

EROSION AND SEDIMENT CONTROL MANUAL

1. TABLE OF CONTENTS	1
2. INTRODUCTION AND SCOPE	3
2.1. Definitions	
2.2 Erosion Control Required	
2.3 Erosion Control Plans	
2.4 Non-Residential and Multi-Family Construction	
2.5 Residential Subdivisions Compliance	
2.6 Franchised Utility Companies	
2.7 Residential Lots with a Building Permit	
2.8 Enforcement	
2.9 Appeals	
2.10 USEPA - NPDES Permit Program	
3. PRINCIPLES OF EROSION & SEDIMENTATION AND PLAN PREPARATION	11
3.1 General	
3.2 Erosion Process	
3.3 Erosion Control	
3.4 Sedimentation Process	
3.5 Sedimentation Control	
3.6 Plan Review & Approval Process	
3.6.1 Single-Family Residential Control Plans	
3.6.2 Non-Single-Family Residential Erosion Control Plans	
3.7 Stormwater Pollution Prevention Plan (SWPPP)	
4. DEVICE STANDARDS AND SPECIFICATIONS	18
4.1 General	
4.2 BMP Type, Name, Purpose, Use, Design Criteria, Application, Limitations, Maintenance and Specifications	
• INTERCEPTOR SWALE	4-5
• DIVERSION DIKE	4-9
• PIPE SLOPE DRAIN	4-13
• VEGETATION	4-17
• MULCHING	4-21
• EROSION CONTROL BLANKETS	4-25
• CHANNEL PROTECTION	4-29
• DUST CONTROL	4-31
• SILT FENCE	4-33
• SILT FENCE & STONE OVERFLOW STRUCTURE	4-35
• ORGANIC FILTER BERM	4-37
• TRIANGULAR SEDIMENT FILTER DIKE	4-39
• INLET PROTECTION	4-43

- STONE OUTLET SEDIMENT TRAP 4-51
- SEDIMENT BASIN 4-55
- CHECK DAMS 4-59
- TEMPORARY SEDIMENT TANK 4-63
- STABILIZED CONSTRUCTION ENTRANCE 4-65
- WHEEL WASH 4-69
- DEBRIS & TRASH MANAGEMENT 4-71
- CHEMICAL MANAGEMENT 4-73
- CONCRETE WASTE MANAGEMENT 4-75
- CONCRETE SAWCUTTING WASTE MANAGEMENT 4-77
- SANDBLASTING WASTE MANAGEMENT 4-79
- LIME STABILIZATION MANAGEMENT 4-81
- SANITARY FACILITIES 4-83

5. INSPECTIONS AND ENFORCEMENT

- 5.1 GENERAL 19
- 5.2 INSPECTION PROCEDURE 19
- 5.3 ENFORCEMENT PROCEDURE 19

6. APPENDICES

- APPENDIX A GLOSSARY OF TERMS 20
- APPENDIX B EXAMPLE OF SINGLE-FAMILY RESIDENTIAL
EROSION CONTROL PLAN 23
- APPENDIX C EXAMPLE OF NON-RESIDENTIAL
EROSION CONTROL PLAN 24
- APPENDIX D DESIGN PROCEDURE FOR TEMPORARY
SEDIMENT BASINS 25

2.0 INTRODUCTION AND SCOPE

Hundreds of acres of land are disturbed every year in the City of Cibolo for the construction of subdivisions, homes, shopping centers, office complexes, highways and other developments. Without erosion control measures this exposed land is vulnerable to accelerated erosion and sedimentation that can cause damage to adjacent properties, storm drain facilities, streams and other water resources of the City and State.

This manual focuses primarily on the design, construction and maintenance of methods that have proven to be effective in the control and prevention of soil erosion caused by rainfall and stormwater runoff. The soil erosion and sedimentation process will be briefly discussed in an overview, but a detailed discussion of these topics is beyond the scope of this manual. The list of references in the Appendix of this manual contains several recommended readings on the subjects of erosion and sedimentation.

The National Pollution Discharge Elimination System (NPDES), administered by the Environmental Protection Agency (EPA), also requires all activities that meet the definition of an "industrial activity" to obtain storm water permits. This program was delegated to the Texas Commission on Environmental Quality (TCEQ) as the Texas Pollutant Discharge Elimination System (TPDES) in March 2003. Currently any construction activity that disturbs 1 acre or more of land meets the TCEQ definition of an "industrial activity" and must comply with TPDES permit requirements.

The City of Cibolo's Erosion and Sediment Control Manual is not meant to duplicate existing State or Federal regulations, but to compliment and precede these rules to help protect property and our water resources and to further clarify all pertinent requirements of the City of Cibolo Unified Development Code. For those construction activities disturbing one or more acres, Erosion control plans per City requirements will meet or exceed State and Federal requirements, thus eliminating duplicate efforts. However, additional forms and documentation may be necessary to comply with State and Federal regulations.

The Erosion and Sediment Control Manual is intended as an aide and reference to implement pertinent requirements of the Cibolo Unified Development Code. This chapter should not be used for legal interpretations or proceedings.

2.1 Definitions

The definitions described in Article 1 of the City of Cibolo UDC shall be the legal basis for defining all terms used in this section. Below are additional definitions that shall only pertain to this manual. The following words, terms, and phrases, when used in this manual, shall have the meanings ascribed to them below, except where the context clearly indicates a different meaning:

Below ground installations means activity that causes excess sediment laden water, concrete sawing wash water, wash water or drilling mud pumped from an excavation or structure and shall be treated as sediment laden runoff for erosion control purposes.

Construction Activities means construction activities that require a building permit.

Disturbance means any operation or activity, such as clearing, grubbing, filling, excavating, mining, cutting, grading, or removing channel linings, which results in the removal or destruction of the protective cover of soil, including vegetative cover, channel linings, retaining walls, and slope protection.

Disturbed areas means any tract of land in which a disturbance is occurring or has occurred but has not been stabilized.

Erosion control plan means a site plan with necessary details, showing the property where land disturbing activity will take place and showing the locations and types of devices, procedures and practices to be used to control erosion and sedimentation.

Final approval means completion of a project, site or building in accordance with City of Cibola requirements and ordinances. In the case of a building, a Certificate of Occupancy is issued.

Land disturbing activity means any activity including but not limited to excavation, planting, tilling, and grading, which disturbs the natural or improved vegetative ground cover so as to expose soil to the erosive forces of rain, storm water runoff or wind. All installations and maintenance of franchise utilities such as telephone, gas, electric, etc., shall be considered land disturbing activities.

Manual means the City of Cibola Erosion and Sediment Control Manual, as amended from time to time.

Off-site borrow area means a source of earth fill material used in the construction of embankments or other earth fill structures, that is located on another parcel of property other than where the principal construction is occurring.

Off-site sedimentation means deposit of soil material beyond the limits of the property undergoing land disturbing activity or in City streets, alleys or drainage facilities in an amount sufficient to constitute a threat to the environment, public safety and comfort.

Off-site spoil area means an area on another parcel of property, other than where the principal construction is occurring, where excess earth, rock or construction material is disposed of.

Permanent erosion control devices means devices or practices installed prior to final approval and maintained after final approval to prevent or minimize the erosion and deposit of soil materials. Such devices may include, but shall not be limited to, permanent seeding (grass shall be thick and of the height to need mowing), sod, storm drain channels, channel linings, storm drain pipes, outlet velocity control structures and storm water detention structures.

Permanent ground cover means permanent vegetative cover on all bare soil areas of a property not covered by a permanent structure or landscaping improvements, including but not

limited to, live sod, perennial grasses or other materials which lessen runoff and soil erosion on the property.

Phased occupancy means use or inhabitation of a single structure or other portion of a project as such structure or portion thereof is completed, but before the project as a whole is fully completed and finally approved by City.

Related land area includes the property where the principal land disturbing activity is taking place, all adjacent property, off-site borrow areas, off-site spoil areas, and off-site properties associated with the principal land disturbing activity/improvements.

Responsible party means a business entity, franchised utility company, developer, property owner, contractor or holder of a building permit who is required to comply with the terms of this manual.

Stabilized means to be protected from possible erosion losses, usually by the use of vegetative cover.

Staging area means an on-site or off-site location used by a Contractor to store materials for a project, to assemble portions of equipment or structures, to store equipment or machinery, to park vehicles, or for other construction related uses.

Stop work order means the suspension of all City permits with no approvals or inspections of work for the site or project being performed.

Temporary erosion control devices means devices installed or practices implemented and maintained during land disturbing activities to prevent, minimize or control the erosion and deposit of soil materials.

2.2 Erosion Control Required

(a) Application of Article. A Responsible Party engaging in any land disturbing activity or any construction activity shall prepare an Erosion Control Plan and submit that Plan to the Engineering Department for approval. This Article shall apply regardless of whether a Responsible Party is required to obtain a permit from the City in order to conduct such land disturbing or construction activity. The Responsible Party shall also be held liable for violations of this Article committed by third parties engaging in activities related to the Responsible Party's project. Agricultural production practices are exempt from this requirement.

(b) Erosion Control Plan Implementation and Compliance. Each Responsible Party shall implement and maintain the erosion control measures shown on its approved Erosion Control Plan in order to minimize the erosion and the transport of silt, earth, topsoil, etc., by water runoff or construction activities, beyond the limits of the Responsible Party's site onto City streets, drainage easements, drainage facilities, storm drains or other public/private property prior to beginning any land disturbing activity.

(c) Off-Site Borrow, Spoil and Staging Areas. Where applicable, off-site borrow areas, spoil areas and construction staging areas shall be considered as part of the project site and shall be governed by this Article.

(d) Related Land Areas. The erosion control requirements of this Article shall apply to all related land areas. Additionally, when land-disturbing activity occurs on a project, all disturbed land areas related to the project shall have permanent erosion control established before final occupancy of structures located thereon or final acceptance of the subdivision may be obtained. This section applies whether or not a building permit is required.

(e) Below Ground Installations. All discharges resulting from below ground installations shall be passed through City approved erosion control device(s) or removed from the site and properly disposed of.

2.3 Erosion Control Plans.

(a) Plan Requirements Generally. Each Erosion Control Plan required by this Article shall clearly identify all erosion and sediment control measures to be installed and maintained throughout the duration of the project for which that Plan is submitted. The Responsible Party shall install and maintain erosion control devices in accordance with his City approved Erosion Control Plan as required by this Article.

2.4 Non-Residential and Multi-Family Construction

When construction or land disturbing activities are conducted as part of a Non-Residential or Multi-Family construction project, permanent erosion control shall be established prior to the occupancy of any non-residential or multi-family structure. Phased occupancy will be allowed only when there are no outstanding erosion control violations for the project for which the request is made.

2.5 Residential Subdivisions Compliance

In addition to the other requirements of this Article, when construction or land disturbing activities are conducted as part of a Residential Subdivision project, the following shall apply:

(a) Erosion Control Deposit Account. Prior to approval of the final plat by the Planning and Zoning Commission, the Developer shall submit an Erosion Control Plan for approval by City and shall pay an erosion control deposit to the City in the amount of \$100.00 per lot. The deposit shall be posted to ensure implementation and continued maintenance of the City approved Erosion Control Plan for the development as required by this Ordinance. No inspection of any type may be performed on a project or portion thereof until a City approved Erosion Control Plan is implemented by the Responsible Party.

(b) Final Acceptance. Permanent erosion control devices and when applicable, temporary erosion control devices, as specified in the approved Erosion Control Plan shall be installed and maintained prior to final acceptance of a subdivision. The Developer for such subdivision shall

continue to maintain all temporary erosion control devices until permanent erosion control has been established on all those lots within the subdivision for which a building permit has not been issued.

(c) Transfer of Property by Developer. If the Developer sells all of the lots in a subdivision to one purchaser, that purchaser becomes the Responsible Party for the subdivision, is liable for violation of this Article and shall post an erosion control deposit as required by this Article. The balance remaining in the original Developer's account shall be released as provided herein upon the submission of written proof of transfer of lots or a new erosion control deposit by the purchaser. As required by this Article, the purchaser shall post an erosion control deposit with the City.

(d) Deductions from Erosion Control Deposit Account/Stop Work Orders/Citation. City shall inspect the erosion control devices located at a site for compliance with the approved Erosion Control Plan submitted by a Developer. If a Developer fails to implement or maintain erosion control devices as specified in his approved Erosion Control Plan, City shall provide such party with written notice of noncompliance identifying the nature of the noncompliance. Such notice shall also inform the Developer of the circumstances under which a deduction from his deposit account will be made and the time frame for the filing of an appeal of such action by City. The Developer shall have twenty-four (24) hours to bring his erosion control devices into compliance with the approved Erosion Control Plan for the site to which notice of noncompliance was issued. Correction shall include sediment clean up, erosion control device repair, erosion control device maintenance and/or installation of additional erosion control devices to prevent re-occurrence of the violation. The 24-hour cure period may be extended for inclement weather or other factors at the discretion of the Chief Building Official.

