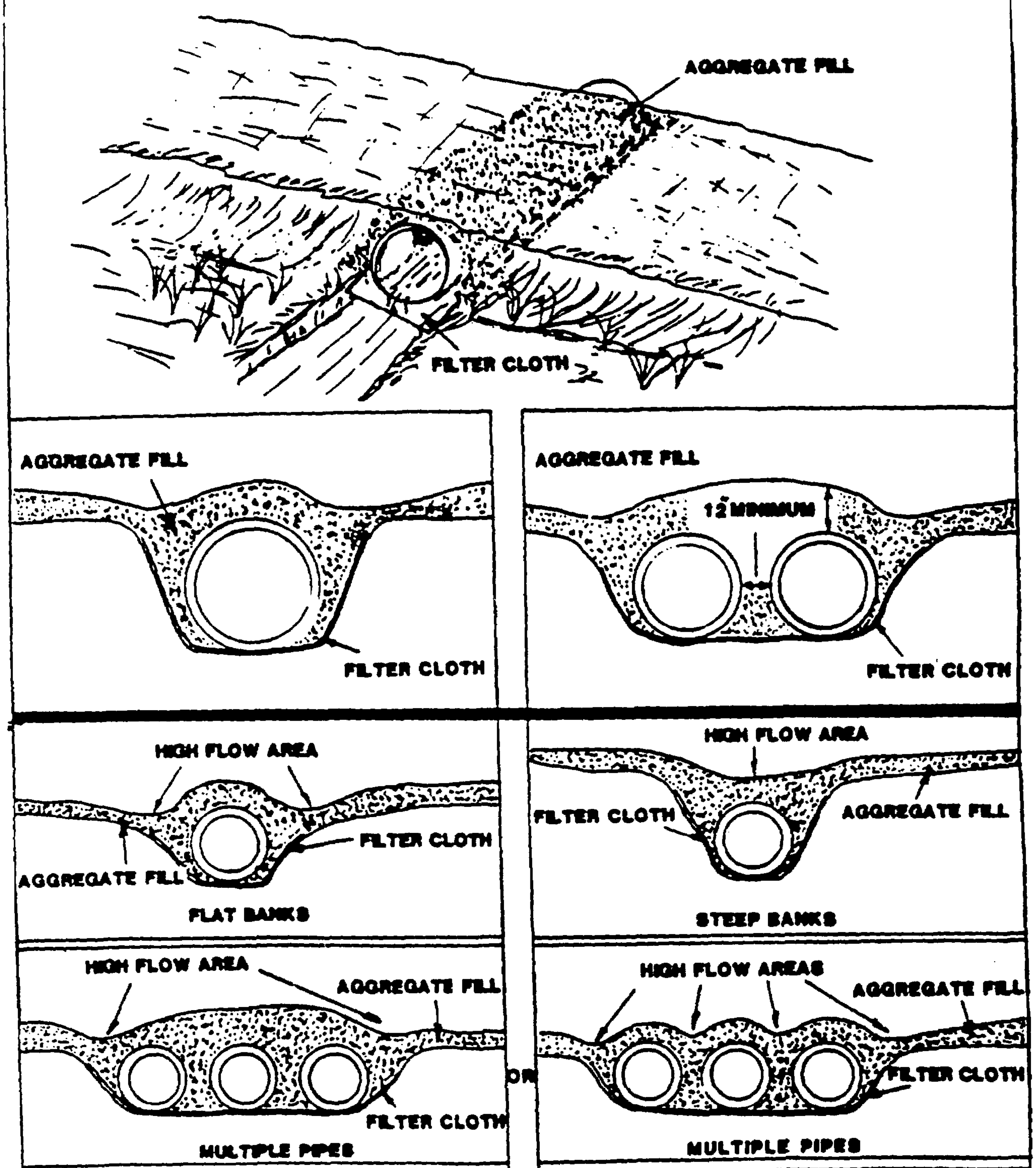
TEMPORARY ACCESS BRIDGE





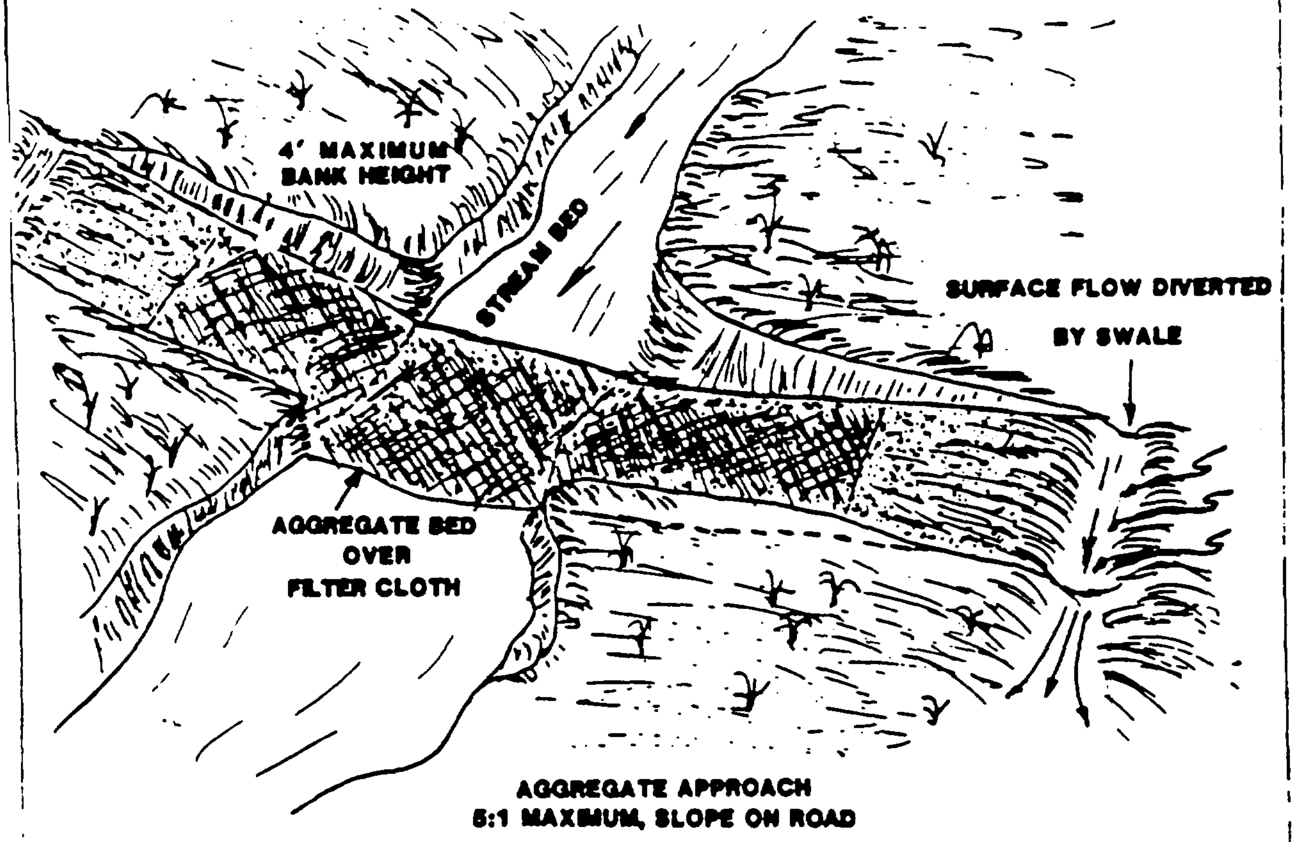
WATER RESOURCES ADMINISTRATION	TEMPORARY ACCESS BRIDGE	STANDARD DRAWING
		TAB 1

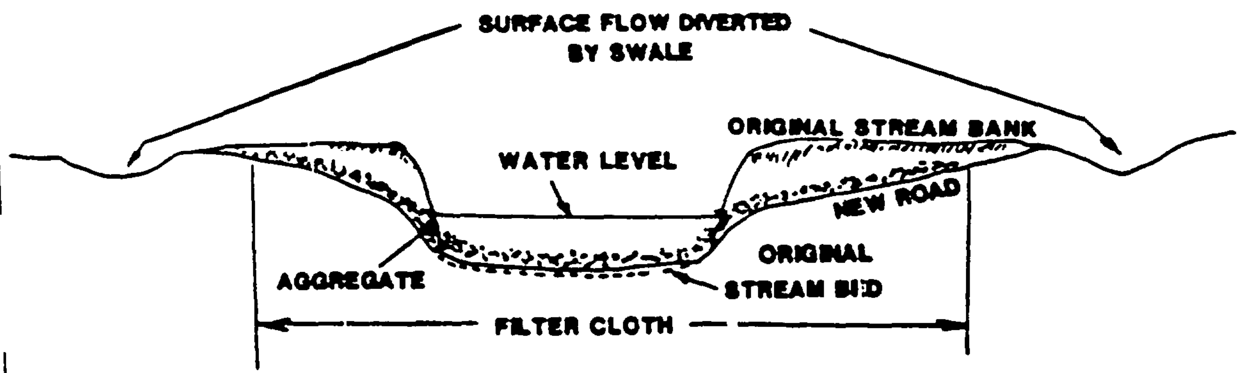
TEMPORARY ACCESS CULVERT



WATER RESOURCES ADMINISTRATION	TEMPORARY ACCESS FORD	STANDARD DRAWING
		TAC 1

TEMPORARY ACCESS FORD





WATER RESOURCES ADMINISTRATION	TEMPORARY ACCESS CULVERT	STANDARD DRAWING
		TAF 1

20. Wind Breaks (4)

- Definition: A temporary structure to slow winds.

- Purpose: Wind breaks are used to lessen the surface and air movement of soil from exposed surfaces and to reduce the presence of airborne substances by reducing the velocity and energy of the winds and allowing soil particles to settle out.

- Conditions Where Practice Applies: Large flat surface areas susceptible to erosion by winds are suitable for wind breaks.

- Effectiveness: Wind breaks are not very effective in slowing winds across large flat open sites but are effective in making airborne soil particles settle out once the winds have reached a break.

- Advantages: Wind breaks are an alternative to chemicals for dust control.