At the end of the twenty-four (24) hour cure period, City shall re-inspect the site and shall deduct a re-inspection fee of \$150.00 from the Developer's erosion control deposit account. If at the time of such re-inspection, the erosion control devices at the site have not been brought into compliance with the approved Erosion Control Plan, City may issue a stop work order and issue a citation for each violation of this Article. All deductions from a Developer's erosion control deposit account may be appealed as provided in Section 14-101 of this Ordinance.

(e) Erosion Control Deposit Account Balance - Deposit Refund. After building permits have been issued for seventy-five percent (75%) of the lots within the development, the Developer may request the return of the remainder of his deposit by submitting a written request to the Development Services Department. However, the Developer shall continue to maintain temporary erosion control devices on those remaining lots for which building permits have not been issued and for any other areas upon which permanent erosion control has not been established. The balance of the deposit remaining in an account after deductions for all violations have been made shall be refunded within thirty (30) days of receipt of the written request for refund along with a list of all deductions made from his deposit account.

(f) Erosion Control Deposits. Erosion control deposits posted pursuant to the requirements of this Article shall not accrue interest.

2.6 Franchised Utility Companies

Subject to the terms of its franchise agreement with City, including but not limited to terms regarding permits, a franchised utility company engaging in land disturbing activities within the City of McKinney shall comply with the following:

A. Erosion Control Plan. Prior to beginning any land disturbing activity or upon the effective date of this ordinance, an Erosion Control Plan shall be submitted for approval by the City.

B. Stop Work Order/Citation. City shall inspect the erosion control devices located at a site for compliance with the approved Erosion Control Plan submitted for such site. If a Responsible Party fails to implement or maintain erosion control devices as specified in his approved Erosion Control Plan, City shall provide such party with written notice of noncompliance identifying the nature of such noncompliance. The Responsible Party shall have twenty-four (24) hours to bring his erosion control devices into compliance with the approved Erosion Control Plan for the site where the violation occurred. Correction shall include sediment clean up, erosion control device repair, and erosion control device maintenance. The 24-hour cure period may be extended for inclement weather or other factors at the discretion of the Chief Building Official.

At the end of the 24-hour cure period, City shall re-inspect the site. If at the time of such re-inspection, the erosion control devices at the site have not been brought into compliance with the approved Erosion Control Plan, City may issue a stop work order and issue a citation for each violation of the City's erosion control requirements. To obtain a re-inspection for removal of the stop work order, a request for re-inspection must be submitted.

2.7 Residential Lots with a Building Permit

When land disturbing activities are conducted on a residential lot for which a building permit must be issued, the Responsible Party shall comply with the following:

A. Erosion Control Plan. Prior to approval of a building permit for a residential lot by the City, the Contractor or other Responsible Party obtaining the building permit shall submit an Erosion Control Plan for approval by the City. No inspection may be performed on a project until a City-approved Erosion Control Plan is implemented.

B. Stop Work Order/Citation. City shall inspect the erosion control devices located at a site for compliance with the approved Erosion Control Plan submitted for such site. If a Responsible Party fails to implement or maintain erosion control devices as specified in his approved Erosion Control Plan, City shall provide such party with written notice of noncompliance identifying the nature of such noncompliance. The Responsible Party shall have twenty-four (24) hours to bring his erosion control devices into compliance with the approved Erosion Control Plan for the site where the violation occurred. Correction shall include sediment clean up, erosion control device repair, erosion control device maintenance, and/or installation of additional erosion control devices to prevent re-occurrence of the violation. The 24-hour cure period may be extended for inclement weather or other factors at the discretion of the Chief Building Official.

At the end of the 24-hour cure period, City shall re-inspect the site and may assess a re-inspection fee. If at the time of such re-inspection, the erosion control devices at the site have not been brought into compliance with the approved Erosion Control Plan, City may issue a stop work order and issue a citation for each violation of the City's erosion control requirements. When a stop work order has been issued, a re-inspection fee shall be assessed. To obtain a re-inspection for removal of the stop work order, a request must be submitted therefore and a re-inspection fee, as set by the Building Inspection Department of the City of McKinney, shall be paid.

C. Removal of Erosion Control Devices. Upon final occupancy or upon establishing permanent ground cover on a lot, all temporary erosion control devices shall be removed.

2.8 Enforcement

(a) Violations. It shall be an offense for a Responsible Party or a third party performing work on a project to violate any of the requirements of this Article, including, but not limited to, the following:

(1) Conducting any land disturbing or construction activity without an approved Erosion Control Plan for the location where the violation occurred.

(2) Failing to install erosion control devices or to maintain erosion control devices throughout the duration of land disturbing activities, in compliance with the approved Erosion Control Plan for the location where the violation occurred.

(3) Failing to remove off-site sedimentation that is a direct result of land disturbing activities where such off-site sedimentation results from the failure to implement or maintain erosion control devices as specified in an approved Erosion Control Plan for the location where the violation occurred.

(4) Allowing sediment laden water resulting from below ground installations to flow from a site without being treated through an erosion control device.

(5) Failing to repair damage to existing erosion control devices, including replacement of existing grass or sod.

(b) Notice of Violation. Written notice of violation shall be given to the Responsible Party or his job site representative as identified in the Erosion Control Plan for a site. Such notice shall identify the nature of the alleged violation and the action required to obtain compliance with the approved Erosion Control Plan.

(c) Class C Misdemeanor. Any person, firm, or corporation violating any of the provisions or terms of this Article shall be deemed guilty of a Class C misdemeanor and, upon conviction thereof, be subject to a fine not exceeding \$500 for each offense, and each and every day such violation shall continue shall be deemed to constitute a separate offense.

2.9 Appeals

(a) Appeal to Director of Development Services. Upon notice of noncompliance, a Responsible Party may appeal the City's decision to take deductions from his erosion control deposit, by filing a written appeal to the Director of Development Services within seven (7) days of City's written notice of its intent to make such deduction for costs as allowed herein. An appeal filed

pursuant to this section shall specifically state the basis for the aggrieved party's challenge to the City's authority to take deductions under this Article.

(b) Standard for Appeals. When reviewing an appeal filed, the Director of Development Services shall evaluate all evidence submitted. The burden of proving that a violation occurred shall be on the City. The City shall provide evidence sufficient to reasonably support a determination that the Responsible Party failed to comply with the requirements as alleged by the City.

(c) Issuance of Opinion by Director. Decisions of the Director of Development Services shall be issued within twenty (20) days of City's receipt of the written appeal. Decisions of the Director of Development Services shall be final.

2.10 USEPA - NPDES Permit Program

Under current Federal law and EPA/State Regulations, all owners/operators of storm water discharges from industrial activities must have applied for and be operating pursuant to a NPDES permit, or risk Federal penalties. The regulations define "storm water discharges associated with industrial activity" to include storm water discharges from construction activities (including clearing, grading and excavation activities) that result in the disturbance of five or more acres of total land area, including areas that are part of a larger common plan of development or sale.

The EPA administers the NPDES program under the Clean Water Act (CWA), but a provision in the CWA allows states to request authorization to administer the NPDES program instead of the EPA. States that develop an EPA approved plan can become responsible for issuing permits and administering the NPDES program locally. To date the State of Texas has not developed an EPA approved plan and is not delegated to issue NPDES permits. Dischargers in Texas must comply with EPA's regulations, which mandate that baseline requirements be met.

Two kinds of permits are issued under the NPDES program. One is an individual permit tailored to fit the specific requirements of a particular facility, while the second, a general permit, provides umbrella-like coverage to a large number of facilities. General permits have been established by the EPA with generic requirements for sediment and erosion control, storm water management, and other controls. Coverage under the general permit will normally be available for all construction activities. The general permit is also the quickest and easiest to obtain.

The operator of a construction site must submit a Notice of Intent (NOI) for coverage under the general permit, prior to the start of construction. For the purposes of this permit, "operator" is the party or parties that either individually or taken together meet the following two criteria:

- They have operational control over the site specifications; and
- They have day-to-day operational control of those activities at the site necessary to ensure compliance with plan requirements and permit conditions.

In many instances, more than one party will have to submit an NOI for the same project in order to satisfy both criteria.

Due to ongoing changes in Federal regulations always check the NOI form for the up-to-date mailing address.

Sites operating under approved state or local sediment or erosion control plans, are required to submit signed copies of the NOI to the approving state or local agencies, as well. Once the NOI is submitted for a general permit, the construction activities are automatically covered and construction may begin within 2 days, unless contacted by EPA. An actual permit will not be issued, although a specific permit number will be assigned to each application.

When the General permit is used a Storm Water Pollution Prevention Plan (SWPPP) is required. The SWPPP consists of an erosion and sediment control plan along with an accompanying report that outlines the methods that will be employed to reduce pollution at the site. The SWPPP shall be prepared in accordance with design guidelines acceptable to the EPA by a Registered Professional Engineer, licensed in the State of Texas. The purpose of the SWPPP is to identify potential sources of erosion and pollution to storm water discharge, and to provide mechanisms to reduce those pollutants. Although the plan is not to be submitted with the NOI, an applicant is required to prepare such a plan prior to NOI submission. Also the erosion and sediment control plan is required by the City of McKinney's erosion control ordinance for land disturbing activities.

Persons required to comply with NPDES requirements under the storm water application rule could be subject to enforcement by the EPA. When required to comply, the permittee is subject to enforcement for breaching any condition of the General Construction Permit. In Texas, the EPA regional office is the primary regulating agency and will undertake enforcement actions where warranted. There are four methods of enforcement that are typically used. They are administrative orders, civil actions, criminal actions, and citizen suits.

3.0 PRINCIPLES OF EROSION AND SEDIMENTATION

3.1 General

The most effective means of reducing the soil lost from property is to prevent the erosion of the soil. Structural barriers can provide 70% to 90% sediment removal efficiencies from runoff, but natural groundcover and mulching can provide 90% to 98% reduction in erosion and soil loss.

3.2 Erosion Process

Erosion is a natural process by which soil and rock is loosened and removed by the action of water or wind. The primary focus of this manual is the control of erosion and sedimentation caused by surface water runoff. Construction-site erosion has been shown to be in most cases, the most excessive form of erosion known causing serious and costly problems, both on-site and off-site.

Runoff, water moving over the soil surface, is caused by rain water falling at a faster rate than it can be absorbed by the soil. The runoff water detaches and transports soil particles from one location to another. The erosiveness of flowing water depends upon its velocity, turbulence, plus the amount and type of abrasive material it transports. The higher the velocity of runoff, the higher the number of soil particles that can be transported.

The potential for an area to erode is related to four factors: soil type, surface cover, topography and climate.

The soil type has a direct impact on the erodibility of the soil. Key factors that affect the erodibility of a type of soil are the soil texture, the organic matter content, the type of soil structure, and the permeability of the soil.

Surface cover primarily in the form of vegetation, shields the soil surface from the impact of falling rain, reduces runoff velocity and spreads out the flow of water.

Topographic features such as the size of drainage basins and the steepness of slopes directly affect runoff rates and volumes.

Climate, particularly the frequency, intensity, and duration of rainfall are primary factors that determine the amount of runoff produced.

3.3 Erosion Control

Effective erosion control addresses the prevention of soil erosion by protecting the soil surface from the erosive forces of rain and runoff. Prevention of erosion is always better than remedial measures and should receive priority in any erosion and sedimentation control plan. Soil erosion cannot be completely prevented, as some natural erosion occurs on the landscape even under ideal conditions. The idea is to prevent accelerated erosion to the extent practicable. The following practices can be used to prevent erosion:

- Plan the development to fit the site topography (Avoid highly erosive areas).
- Minimize the duration and size of area exposed without ground cover.
- Protect exposed ground areas from off-site runoff.
- Stabilize exposed ground areas as soon as possible.
- Reduce runoff velocities whenever possible.
- Protect steep slopes from excessive runoff.

Project phasing, particularly on large projects, can be critical to successful erosion control. The minimizing of disturbed land area; re-establishment of ground cover and the installation of BMPs should be carefully coordinated with the phases of a project.

3.4 Sedimentation Process

Sedimentation is the deposition of soil particles that have been transported by runoff. The amount and size of the material that can be transported increases with the velocity of the runoff. Sedimentation occurs when the runoff slows down enough and for a long enough period of time to allow the suspended soil particles to settle from the runoff. Gravel and sand particles are usually not transported very far by running water and are deposited when the water first slows down. Conversely, some very small clay particles, may not settle out even when the water stops moving. This is because the particles are held in suspension.

3.5 Sedimentation Control

Sedimentation control is a remedial measure that involves trapping sediment as runoff leaves the land during storm events. Most sedimentation control is achieved through the use of structural controls, sometimes referred to as Best Management Practices (BMPs). Effective sedimentation control requires that the majority of the eroded soil be captured on-site. Chapter 5 of this manual provides the user with an inventory of BMPs, that when properly used, installed and maintained will effectively control sedimentation from a construction site. BMPs are generally applicable to a specific site situation and the erosion control plan for a site shows the correct BMP to control off-site sedimentation.

3.6 Plan Review & Approval Process

This section provides guidance and examples on how to prepare an Erosion Control Plan. For use in preparing erosion control plans for single-family residential home construction. The plan requirements are somewhat less stringent than what is required for other major types of land disturbing activity. For use in preparing erosion control plans for all other types of land disturbing activity within the City of McKinney. Plans prepared in accordance with these requirements will be very close to meeting EPA requirements for a Soil and Water Pollution Prevention Plan (SWPPP).

3.6.1 Single-Family Residential Erosion Control Plans

For single-family residential buildings the erosion control devices for the control of sediment shall be shown on the plot plan, which is submitted to obtain the individual building permit for a lot.

On most residential building lots in the City of McKinney the erosion control devices required will be minimal. A standard lot will require a 20' temporary stone construction entrance/exits; erosion control matting, silt fence or diversion ditches to control off-site sediment; and possibly a small stone overflow or outlet structure where concentrated flow leaves the property. The largest erosion control problem that is foreseen for these lots is the maintenance and upkeep of these devices during the construction period. Upkeep includes making sure that the homebuilder's employees and sub-contractors do not destroy or disturb the devices, thus rendering them useless.

The implementation of these erosion control requirements will mean some minor changes in the way that a contractor conducts his/her operations on a building lot, but the proper use of the BMPs in this manual also will provide benefits. Some benefits of controlling sediment runoff from a lot include:

- Preventing the loss of valuable fill material and/or topsoil.
- Preventing additional man-hours spent cleaning up off-site sediment damage.
- Minimizing damage claims from downstream neighbors.
- Emphasizing "good neighbor relations" with your client and the neighborhood.
- Not delaying your project with stop work orders and re-permit fees.
- Keeps your company legal, since erosion control is the law!

The City of McKinney Erosion Control Ordinance also makes the Contractor responsible for erosion control and stabilization of off-site areas disturbed as a result of the home building operation. This includes adjacent lots used for material storage and/or staging during the construction.

To complete a single-family residential erosion control plan for a typical lot in the City of McKinney, the following information should be added to an already completed plot plan:

- Show location of the high point for side lot drainage.
- Show the direction of drainage flow in the street(s) and alley(s).
- Show locations of 20' temporary rock construction exits/entrances. Three to six inch diameter minimum.
- Show locations of other erosion control devices or methods necessary to control off-site sedimentation

The following two pages show example single-family residential erosion control plans. It should be noted that different BMPs could be used depending upon the site orientation and topography

3.6.2 Non-Single-Family Residential Erosion Control Plans

This Section covers requirements for erosion control plans for all land disturbing activities except single-family residential construction. An erosion control plan in accordance with this

Section shall be required for all other activities that require a building permit or disturb more than 5,000 square feet of existing ground cover. Plans and specifications prepared for construction of improvements shall address specific erosion and sediment control measures or techniques to implement a suitable program to control erosion from disturbed areas on site and to protect downstream properties from the deposition of sediment.

The requirements for erosion control plans within the City of McKinney are very similar to the requirements established for the EPA-NPDES permit program, but with much more emphasis on the actual performance of BMPs installed.

An erosion control plan design checklist that is provided to assist the design professional in the preparation of an erosion control plan for a site and to ensure that all minimum required items has been addressed. All of the items listed should be included somewhere in the construction plan set, but do not necessarily have to be on one separate erosion control plan sheet. The use of this checklist does not relieve the design professional of his or her responsibilities in preparing construction plans and documents. Sound engineering design and judgment should be used by design professionals preparing construction documents for erosion and sediment control. Most of the information listed is already required for the preparation of construction plans or site plans for property development. On small sites some information may not be available or pertinent to the work involved. On a case-by-case basis City review staff may allow the omission of non-pertinent information. The following paragraphs briefly describe each item listed on the checklist:

GENERAL INFORMATION:

1. Owner's Name, Address & Phone - Is the property owner's name, current mailing address and phone number noted on the plans?
2. Developer's Name, Address & Phone - Is the developer's name, the job site representative for the project, current mailing address and phone number noted on the plans?
3. Engineer's Name, Address & Phone - Is the design engineer's name, the engineering company's name, current mailing address and phone number noted on the plans?
4. PE Seal, Sign & Date - Final construction documents shall be sealed, signed and dated by a professional engineer licensed to practice engineering in the State of Texas.
5. Site Acreage Noted - Note the total acreage of the property being developed.
6. Vicinity Map - Provide a vicinity map on the plans showing the general location of the project.
7. North Arrow & Graphic Scale - Provide a properly orientated north arrow and a properly sized graphic scale bar on each plan view sheet.
8. Title Block Complete - Is all information in the title block complete and correct on all plan sheets?
9. Revision Block Complete - Is there a revision block provided on the plan sheets? This item is particularly important on erosion control plans since it is very likely that there will be changes to the plan during the construction process. The use of a revision block on the plans makes keeping track of any revisions much easier.
10. Symbol Legend - Is there a complete and legible symbol legend provided on the plan sheets?
11. General Notes - Provide standard general notes as required by this UDC.

TOPOGRAPHIC INFORMATION:

1. Site Boundaries - Show the property lines, easement lines and right-of-way lines for the property being developed.
2. Existing Ground Contours - Show existing ground contours for the entire property and to the extent necessary around the perimeter of the site to show the relationship of the surrounding properties to the site. Use a 2-foot contour interval (or less) and make sure that at least two contours on the plan are labeled.
3. Existing Structures - Show any existing structures on the site and list them as either "to remain" or "to be removed" as appropriate.
4. Existing Utilities - Show any above ground and below ground utility locations for the site. Coordination with local utility companies and the use of utility locating services can solve many problems before they become major issues.
5. Existing Drainage Features - Show any existing on-site drainage features such as streams, rivers, lakes, ditches, wetlands, springs, etc.
6. 100-yr. Flood Plain with Elevations - Show any mapped 100-year flood plain located on or adjacent to the site. Flood Insurance Rate Maps are available for inspection in the City of McKinney Engineering Department, which show the general locations of mapped flood plains within the City and the 100-year flood elevations. Erosion control devices should be located outside the 100-year flood plain.
7. On-site Drainage Area Map - Show the drainage area boundaries for drainage sub-basins on site in accordance with the City of McKinney's, Design Manual for Storm Drainage Facilities.
8. Benchmark or TBM - Note the location and vertical information for the benchmark(s) or temporary benchmark(s) used for vertical control on the project.
9. Off-site Drainage Area Map - Show the drainage area boundaries for off-site drainage areas that impact the site in accordance with the City of McKinney's, Design Manual for Storm Drainage Facilities. If off-site drainage areas do not impact the site, then this item is not required.
10. Limits of Trees/Shrubs to Remain - Show and label the locations of individual trees and shrubs plus areas of dense trees and shrubs that are slated to remain on the property after development is complete.
11. Limits of Undisturbed Areas - Show and label the limits of existing ground cover on the site that are to remain undisturbed during the construction process.

DESIGN INFORMATION:

1. Construction Limits Shown - Clearly show the limits of construction on the plans.
2. Disturbed Area Noted (Acres) - Note the number of acres of disturbed land area for the project. This includes all areas disturbed on site as well as any off site borrow, spoil or utility construction areas. Areas in excess of 5 acres are required to obtain an NPDES permit in accordance with EPA regulations.
3. Proposed Grading Plan - Show proposed ground contours for the entire property and to the extent necessary around the perimeter of the site to show how proposed grades are to match existing grades. Use a 2-foot contour interval (or less) and make sure that at least two contours on the plan are labeled. Very flat sites may require the use of spot elevations and/or cross section views.

4. Proposed Structures & Pavement - Show layout of proposed improvements for the site as per the site plan or preliminary subdivision plat for the property.
5. Proposed Storm Drainage Plan & Calculations - Submit storm drainage plans and calculations in accordance with the City of McKinney's, Design Manual for Storm Drainage Facilities.
6. Proposed Site Utilities - Submit site utility layout plans.
7. Construction Schedule & Phasing Plan - A written construction schedule of major site construction items must be on the plan. If the project is being done in phases the erosion control plan must be also phased to take into account the sequence of construction. Very complicated projects may require that several different phases of erosion control plans be implemented over the life of the project. Specific dates are not required and the schedule can be in a generic, outline type format.
8. Borrow & Spoil Areas Identified - Off site borrow and spoil areas are considered as part of the project site and must also comply with the erosion control requirements for the project. This includes the installation of BMPs to control off site sedimentation and the establishment of permanent ground cover on disturbed areas prior to final approval of the project.
9. BMP Locations - Are erosion control devices located properly to control sediment from leaving the site? Also, are the correct types of BMPs being used?
10. BMP Calculations - Submit calculations for the sizing and design of each BMP used for the project. BMPs should be properly labeled for easy identification.
11. BMP Details - BMPs require adequate details for proper construction. This includes proper dimensioning and material specifications. The details included in this manual are accepted by the City of McKinney for the control of erosion and sediment on construction sites. Some of these devices do require additional dimensions to be provided by the designer.
12. BMP Maintenance Schedule - Submit a BMP maintenance schedule for the BMPs proposed for use on the project. Chapter 5 in this manual gives recommended inspection and maintenance intervals for the different types of BMPs. The schedule should also identify the responsible party for the maintenance of the different BMPs used throughout the life of the project.

3.7 Storm Water Pollution Prevention Plan (SWPPP)

Environmental Protection Agency (EPA) regulations require a National Pollutant Discharge Elimination System (NPDES) permit for all construction activities that result in the disturbance of 5 acres or more of total land area.

When the General permit is used a Storm Water Pollution Prevention Plan (SWPPP) is required. The SWPPP consists of an erosion and sediment control plan along with an accompanying report that outlines the methods that will be employed to reduce pollution at the site. The SWPPP shall be prepared in accordance with design guidelines acceptable to the EPA by a Registered Professional Engineer, licensed in the State of Texas. The purpose of the SWPPP is to identify potential sources of erosion and pollution to storm water discharge, and to provide mechanisms to reduce those pollutants. Although the plan is not to be submitted with the Notice of Intent (NOI), an applicant is required to prepare such a plan prior to NOI submission.

The following is a summary of SWPPP requirements. The items indicated with an asterisk, would normally be included in an Erosion Control Plan prepared in accordance with City of McKinney requirements as specified in this Manual:

SUMMARY OF SWPPP COMPONENTS

A. Site Description

1. Describe nature of construction activity
2. List proposed disturbed area
3. Runoff coefficient
4. Site plan showing drainage patterns, approximate slopes, limits of disturbed area, surface waters, surface water types, location of structural & non-structural BMPs and location(s) where stabilization practices are proposed.
5. Receiving waters (Name)

B. Description of Controls

1. Sequence of major activities
2. Timing for each control measure, installation thru removal
3. Description of erosion and sediment controls
4. Stormwater management
5. Other controls
6. Approved State or local plans
7. Description of maintenance
8. Inspector's responsibility: Changes to the plan Inspection reports

C. Description of Non-Storm Water Discharges

D. Industrial Activities On-Site

E. Contractors Certification

4.0 DEVICE STANDARDS AND SPECIFICATIONS

4.1 GENERAL

The details depicted on the following pages of this manual provide standards and specifications for the design, construction, and maintenance of BMPs for the control of sediment from land disturbing activities. These devices are primarily for the control of sediment caused by storm water induced erosion and will generally be accepted by City of Cibolo if they are properly designed and used.

These are the details to be implemented with any construction project within McKinney as indicated by McKinney's General Notes. The use of new devices and ideas for sediment or erosion control will be accepted for review, if accompanied by adequate supporting information. Other BMP's of better effectiveness may be considered, but may not implemented without prior approval by McKinney's reviewing Engineer as well as McKinney's Erosion Control Officer. Also, always check with the reviewing authority to make sure that this Manual is up-to-date prior to proceeding with specific plan preparation.

Each sediment control device in this chapter is placed in a section by itself with the following information provided: Description, Purpose, Application, Limitations, Design Criteria, Material Specifications, Maintenance Requirements, and a Detail. This format will place all of the information relative to a specific device all in one location for use by the designer, contractor, inspector, and plan reviewer.