- Disadvantages: Wind breaks are not as effective as chemicals or mulching and seeding for dust control.

- Costs: The costs for wind breaks are those incurred in the establishment of fence, at about $2.50 per linear foot for temporary control. Permanent controls in the form of tree rows may be installed for about $200 per tree.

- Geographical Considerations:

C. Special Practices

During the last five to ten years there has been rapid advancement in the production and marketing of new sediment and erosion control technologies. The emphasis of these new technologies has been on enhancing the effectiveness of vegetative practices through the use of new materials designed to hold soil in place, allowing vegetation to become established. Many of the newer products have been developed by major chemical corporations such as Exxon, Dupont, and Amoco. It should be noted that there are an immeasurable number of different products manufactured by different companies being used over the country. It is beyond the scope of this report to investigate all of these new products, but some general discussion is included. On the whole, new sediment and erosion control technologies can be categorized into three general areas:1) Chemical solution mulch and tack coatings, 2) Natural fiber erosion control matting, and 3) Synthetic geotextile erosion control matting.

1. Chemical Solution Mulch and Tack Coatings

The first type of new technology, chemical mulch and tack coatings, are quite numerous and diverse. Many different types of chemicals are used in different solutions to best fit the desired use and site climate. Most chemical mulchs are water dispensable and are sprayed onto a site area. They immediately act to bond surface soils and mulches in order to reduce erosion due to wind or rain. A chemical based mulch and tack coat can eliminate the need for separate mulch and mulch anchoring installations. As with any chemical, care must be exercised in handling and applying these products. Many chemical mulches can be poisonous to humans if breathed or touched during application. Also, often times there are limits on when application can occur such as avoiding frozen soils or rainy weather. Individual products must be investigated and selected based upon the site specific application requirements. (3) Examples of these products include:

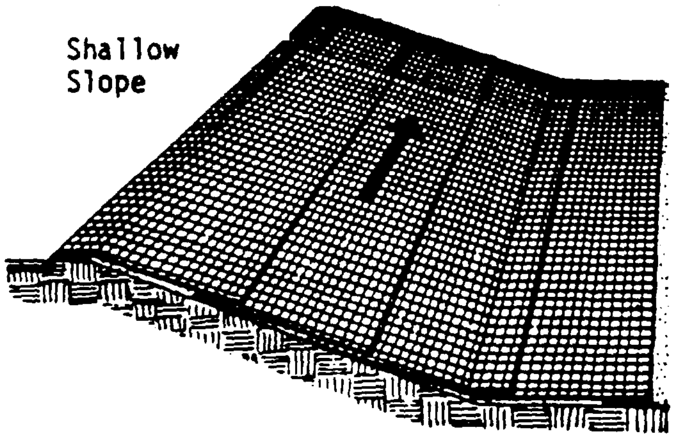
2. Natural Fiber Matting

A second type of new technology for controlling erosion is natural fiber matting. Large rolls of natural materials are applied to critical site areas such as steep slopes or channel bottoms. The two most common types of natural fibers used are wood excelsior and jute. Normally the fiber blankets must be anchored using metal or wooden pins and trenches. Natural fiber matting greatly reduces erosion by holding soil in place while vegetation is established. Often natural matting can be used in place of riprap with considerable cost savings. Also, natural fiber matting is biodegradable and non-toxic. Therefore, after a few years vegetation is fully established and all the matting material has degraded away with no environmental damage. (9)

3. Synthetic Fiber Matting

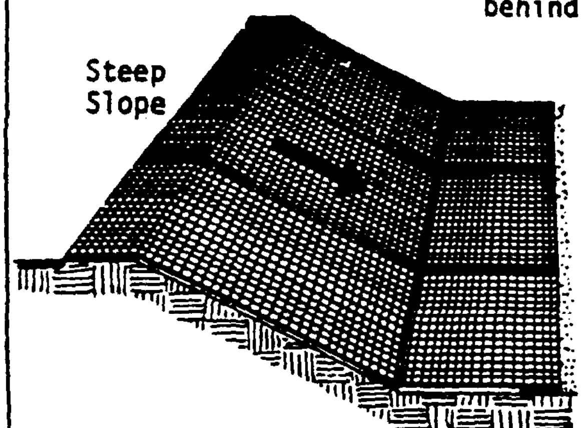
A third new technology category is synthetic matting. This matting acts exactly like natural matting but is made from chemical-based products such as fiberglass, vinyl, plastics, polyester, etc. Synthetic matting generally has much more strength than natural matting and can be accurately designed and specified to fit site specific drainage characteristics. (10) (11) One item to note is that most synthetic matting products do not biodegrade easily and therefore will remain on site indefinitely which may cause future environmental impacts.

There are many new sediment control products on the market today and more under development. Their uses are still limited due to a lack of historical data on their performance and governmental agencies reluctance to accept new technologies as standard. As time progresses and more is known and understood about sedimentation and erosion use of these new technologies should increase.



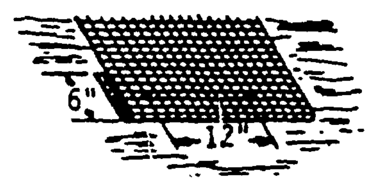
On shallow slopes, strips of netting may be applied across the slope.

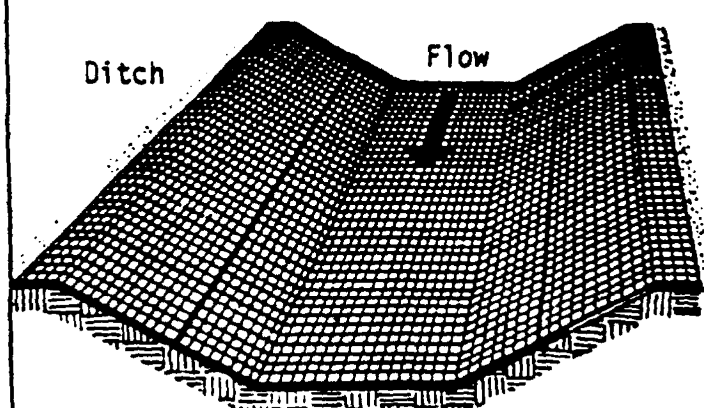
Where there is a berm at the top of the slope, bring the netting over the berm and anchor it behind the berm.



On steep slopes, apply strips of netting parallel to the direction of flow and anchor securely.

Bring netting down to a level area before terminating the installation. Turn the end under 6" and staple at 12" intervals.



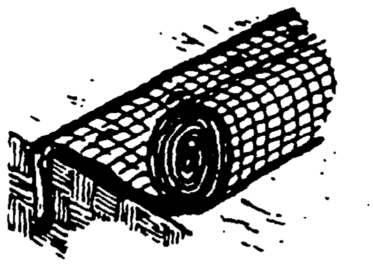


In ditches, apply netting parallel to the direction of flow. Use check slots every 15 feet. Do not join strips in the center of the ditch.