Most all devices listed in this Manual will require maintenance, including sediment cleanout and removal, at some time during the construction process. Unless special provisions have been made, this sediment should be disposed of on site, with proper BMP protection, and stabilized with permanent ground cover prior to final approval of a site. Material can be disposed of off-site, but the area used for disposal becomes a part of the construction site by definition and will require erosion control devices and stabilization prior to finalizing the project.

Maintenance inspections are the responsibility of the Contractor performing the work on site. City inspection staff will make periodic inspections to enforce compliance and are available to assist the Contractor on a case-by-case basis for particularly difficult situations.

4.2 BMP Type, Name, Purpose, Use, Design Criteria, Application, Limitations, Maintenance and Specifications

4.2.1 Erosion Prevention

These BMPs protect the soil to reduce erosion. They are primarily used in perimeter areas around construction sites to either limit flows across the site or limit the erosion in areas disturbed but not active.

BMP ID	BMP Name	Primary Purpose	Efficiency Rating (Fe)
E-1	Interceptor Swale	Route flows around areas of disturbance	1.0
E-2	Diversion Dike	Route flows around areas of disturbance	1.0
E-3	Pipe Slope Drain	Route overland flow on a slope into a pipe to protect the slope	Varies
E-4	Vegetation	Provide natural soil protection through seeding, hydromulch or phasing	0.90
E-5	Mulching	Protect disturbed soil with a layer of hay, straw, or other material	0.90
E-6	Erosion Control Blankets	Protect disturbed soil or slopes with geotextile and biodegradable fabrics	0.90
E-7	Channel Protection	Protects the soil through the use of grass-lining, turf reinforcement mats, or riprap	Varies
E-8	Dust Control	Techniques to limit wind erosion and air-borne soil particles from leaving site	Varies

4.2.2 Sediment Loss Prevention

Construction activities normally result in disturbance on the site due to grading operations, clearing and other operations. Erosion will occur in these disturbed areas and BMPs must be used to contain the sediment from these disturbed areas. The following techniques reduce soil loss from the site by retaining the soil through sedimentation or filtration of the runoff.

BMP ID	BMP Name	Primary Purpose	Efficiency Rating (Fe)
S-1	Silt Fence	Slow and filter runoff to retain sediment	0.75
S-2	Organic Filter Berm	Slow and filter runoff to retain sediment	0.75
S-3	Triangular Sediment Filter Dike	Similar to silt fence but more portable, reusable and sturdy with high flows	0.75
S-4	Inlet Protection	Intercept sediment at curb and field inlets. Should be used in conjunction with other onsite techniques	Varies
S-5	Stone Outlet Sediment Trap	Intercept and filter small concentrated flows such as small creeks and defined waterways	0.85

The Efficiency Ratings listed for the BMPs are the assumed efficiencies in reducing erosion or trapping sediment for the BMP, assuming the BMPs are designed and installed in accordance with the Fact Sheets and based on accommodating the flow and volumes from the design storm.

BMP ID	BMP Name	Primary Purpose	Efficiency Rating (Fe)
S-6	Sediment Basin	Large pond with controlled outflow which allows sediment to settle out of runoff	0.90
S-7	Check Dam	Provide minor detention and retention of sediment for small swales and concentrated flows	0.50
S-8	Temporary Sediment Tank	Provide sedimentation for sediment laden runoff from trenches and depressed areas	0.70
S-9	Stabilized Construction Entrance	Reduce offsite sediment tracking from trucks and construction equipment	N/A
S-10	Wheel Wash	Reduce offsite sediment tracking from trucks and construction equipment	N/A

4.2.3 Materials and Waste Management

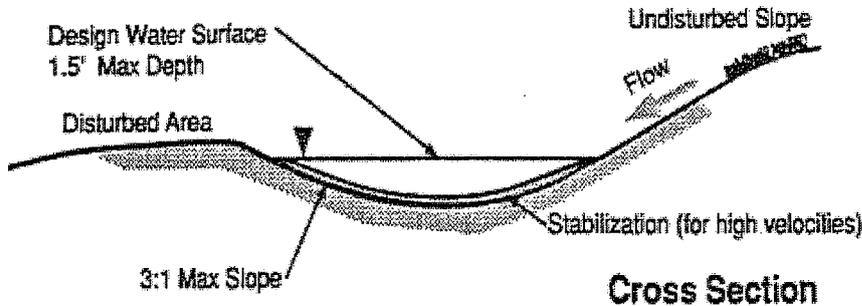
These techniques will be applied on the majority of construction projects due to their general topic of reducing waste from construction activities. They form the basis of general housekeeping procedures that should be followed during construction.

BMP ID	BMP Name	Primary Purpose	Efficiency Rating (Fe)
M-1	Debris and Trash Management	Techniques for management of paper, packaging, general building materials, etc.	Very Effective
M-2	Chemical Management	Techniques for management of paints, chemicals, fertilizer, oil and grease, etc.	Very Effective
M-3	Concrete Waste Management	Techniques for disposal of concrete washout, demolished concrete, etc.	Very Effective
M-4	Concrete Sawcutting Waste Management	Techniques for disposal of concrete cuttings from concrete sawing	Effective
M-5	Sandblasting Waste Management	Techniques for disposal of sandblasting waste and containment of wastes during operations	Effective
M-6	Lime Stabilization Management	Control lime runoff from areas being stabilized with hydrated or quicklime	Effective
M-7	Sanitary Facilities	Techniques for control of sanitary waste	Effective

The Efficiency Ratings listed for the BMPs are the assumed efficiencies in reducing erosion or trapping sediment for the BMP, assuming the BMPs are designed and installed in accordance with the Fact Sheets and based on accommodating the flow and volumes from the design storm.

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Interceptor Swale



DESCRIPTION

An interceptor swale is a small v-shaped, trapezoidal, or parabolic channel that collects runoff and directs it to a desired location. It can either have a natural grass lining or, depending on slope and design velocity, a protective lining of erosion control matting, crushed stone or concrete.

PRIMARY USE

The interceptor swale can either be used to direct sediment-laden flow from disturbed areas into a controlled outlet or to direct 'clean' runoff around disturbed areas. Since the swale is easy to install during early grading operations, it can serve as the first line of defense in reducing runoff across disturbed areas. As a method of reducing runoff across the disturbed construction area, it reduces the requirements of structural measures to capture sediment from runoff since the flow is reduced. By intercepting sediment laden flow downstream of the disturbed area, runoff can be directed into a sediment basin or other BMP for sedimentation as opposed to long runs of silt fence or other filtration method.

Base on site topography, swales can be effectively used in combination with diversion dikes.

APPLICATIONS

Common applications for interceptor swales include roadway projects, site development projects with substantial offsite flow impacting the site and sites with a large area(s) of disturbance. It can be used in conjunction with diversion dikes to intercept flows. Temporary swales can be used throughout the project to direct flows away from staging, storage and fueling areas along with specific areas of construction. Note that runoff which crosses disturbed areas or is directed into unstabilized swales must be routed into a treatment BMP such as a sediment basin.

Grass lined swales are an effective permanent stabilization technique. The grass effectively filters both sediment and other pollutants while reducing velocity.

DESIGN CRITERIA

- Maximum depth of flow in the swale shall be 1.5 feet based on a 2-year return period design storm peak flow. Positive overflow must be provided to accommodate larger storms.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

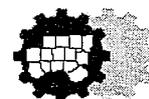
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=1.00

E-1



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Interceptor Swale

- The maximum contributing drainage area should be 5 acres or less depending on site conditions.
- Channels may be trapezoidal, parabolic, or v-shaped; however v-shaped channels may be difficult to stabilize, so they are generally used only where the volume and rate of flow is low.
- Side slopes of the swale shall be 3:1 or flatter.
- Minimum design channel freeboard shall be 6 inches.
- For grades less than 2 percent and velocities less than 6 feet per second, the minimum required channel stabilization shall be grass, erosion control mats or mulching. For grades in excess of 2 percent or velocities exceeding 6 feet per second, stabilization is required in the form of turf reinforcement mats (or a layer of crushed stone or rip-rap with appropriate size, gradation, and thickness depending on flow conditions). Velocities greater than 8 feet per second will require approval by the local jurisdiction and is discouraged.
- Check dams can be used to reduce velocities in steep swales. See BMP S-7, Check Dam, for design criteria.
- Interceptor swales must be designed for flow capacity based on Manning's Equation to ensure a proper channel section. Alternate channel sections may be used when properly designed and accepted.
- Consideration must be given to the possible impact that any swale may have on upstream or downstream conditions.
- Swales must maintain a negative grade to a controlled outlet.
- Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment-trapping device.

LIMITATIONS

Interceptor swales must be stabilized quickly upon excavation so as not to contribute to the erosion problem they are addressing.

Swales may be unsuitable to the site conditions (too flat or steep).

For permanent swales, the 1.5 feet maximum depth can be increased as long as provisions for public safety are implemented.

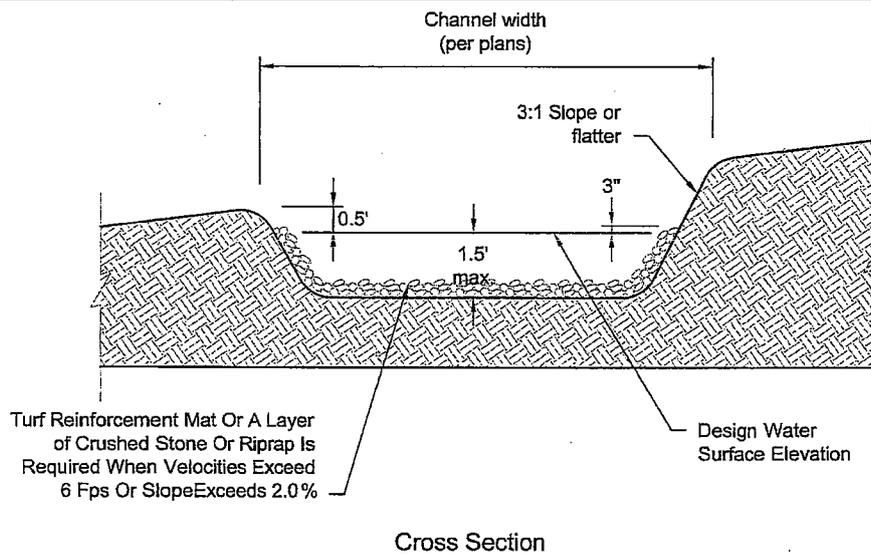
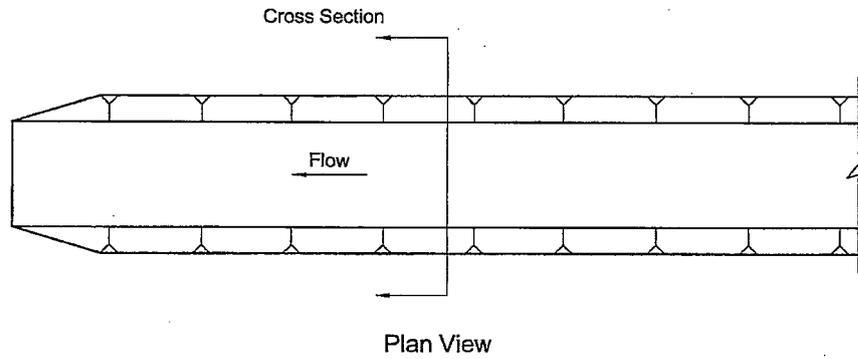
MAINTENANCE REQUIREMENTS

Swales should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) to locate and repair any damage to the channel or to clear debris or other obstructions so as not to diminish flow capacity. Damage from storms or normal construction activities such as tire ruts or disturbance of swale stabilization shall be repaired as soon as practical.

SPECIFICATIONS

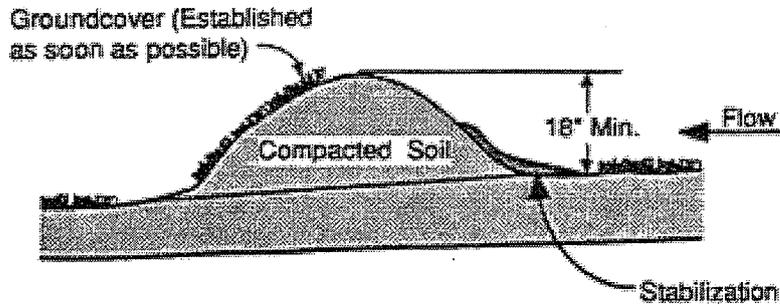
Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.6 Interceptor Swale.