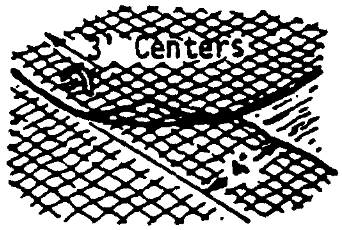
ORIENTATION OF NETTING AND MATTING

Source: Adapted from Ludlow Products Brochure Plate 1.75b

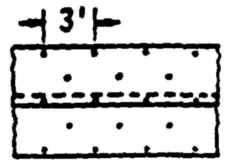
INSTALLATION OF NETTING AND MATTING

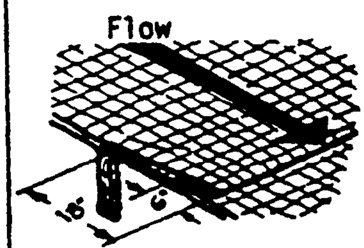


Anchor Slot: Bury the up-channel end of the net in a 6" deep trench. Tamp the soil firmly. Staple at 12" intervals across the net.

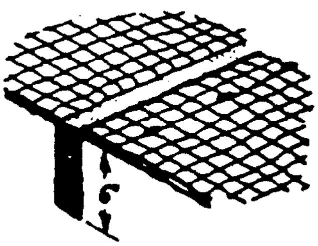


Overlap: Overlap edges of the strips at least 4". Staple every 3 feet down the center of the strip.

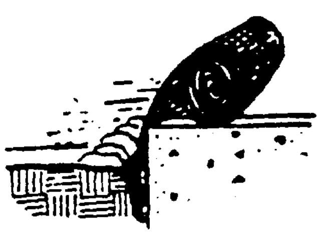




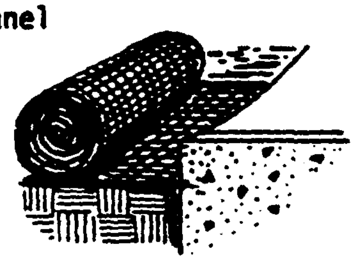
Joining Strips: Insert the new roll of net in a trench, as with the Anchor Slot. Overlap the up-channel end of the previous roll 18" and turn the end under 6". Staple the end of the previous roll just below the anchor slot and at the end at 12" intervals.



Check Slots: On erodible soils or steep slopes, check slots should be made every 15 feet. Insert a fold of the net into a 6" trench and tamp firmly. Staple at 12" intervals across the net. Lay the net smoothly on the surface of the soil - do not stretch the net, and do not allow wrinkles.



Anchoring Ends At Structures: Place the end of the net in a 6" slot on the up-channel side of the structure. Fill the trench and tamp firmly. Roll the net up the channel. Place staples at 12" intervals along the anchor end of the net.



Source: Adapted from Conwed Products Brochure

Plate 1.75a

V CONCLUSIONS

Erosion and sediment control as a means of reducing non-point source pollution is a concern of jurisdictions across the country. However, enabling legislation, regulations and standard practices vary greatly among states and local jurisdictions. Of those jurisdictions with active sediment and erosion control programs, this investigation found a consensus on the following program elements:

A. Vegetative practices should be used whenever possible. Vegetative practices cost less and are easier to install and maintain. These practices also are highly efficient in controlling sediment and erosion.

B. Clean water should be diverted away from construction areas - runoff from areas offsite or onsite areas not yet disturbed, should be diverted. This additional flow, if not diverted, can add volume and size to structural practices, requiring more frequent maintenance and limiting the effectiveness of vegetative practices.

C. Concentrated flows should be controlled by structural practices - vegetative practices are not effective in controlling sediment in concentrated flows. Concentrated flows are characterized by high velocities which can destroy vegetative measures. Concentrated flows must be trapped so that water borne sediment can be settled out.

During the study it became apparent that additional research into sediment and erosion control legislation and regulations is necessary, particularly with regard to the effect of local jurisdiction regulations on sediment and erosion control practices in the field. For example some jurisdictions limit the amount of area disturbed at one time and how long it may be disturbed. This greatly reduces erosion from large construction sites that would have previously been completely cleared and left unstabilized for long periods of time. Other regulations specify land disturbance activities requiring control measures and activities that are exempt.

With regard to vegetative practices the vast variety of methods and products greatly effect the efficiency of the practice especially prior to seed germination. These technologies are relatively new and many jurisdictions have not yet accepted their use.

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