Interceptor Swale



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Diversion Dike



DESCRIPTION

A diversion dike is a compacted soil mound, which redirects runoff to a desired location. The dike is typically stabilized with natural grass for low velocities or with stone or erosion control mats for higher velocities.

PRIMARY USE

The diversion dike is normally used to intercept offsite flow upstream of the construction area and direct the flow around the disturbed soils. It can also be used downstream of the construction area to direct flow into a sediment reduction device such as a sediment basin or protected inlet. The diversion dike serves the same purpose as an interceptor swale and, based on the topography of the site, can be used in combination with an interceptor swale.

APPLICATIONS

By intercepting runoff before it has the chance to cause erosion, diversion dikes are very effective in reducing erosion at a reasonable cost. They are applicable to a large variety of projects including site developments and linear projects such as roadways and pipeline construction. Diversion dikes are normally used as perimeter controls for construction sites with large amounts of offsite flow from neighboring properties. Used in combination with swales, the diversion dike can be quickly installed with a minimum of equipment and cost, using the swale excavation material to construct the dike. No sediment removal technique is required if the dike is properly stabilized and the runoff is intercepted prior to crossing disturbed areas.

Significant savings in structural controls can be realized by using diversion dikes to direct sheet flow to a central area such as a sediment basin or other sediment reduction structure if the runoff crosses disturbed areas

DESIGN CRITERIA

- The maximum contributing drainage area should be 5 acres or less depending on site conditions.
- Maximum depth of flow at the dike shall be 1 foot based on a 2-year return period design storm peak flow.
- Side slopes of the diversion dike shall be 3:1 or flatter.
- Minimum width of the embankment at the top shall be 2 feet.
- Minimum embankment height shall be 18 inches as measured from the toe of slope on the upgrade side of the berm.

Applications

Perimeter Control

Slope Protection

Sediment Trapping

Channel Protection

Temporary Stabilization

Permanent Stabilization

Waste Management

Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

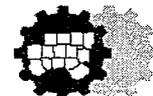
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=1.00

E-2



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Diversion Dike

- For grades less than 2 percent and velocities less than 6 feet per second, the minimum required channel stabilization shall be grass, erosion control mats or mulching. For grades in excess of 2 percent or velocities exceeding 6 feet per second, stabilization is required in the form of turf reinforcement mats (or a layer of crushed stone or rip-rap with appropriate size, gradation, and thickness depending on flow conditions). Velocities greater than 8 feet per second will require approval by the local jurisdiction and is discouraged.
- The dikes shall remain in place until all disturbed areas, which are protected by the dike are permanently stabilized unless other controls are put into place to protect the disturbed area.
- The flow line at the dike shall have a positive grade to drain to a controlled outlet.
- Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment-trapping device.
- Soil used in construction of the dike can be on-site material. It should be free of rocks larger than three inches in diameter and should be clay, silty clay or sandy clay with a plasticity index greater than 25. If only low PI material is available, it will be necessary to armor the slopes with stone or geotextile to prevent erosion of the dike.

LIMITATIONS

Compacted earth dikes require stabilization immediately upon placement so as not to contribute to the problem they are addressing.

The diversion dikes can be a hindrance to construction equipment moving on the site; therefore their locations must be carefully planned prior to installation.

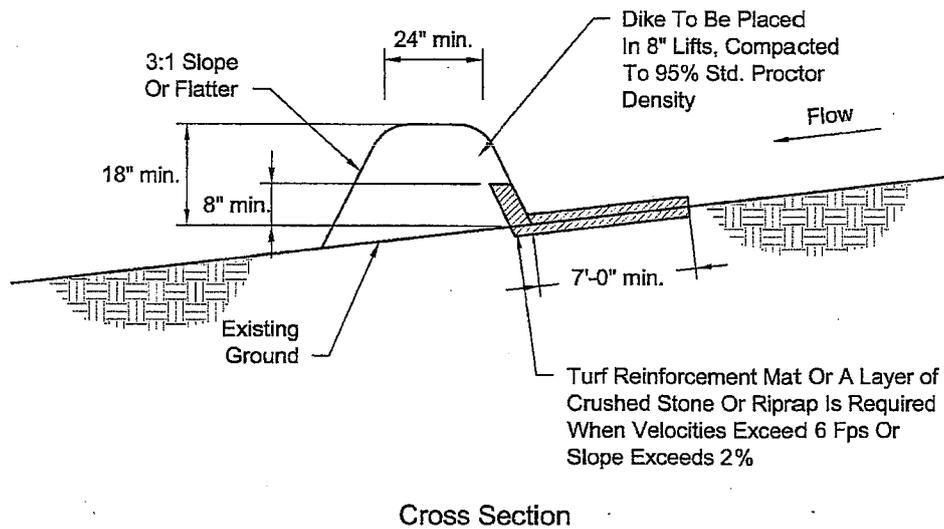
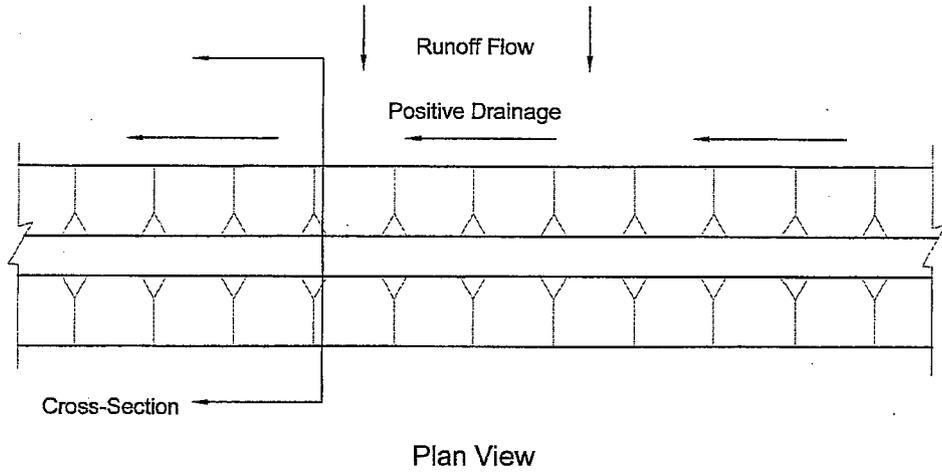
MAINTENANCE REQUIREMENTS

Dikes should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) to determine if silt is building up behind the dike, or if erosion is occurring on the face of the dike. Silt shall be removed in a timely manner. If erosion is occurring on the face of the dike, the face of the slopes shall either be stabilized through mulch or seeding or the slopes shall be flattened.

SPECIFICATIONS

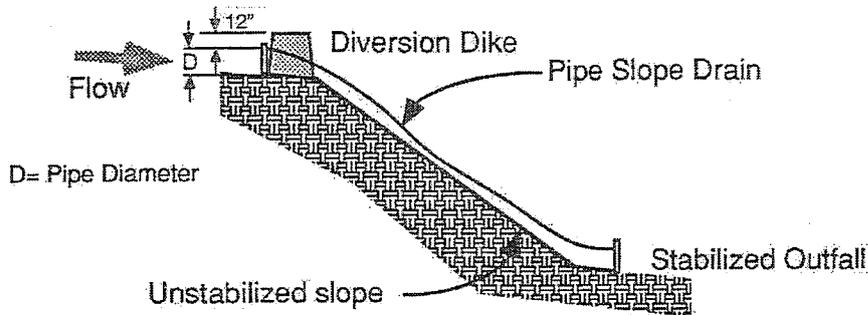
Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.7 Diversion Dike.

Diversion Dike



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Pipe Slope Drain



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

A pipe slope drain is a temporary (or permanent) pipeline typically utilizing flexible pipe that conveys runoff down unstabilized slopes. The drain is anchored on the upstream end with some form of headwall to limit erosion and secure the pipe.

PRIMARY USE

Pipe slope drains are used to protect preliminary and final graded slopes during establishment of temporary and permanent ground covers. They are used on sites with a long, unstabilized, steep slope area that is subject to erosion from overland flow. They are normally used in combination with interceptor swales or diversion dikes to direct the flow into the pipe area. The pipe slope drain can provide service for a relatively large area. It does not treat the runoff, therefore if the runoff contains sediment, treatment through a controlled outlet will be required before the flow is released offsite.

APPLICATIONS

Sites with large berms or grade changes such as roadway embankments are candidates for a pipe slope drain. Since provisions must be made to direct the flow into the pipe drain, some grading is normally required upstream of the pipe slope drain. Installed properly, slope erosion can be greatly reduced (but not entirely eliminated) through the use of the drain.

Pipe slope drains also require a stabilized outlet. This is critical since the velocities at the outfall are normally high. Velocity dissipators such as stone or concrete rip-rap are typically required to reduce the velocity and spread the flow, reducing erosion. Flow from a pipe slope drain should be routed to a sediment reduction practice (BMP with S prefix) through interceptor swales, diversion dikes or other suitable methods.

DESIGN CRITERIA

- The entrance to the pipe slope drain may be a standard corrugated metal pre-fabricated flared end section with an integral toe plate extending a minimum of 6 inches from the bottom of the end section.
- The grade of the entrance shall be 3 percent maximum.
- The berm at the entrance shall have a minimum height of the pipe diameter + 12" and a minimum width of 3 times the pipe diameter.
- All sections of the pipe slope drain shall be connected using watertight collars or gasketed watertight fittings.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

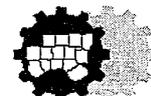
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Varies

E-3



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Pipe Slope Drain

- All sediment-laden runoff conveyed by the pipe slope drain shall be directed to a sediment trapping facility.
- The pipe shall be secured with hold down anchors spaced 10 feet on center.
- Temporary pipe slope drains are to be sized to accommodate runoff flows equivalent to a 10-year storm as calculated using the Rational Method and Manning's equation, but in no case shall pipes be sized smaller than shown on the following table:

Minimum Pipe Size	Maximum Contributing Drainage Area
12"	0.5 Acres
18"	1.5 Acres
21"	2.5 Acres
24"	3.5 Acres
30"	5.0 Acres

- Maximum drainage areas for individual pipe slope drains shall be 5 acres. For areas larger than 5 acres, additional drains shall be added.
- Both the entrance and outfall of the pipe slope drain should be properly stabilized. Grass can normally be used at the entrance, but armor type stabilization such as stone or concrete riprap is normally required to address the high velocities of the outfall.
- A riprap lined apron shall be excavated to accept the discharge from the pipe and dissipate the energy of the flow. The width of the bottom of the apron shall be 3 times the pipe diameter, and the length shall be a minimum of 6 times the pipe diameter of the drain pipe. The apron shall be a minimum of 12 inches in depth and shall be lined with riprap weighing between 50 and 150 pounds per stone at a thickness of 12 inches minimum. The apron shall be designed so that the released flow has a velocity less than 3 feet per second.

LIMITATIONS

- Drains must be located away from construction areas since the drain can easily be damaged by construction traffic.
- Grading is normally required upstream of the pipe slope drain in order to direct flow into the system. This can cause additional cost and maintenance. Securing the pipe to the slope can be difficult and require significant maintenance during the life of the system.
- In situations where pipe slope drains convey sediment-laden runoff, pipes can become clogged during large rain events causing water to overtop the diversion dike thereby creating a serious erosion condition.
- A pipe slope drain reduces erosion but does not prevent it or reduce the amount of sediment in runoff. Additional measures should be used in conjunction with the pipe slope drain to treat the flow.

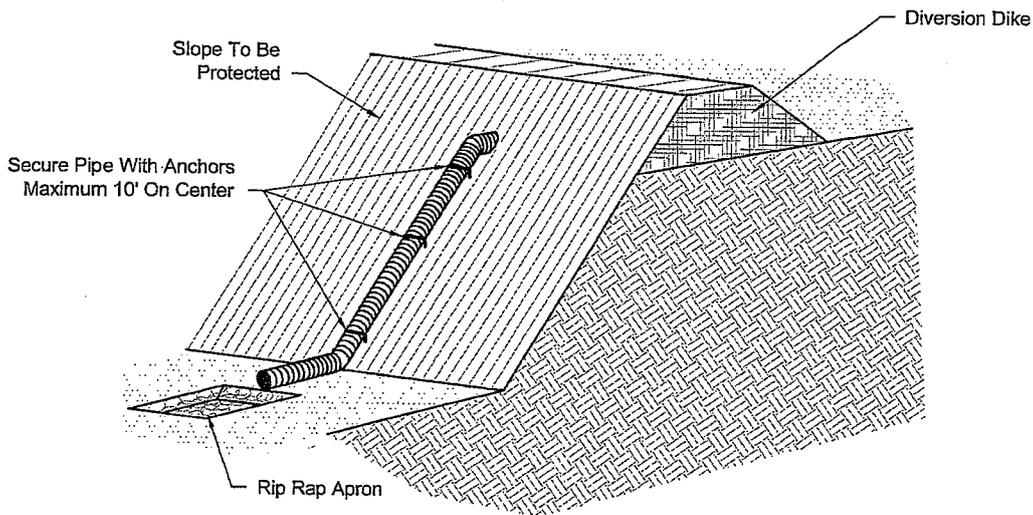
MAINTENANCE REQUIREMENTS

Pipe slope drains should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) to locate and repair any damage to joints or clogging of the pipe. In cases where the diversion dike has deteriorated around the entrance of the pipe, it may be necessary to reinforce the dike with sandbags or to install a concrete collar to prevent failure. Signs of erosion around the pipe drain should be addressed in a timely manner by stabilizing the area with erosion control mats, crushed stone, concrete, or other acceptable methods.

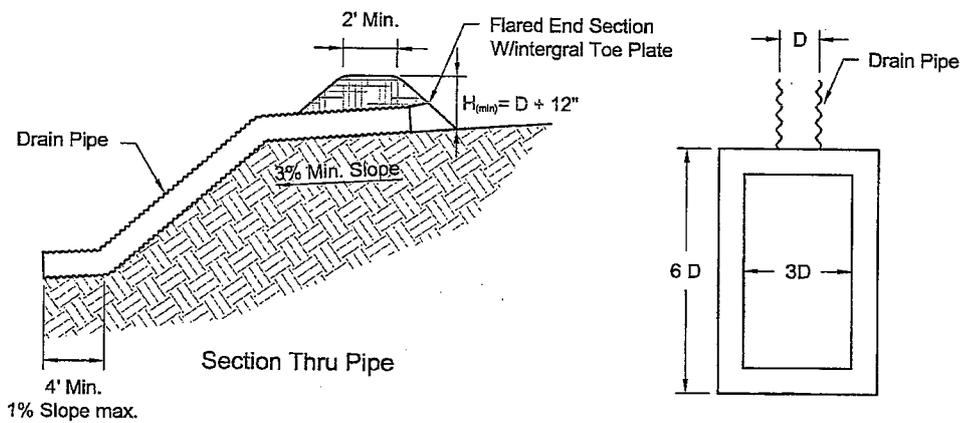
SPECIFICATION

Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.14 Pipe Slope Drain.

Pipe Slope Drain

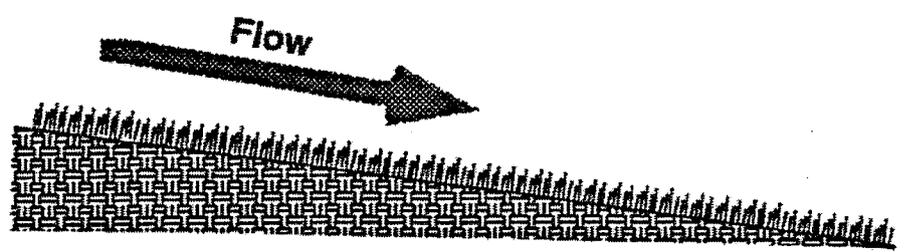
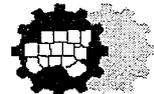


Isometric Plan View



Riprap shall consist of 50 to 150 pound stones placed in a layer of not less than 12 inches. The depth of the apron shall equal the pipe diameter but in no case shall it be less than 12 inches.

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<h1>Vegetation</h1> 	<h3>Applications</h3> <ul style="list-style-type: none"> Perimeter Control <input type="checkbox"/> Slope Protection Sediment Trapping <input type="checkbox"/> Channel Protection <input type="checkbox"/> Temporary Stabilization <input type="checkbox"/> Permanent Stabilization Waste Management Housekeeping Practices
<p>DESCRIPTION Vegetation, as a Best Management Practice, is the sowing or sodding of annual grasses, small grains, or legumes to provide interim and permanent vegetative stabilization for disturbed areas.</p> <p>PRIMARY USE Vegetation is used as a temporary or permanent stabilization technique for areas disturbed by construction. As a temporary control, vegetation is used to stabilize stockpiles and barren areas that are inactive for long periods of time. As a permanent control, grasses and other vegetation provide good protection from erosion along with some filtering for overland runoff. Subjected to acceptable runoff velocities, vegetation can provide a positive method of permanent storm water management as well as a visual amenity to the site.</p> <p>Other BMPs may be required to assist during the establishment of vegetation. These other techniques include erosion control matting, swales, and dikes to direct flow around newly seeded areas and proper grading to limit runoff velocities during construction.</p>	<p>Targeted Constituents</p> <ul style="list-style-type: none"> ● Sediment ● Nutrients Toxic Materials ○ Oil & Grease ○ Floatable Materials ○ Other Construction Wastes
<p>APPLICATIONS Vegetation effectively reduces erosion in swales, stockpiles, berms, mild to medium slopes, and along roadways. Vegetative strips can provide some protection when used as a perimeter control for utility and site development construction.</p> <p>In many cases, the initial cost of temporary seeding may be high compared to tarps or covers for stockpiles or other barren areas subject to erosion. This initial cost should be weighed with the amount of time the area is to remain inactive, since maintenance cost for vegetated areas is much less than most structural controls.</p>	<p>Implementation Requirements</p> <ul style="list-style-type: none"> ● Capital Costs ● Maintenance ○ Training ● Suitability for Slopes > 5%
<p>DESIGN CRITERIA <i>Surface Preparation</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Interim or final grading must be completed prior to seeding or sodding. <input type="checkbox"/> Install all necessary erosion structures such as dikes, swales, diversions, etc. prior to seeding or sodding. <input type="checkbox"/> When establishing vegetation from seed, groove or furrow slopes steeper than 3:1 on the contour line before seeding. 	<p>Legend</p> <ul style="list-style-type: none"> ● Significant Impact ● Medium Impact ○ Low Impact ? Unknown or Questionable Impact <p style="text-align: center;">Fe=0.90</p> <p style="text-align: center;">E-4</p> <div style="text-align: center;">  <p>North Central Texas Council of Governments</p> </div>

Vegetation

- Provide 4-6 inches of topsoil over rock, gravel or otherwise unsuitable soils. Poor quality topsoil should be amended with compost before applying seed or sod. Amendment should be three parts of topsoil to one part compost by volume thoroughly blended.
- Seed bed should be well pulverized, loose and uniform.

Plant Selection, Fertilization and Seeding

- Use only high quality, USDA certified seed.
- Use an appropriate species or species mixture adapted to local climate, soil conditions and season as shown below, or consult with the local office of the Natural Resource Conservation Service (NRCS) or Engineering Extension service as necessary for selection of proper species and application technique in this area.
- Seeding rate should be in accordance with the table below or as recommended by the NRCS or Engineering Extension service.
- Fertilizer shall be applied according to the manufacturer's recommendation with proper spreader equipment. Typical application rate for 10-10-10 grade fertilizer is 10 lbs. per 1,000 ft².
- If hydro-seeding is used, do not mix seed and fertilizer more than 30 minutes before application.
- Evenly apply seed using cyclone seeder, seed drill, cultipacker, terraseeding, or hydroseeder.
- Provide adequate water to aid in establishment of vegetation.
- Use appropriate mulching techniques where necessary, especially during cold periods of the year.

Sodding

- Sod shall be St. Augustine grass, common bermudagrass, buffalograss, an approved hybrid of common Bermudagrass or an approved zoysiagrass.
- The sod should be mowed prior to sod cutting so that the height of the grass shall not exceed 2-inches and should not be harvested or planted when its moisture condition is so excessively wet or dry that its survival shall be affected.
- Sod shall be planted within 3-days after it is excavated.
- In areas subject to direct sunlight, pre-moisten prepared sod bed by watering immediately prior to placing sod.
- Sodded areas shall be thoroughly watered immediately after they are planted.

ADDITIONAL GUIDANCE

- Establishing a good vegetative cover is dependent of the season of the year. Projects that commence in the fall of the year may not be candidates for vegetation used as a BMP.
- Where vegetation is used in swales and channels it may be necessary to use sod, rather than seeding, to establish an erosion resistant surface to accommodate rainfall runoff flows.
- Where vegetation is used for perimeter control, the use of sod is necessary for a fifteen-foot width.
- Mulch should be used to enhance vegetative growth, in that mulch protects seeds from heat, prevents soil moisture loss, and provides erosion protection until the vegetation is established.
- Fertilizers have both beneficial and adverse effects. Fertilizers provide nutrients to the vegetation, but also fertilizers are a source of nutrients to streams and lakes. In this latter regard they are a pollutant. The use of native vegetation rather than exotics reduces the need of fertilizer. Organic fertilizers are generally preferred over chemical fertilizers from the standpoint of environmental conditions.
- Steep slopes represent a problem for establishing vegetation. Bonded Fiber Matrix or Mechanically Bonded Fiber Matrix products applied with a tackifier are useful for establishing vegetation on slopes.

TEMPORARY VEGETATION

The table on the following page lists recommended plant species for the North Central Texas region depending on the season for planting.

Vegetation

RECOMMENDED GRASS MIXTURE FOR TEMPORARY EROSION CONTROL:

SEASON	COMMON NAME	RATE (LBS/ACRE)
Aug 15 - Nov 30	Tall Fescue	4.0
	Western Wheat Grass	5.0
	Wheat (Red, Winter)	30.0
May 1 - Aug 31	Foxtail Millet	30.0
Feb 15 - May 31	Annual Rye	20.0
Sep 1 - Dec 31		

PERMANENT VEGETATION

Grass seed for permanent vegetation can be sown at the same time as seeding for temporary (annual) vegetation. Drought tolerant native vegetation is recommended rather than exotics as a long-term water conservation measure. Native grasses can be planted as seed or placed as sod. Buffaloe 609, for example, is a hybrid grass that is placed as sod. Fertilizers are not normally used to establish native grasses, but mulching is effective in retaining soil moisture for the native plants.

RECOMMENDED NATIVE GRASSES FOR PERMANENT EROSION CONTROL

GRASS		RATE
Buffaloe Grass	Full Turf Application	3-4 lbs/1000 sqft
Blue Grama	Full Turf Application	2 lbs/1000 sqft
Side Oats Grama	Applied with other native seed	¼ lb/1000 sqft

LIMITATIONS

Vegetation is not appropriate for areas subjected to heavy pedestrian or vehicular traffic. As a temporary technique, vegetation may be costly when compared to other techniques. Vegetation may require a period of days to weeks before becoming established. Lack of water and lack of or improper use of soil amendments (compost, fertilizer, etc.) will usually result in poor turf establishment. Alternate erosion control (e.g. mulching, sodding vegetative strips, etc.) should be used until vegetation can be established.

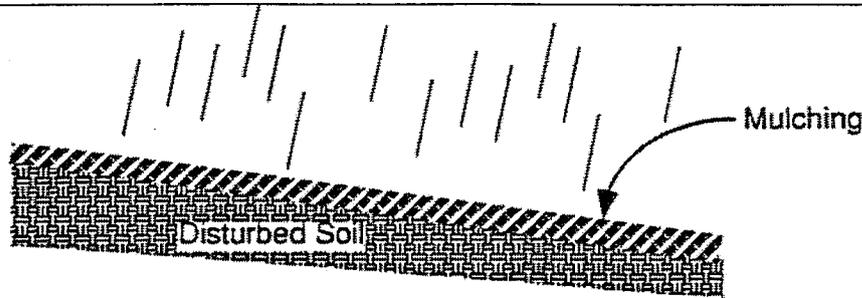
Vegetation is not appropriate for rock, gravel or coarse-grained soils unless 4 to 6 inches of topsoil is applied.

MAINTENANCE REQUIREMENTS

Protect newly seeded areas from excessive runoff and traffic until vegetation is established. A watering and fertilizing schedule will be required as part of the SWPPP to assist in the establishment of the vegetation. Vegetation should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) to ensure that the plant material is established properly and remains healthy. Bare spots shall be reseeded and/or protected from erosion by mulch or other BMP. Accumulated sediment deposited by runoff should be removed to prevent smothering of the vegetation. In addition, determine the source of excess sediment and implement appropriate BMPs to control the erosion.

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Mulching



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

Mulching is the application of a layer of chopped straw, hay, chipped site vegetation, or other material, which is spread uniformly over barren areas to reduce the effects of erosion from rainfall. Types of mulch include organic materials (e.g. compost mixtures), straw, wood chips, bark, or other fibers. Another form of mulch, which has been commercialized, uses straw or other material with organic and inorganic binding systems which are typically sprayed over the control area. Some of these products may be very effective on steeper slopes where there is no vehicular or foot traffic to disrupt the application until vegetation is established. Mulch should not contain chipped manufactured boards or chemically treated wood such as particleboard, railroad ties or similar treated wood. Hay should not be used as a replacement for straw unless it can be determined that it is weed and seed free.

PRIMARY USE

Mulch is used to temporarily and/or permanently stabilize bare or freshly seeded areas. It protects the soil from erosion and moisture loss by lessening the effects of wind, water, and sunlight. It also decreases the velocity of sheet flow, thereby reducing the volume of sediment-laden water flow leaving the mulched area.

APPLICATIONS

Mulch may be used on most construction-related disturbed area for surface protection including:

- Freshly seeded or planted areas,
- Areas at risk due to the time period being unsuitable for growing vegetation,
- Areas that are not conducive to seeding or planting.
- Steep slopes (e.g. >3H:1V), provided the mulch is anchored to the soil by use of a combination of tackifiers and netting, or crimping.

DESIGN CRITERIA

Mulch may be used by itself or in combination with netting or other anchors to promote soil stabilization.

- Choice of mulch depends largely on slope, climate, and soil type in addition to availability of materials.
- Mulch should be applied in an even and uniform manner where concentrated water flow is negligible.
- The application of straw mulch should be approximately 2 tons dry straw per acre spread uniformly across the area. Other forms of mulch, such as wood chips or chopped site vegetation, should be placed in thicknesses of two-inches or greater over the area.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

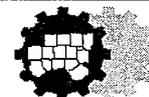
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.90

E-5



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Council of Governments

Mulching

- Straw mulch should be anchored by application of a fiber mulch binder, by the application of a synthetic liquid mulch binder, by using a tractor-drawn crimper to punch into the soil, or by placing a netting above the mulch stapled to the ground, as required.
- Mulch hydraulically applied with tackifiers and binding agents is commercially available as a bonded fiber matrix (BFM) which may be particularly effective on slopes steeper than 2.5:1.
- Wood chips are suitable for areas that will not require mowing frequently and are heavy enough that they do not require anchoring. They do, however, deplete nitrogen from the soil, which is a necessary nutrient for all plants. To alleviate this condition, wood chips must be treated with 12 pounds of ammonium nitrate per ton of mulch used.
- Bark chips are popular for ornamental applications, as they do not require anchoring, do not decompose very rapidly, and serve as an excellent insulation material. When using bark chips, it is not necessary to treat for nitrogen deficiency or to fertilize.
- Compost and wood mulch mixtures should be a blend of 50% untreated wood mulch with 50% compost measured by volume. Wood mulch should be less than or equal to 5 in. in length with 95% passing a 2-in. screen and less than 30% passing a 1-in. screen. The compost shall meet the Physical Requirements specified in Table 1 of TxDOT Special Specification 1058, Compost, which can be found in Appendix F.
- Prior to the placement of any mulch, the area to be protected must be graded in accordance with plans.
- Fertilization and soil treatment should then be done prior to placement of mulch with the exceptions of when seed is to be applied by means of hydro-seed or when seed is distributed following straw mulch spreading during winter months.
- Organic mulches may be distributed by hand or by mechanical means, but to be effective a complete covering is required.
- Refer to the table on the following page for additional guidance.

LIMITATIONS

Mulches are subject to removal by wind or water under severe climatic conditions.

Mulches lower the soil temperature, which may result in longer seed germination periods.

Mulch should not be applied within the ordinary high-water mark of surface waters, as it can be a potential floatation material.

MAINTENANCE REQUIREMENTS

Mulched areas should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) for thin or bare spots caused by natural decomposition or weather related events. Mulch in high traffic areas should be replaced on a regular basis to maintain uniform protection. Excess mulch should be brought to the site and stockpiled for use during the maintenance period to dress problem spots.

SPECIFICATION

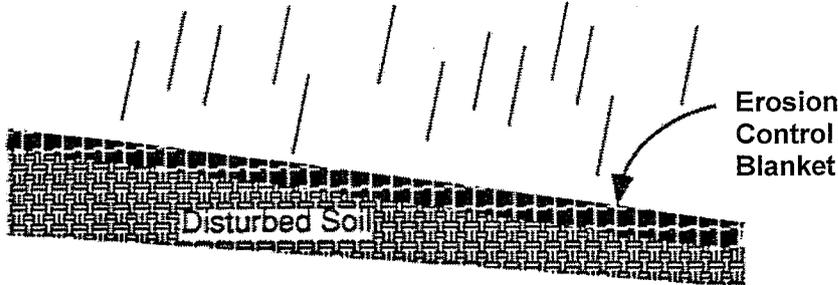
Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.17 Mulching.

Mulching

Mulch Standards and Guidelines			
Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried, free from undesirable seed and from coarse material.	2"-3" thick, Approx 2 tons per acre.	Cost-effective when applied with adequate thickness. Hay can be used if weed and seed free. In windy areas and on steep slopes, straw must be held in place by crimping, using a tackifier, or covering with netting.
Chipped Site Vegetation	Should include gradation from fine to coarse to promote interlocking properties. Maximum size 6 inches in length.	2" minimum thickness over area; approx. 10 tons per acre.	Cost-effective manner of disposing of vegetative debris from site. Do not place in areas subject to flooding. Decomposition of chipped vegetation competes with nutrients important to subsequent grass establishment. Mulch must be free of waste materials such as plastic bag, metal debris, etc.
Wood Mulch and Compost Mixture	Compost shall meet the Physical Requirements (Table 1) of Appendix F.	2" minimum thickness over area; approx. 10 tons per acre.	Special caution is advised regarding the source and composition of wood mulches. Determine whether the preparation include weed seed control. Wood mulches are an excellent soil amendment, ultimately improving the organic content of the soil.
Hydromulch	No growth inhibiting factors.	Approx 25-30 lbs per 1000 sf or 1500-2000 lbs per acre.	Apply with a hydromulcher. Fibers should be kept to less than ¼ inch to prevent clogging equipment. Best used in conjunction with seed at time of application.
Bonded Fiber Matrix	Hydraulically applied mulch with tackifiers and binding agents.	Follow the manufacturer's recommendations. (typically 3000 lbs per acre or greater).	Bonded fiber matrix may be particularly effective on slopes steeper than 2.5:1.

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Erosion Control Blankets



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

An erosion control blanket (ECB) is a temporary degradable erosion prevention product placed over disturbed areas to limit the effects of erosion due to rainfall impact and runoff across barren soil. Erosion control blankets are manufactured by a wide variety of vendors addressing a wide variety of conditions such as slope and functional longevity. Blankets are typically constructed of natural materials such as coir (coconut husk) fibers, excelsior (wood) or straw covered on both sides by degradable synthetic netting.

PRIMARY USE

Erosion control blankets are designed to hold seed and soil in place until vegetation is established on disturbed areas. They can be used on any disturbed areas, but are particularly effective for slopes and embankments. When used in combination with sediment trapping BMPs such as silt fence or wattles, blankets may be used as a perimeter control with or without vegetation.

DESIGN CRITERIA

- The type and class of erosion control mat must be specified as appropriate for the slope of the area to be protected and the anticipated length of service.
- ECBs should meet the applicable "Minimum Performance Standards for TxDOT" as published by TxDOT in its "Erosion Control Report" and/or be listed on the most current annual "Approved Products List for TxDOT" applicable to TxDOT Item 169 Soil Retention Blanket and its Special Provisions.
- Prior to the installation of any erosion control matting, all rocks, dirt clods, stumps, roots, trash and any other obstructions that would prevent the mat from lying in direct contact with the soil shall be removed. Anchor trenching shall be located along the entire perimeter of the installation area, except for small areas with less than 2% slope.
- Installation and anchoring shall conform to the recommendations shown within the manufacturer's published literature for the approved erosion control blanket. Particular attention must be paid to joints and overlapping material.
- After appropriate installation, the blankets should be checked for uniform contact with the soil; security of the lap joints, and flushness of the staples with the ground.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

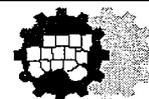
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.90

E-6



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Erosion Control Blankets

LIMITATIONS

Care must be exercised in specifying the proper Erosion Control Blanket product for the intended application.

For application requiring a permanent erosion control product, or for stabilizing slopes greater than 2H:1V or lining open conveyance channels, Turf Reinforcement Mats should be utilized.

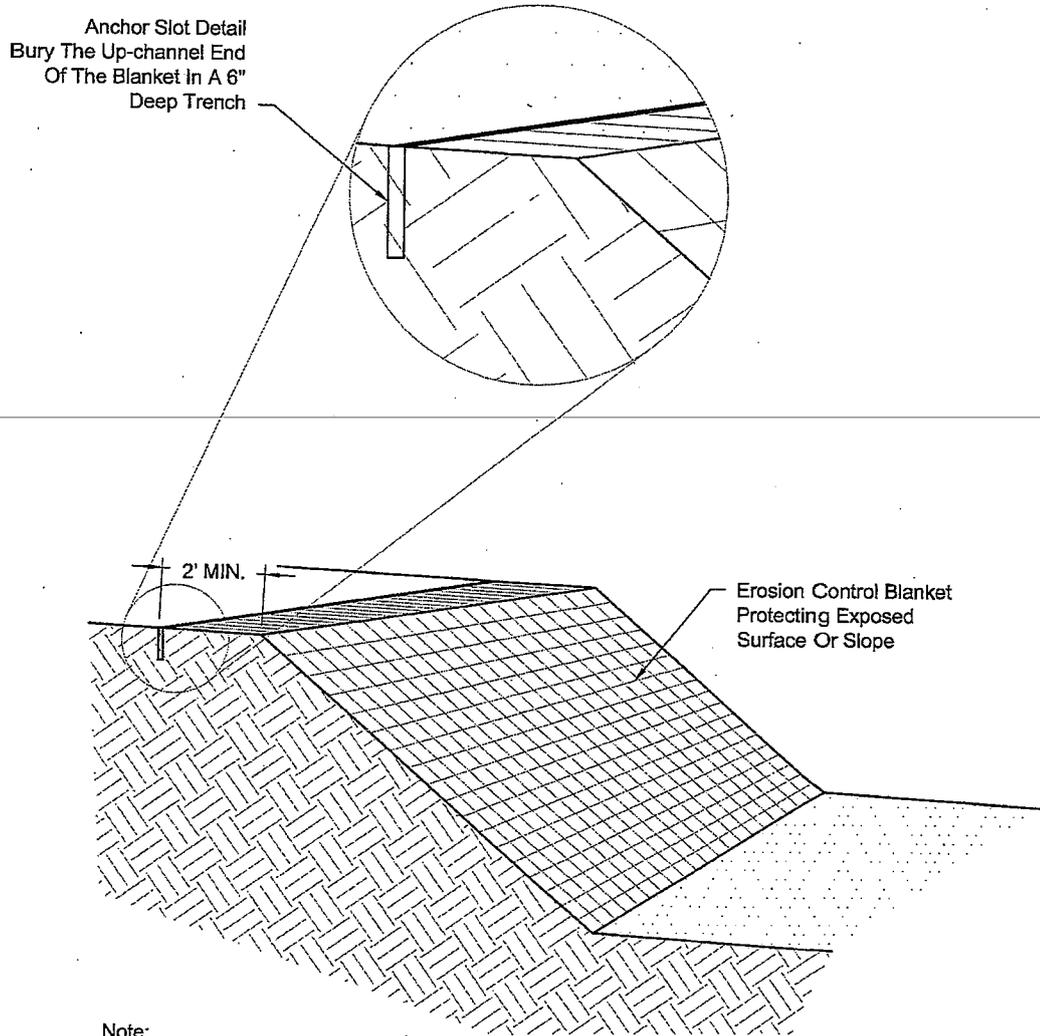
MAINTENANCE REQUIREMENTS

Erosion Control Blankets should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) for bare spots caused by weather related events. Missing or loosened blankets must be replaced or re-anchored. Also check for excess sediment deposited from runoff. Remove sediment and/or replace blanket as necessary. In addition, determine the source of excess sediment and implement appropriate BMPs to control the erosion.

SPECIFICATIONS

Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.16 Erosion Control Blankets.

Erosion Control Blankets

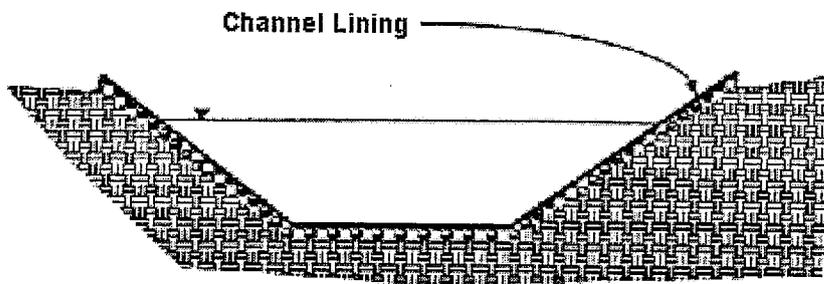


Note:
Anchoring of the Erosion Control Blankets Shall Be
Done In Accordance With the Manufacturer's Recommendations.

December 2003

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Channel Protection



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

Channel protection includes a variety of erosion prevention techniques including vegetation, turf reinforcement mats, and riprap. Channel protection is required to protect the sides and bottom of open channels from erosion caused by storm water flows.

PRIMARY USE

The information presented in this Fact Sheet primarily addresses protection of temporary channels constructed to convey storm water runoff on a property under development. Grass-lining should be adequate for most temporary channels, although some situations may require additional protection provided by turf reinforcement mats or riprap.

There are separate requirements for design of permanent open channels in the iSWM Design Manual for Development/Redevelopment and/or local drainage manual; however, permanent channels must also be protected from erosion during the construction phase.

APPLICATIONS

Channel protection for constructed open channels conveying concentrated storm water runoff. Examples include:

- discharge from diversion dikes or interceptor swales;
- flows to and discharges from sediment traps or basins;
- roadside drainage channels;
- conveyances in low areas.

This Fact Sheet does not apply to alterations of natural channels. Contact the local jurisdiction and/or the Corps of Engineers, Fort Worth District Office for information on regulatory requirements.

DESIGN CRITERIA

Temporary Channel Design

- All temporary channels shall be designed to carry the peak runoff for the 10-year design storm without eroding. Permanent channels must be designed in accordance with the iSWM Design Manual for Development/Redevelopment (and/or local requirements).
- Channels may be trapezoidal, parabolic, or v-shaped; however v-shaped channels may be difficult to stabilize, so they are generally used only where the volume and rate of flow is low.
- Side slopes shall be 3:1 or flatter to aid in the establishment of vegetation and/or for maintenance.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

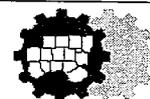
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Varies

E-7



North Central Texas
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Channel Protection

Grass-Lining

- Grass-lining is appropriate for grades less than 2 percent and velocities less than 6 feet per second.
- If the design velocity of a channel to be vegetated by seeding exceeds 2 feet per second, Erosion Control Blankets (Fact Sheet E-6) must be used to provide protection and assist in establishing the vegetation.
- Refer to the Fact Sheet E-4, Vegetation, for appropriate vegetation types and information on establishment of vegetation. In addition, consult manufacturer's literature where erosion control blankets are used.

Turf Reinforcement Mat Lining

- Turf reinforcement mats (TRMs) provide long-term erosion protection in channels where flow conditions exceed the ability of vegetation alone to withstand erosive forces (grades in excess of 2 percent or velocities exceeding 6 feet per second).
- Turf reinforcement mats may provide channel protection for conditions of up to approximately 8 lbs/ft² shear stress. The appropriate TRM product must be selected in accordance with the manufacturer's specifications to meet the design flow conditions.
- Turf reinforcement mats are generally preferred over stone stabilization.
- TRM installation and anchoring shall conform to the recommendations shown within the manufacturer's published literature.
- Refer to the Fact Sheet E-4, Vegetation, for appropriate vegetation types and information on establishment of vegetation. In addition, consult the TRM manufacturer's literature for special considerations.

Crushed Stone and Riprap

- As an alternate to turf reinforcement mats, a layer of crushed stone or rip-rap with appropriate size, gradation, and thickness depending on flow conditions may also be used for grades in excess of 2 percent or velocities exceeding 6 feet per second.
- The size and gradation of the stone or riprap and thickness of the lining must be designed appropriately for the flow conditions to prevent the lining from washing away.
- Riprap should be placed on a lining of geotextile fabric to prevent soil movement into or through the riprap. The geotextile must be keyed in at the top of the bank.

LIMITATIONS

The vegetation for grass-lined channels may be difficult to establish unless the seedbed is protected from high flows until the seed germinates and matures.

MAINTENANCE REQUIREMENTS

Channel protection measures should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) for signs of bare spots, erosion, or excessive sediment deposition. Bare spots or areas experiencing erosion should be repaired immediately by replacing lining material. Where excessive sediment is discovered, remove sediment and repair lining as necessary. In addition, determine the source of excess sediment and implement appropriate BMPs to control the erosion.

While vegetation is being established for grass-lining and turf reinforcement mats, check frequently to ensure proper growing conditions and adequate coverage. Also, remove any accumulated sediment in the channel bottom frequently to prevent damage to the vegetation.

SPECIFICATIONS

No specification for construction of temporary channel protection is currently available in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments.

Dust Control

DESCRIPTION

Dust control includes those measures necessary to prevent wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

PRIMARY USE

Dust control is applied in areas (including roadways) subject to surface and air movement to dust where on-site and off-site impacts to roadways, drainage ways, or surface waters are likely.

DESIGN CRITERIA

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition, if stable. Maintain the original cover as long as practicable.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until dampened sufficiently to prevent dust and repeat as needed. Do not apply water in quantities to cause runoff.
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.

SPECIFICATIONS

No specification for construction of this item is currently available in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients/Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

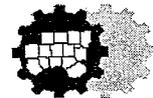
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- ◐ Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

E-8

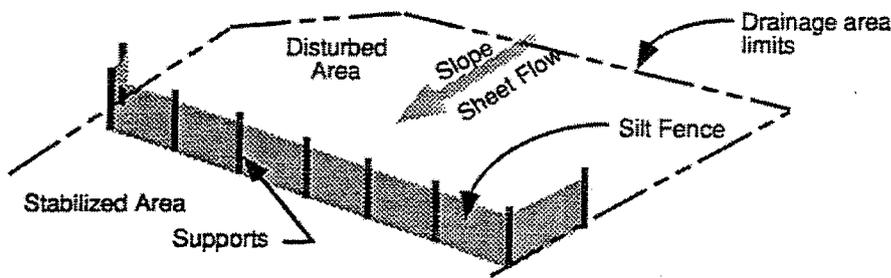


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Council of Governments

December 2003

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Silt Fence



Applications

- | |
|-------------------|
| Perimeter Control |
| Slope Protection |
| Sediment Trapping |
- Channel Protection
 - Temporary Stabilization
 - Permanent Stabilization
 - Waste Management
 - Housekeeping Practices

DESCRIPTION

A silt fence consists of geotextile fabric supported by wire mesh netting or other backing stretched between either wooden or metal posts with the lower edge of the fabric securely embedded six-inches in the soil. The fence is typically located downstream of disturbed areas to intercept runoff in the form of sheet flow. A silt fence provides both filtration and time for sediment settling by reducing the velocity of the runoff.

PRIMARY USE

Silt fence is normally used as perimeter control located downstream of disturbed areas. It is only feasible for non-concentrated, sheet flow conditions. If it becomes necessary to place a silt fence where concentrated flows may be experienced (e.g. where two silt fences join at an angle, or across minor channels or gullies), it will be necessary to reinforce the silt fence at that area by a rock berm or sand bag berm, or other structural measures that will support the silt fence.

APPLICATIONS

Silt fence is an economical means to treat overland, non-concentrated flows for all types of projects. Silt fences are used as perimeter control devices for both site developers and linear (roadway) type projects. They are most effective with coarse to silty soil types. Due to the potential of clogging and limited effectiveness, silt fences should be used with caution in areas that have predominantly clay soil types. In this latter instance a soils engineer or soil scientist should confirm the suitability of silt fence for that application

DESIGN CRITERIA

- Fences are to be constructed along a line of constant elevation (along a contour line) where possible.
- Maximum drainage area shall be 0.25 acre per 100 linear feet of silt fence.
- Maximum flow to any 20 foot section of silt fence shall be 1 CFS.
- Maximum distance of flow to silt fence shall be 200 feet or less. If the slope exceeds 10 percent the flow distance shall be less than 50 feet.
- Maximum slope adjacent to the fence shall be 2:1.
- If 50% or less soil, by weight, passes the U.S. Standard sieve No. 200; select the apparent opening size (A.O.S.) to retain 85% of the soil.
- If 85% or more of soil by weight, passes the U.S. Standard sieve No. 200, silt fences shall not be used unless the soil mass is evaluated and deemed suitable by a soil scientist or geotechnical engineer concerning the erodibility of the soil mass, dispersive characteristics, and the potential grain-size characteristics of the material that is likely to be eroded.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

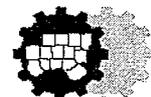
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.75

S-1



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Council of Governments

Silt Fence

- ❑ Stone overflow structures or other outlet control devices shall be installed at all low points along the fence or spaced at approximately 300 feet if there is no apparent low point.
- ❑ Filter stone for overflow structure shall be 1-1/2" washed stone containing no fines. Angular shaped stone is preferable to rounded shapes.
- ❑ Silt fence fabric must meet the following minimum criteria:
 - Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 90-lbs.
 - Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 60-lbs.
 - Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 280-psi.
 - Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 70 (max) to No. 100 (min).
 - Ultraviolet Resistance, ASTM D4355. Minimum 70 percent.
- ❑ Fence posts shall be galvanized steel and may be T-section or L-section, 1.3 pounds per linear foot minimum, and 4 feet in length minimum. Wood Posts may be used depending on anticipated length of service and provided they are 4 feet in length minimum and have a nominal cross section of 2 inches by 4 inches for pine or 2 inches by 2 inches for hardwoods.
- ❑ Silt fence shall be supported by galvanized steel wire fence fabric as follows:
 - 4" x 4" mesh size, W1.4 /1.4, minimum 14-gauge wire fence fabric;
 - Hog wire, 12 gauge wire, small openings installed at bottom of silt fence;
 - Standard 2" x 2" chain link fence fabric; or
 - Other welded or woven steel fabrics consisting of equal or smaller spacing as that listed herein and appropriate gauge wire to provide support.
- ❑ A 6-inch wide trench is to be cut 6 inches deep at the toe of the fence to allow the fabric to be laid below the surface and backfilled with compacted earth or gravel to prevent bypass of runoff under the fence. Fabric shall overlap at abutting ends a minimum of 3 feet and shall be joined such that no leakage or bypass occurs.
- ❑ Sufficient room for the operation of sediment removal equipment shall be provided between the silt fence and other obstructions in order to properly maintain the fence.
- ❑ The ends of the fence shall be turned upstream to prevent bypass of storm water.

LIMITATIONS

Minor ponding will likely occur at the upstream side of the silt fence, which could result in minor localized flooding. Silt fences are not intended for use as check dams in swales or low areas subject to concentrated flow. Silt fences shall not be used where soil conditions prevent a minimum toe-in depth of 6 inches or installation of support posts to a depth of 12 inches.

Silt fence can interfere with construction operations; therefore planning of access routes onto the site is critical. Silt fence can fail structurally under heavy storm flows, creating maintenance problems and reducing the effectiveness of the system.

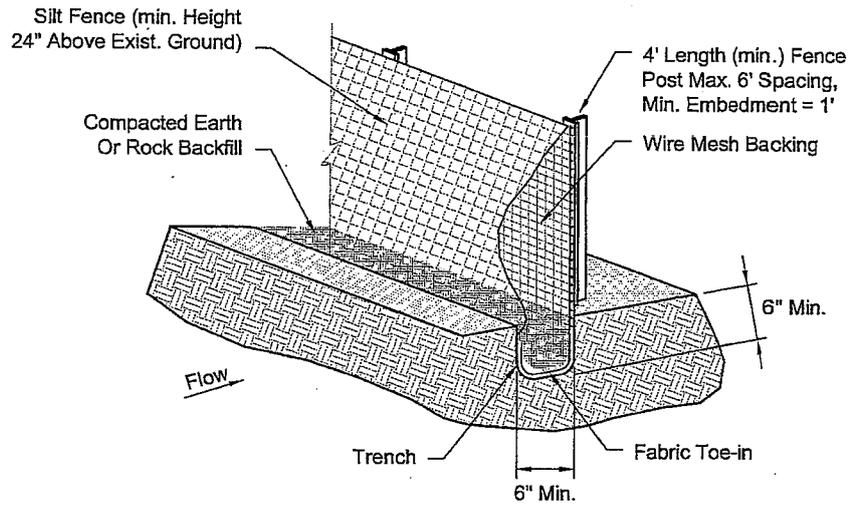
MAINTENANCE REQUIREMENTS

Silt fence should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) for buildup of excess sediment, undercutting, sags, and other failures. Sediment should be removed when it reaches approximately one-half the height of the fence. In addition, determine the source of excess sediment and implement appropriate BMPs to control the erosion. If the fabric becomes damaged or clogged, it should be repaired or replaced as necessary.

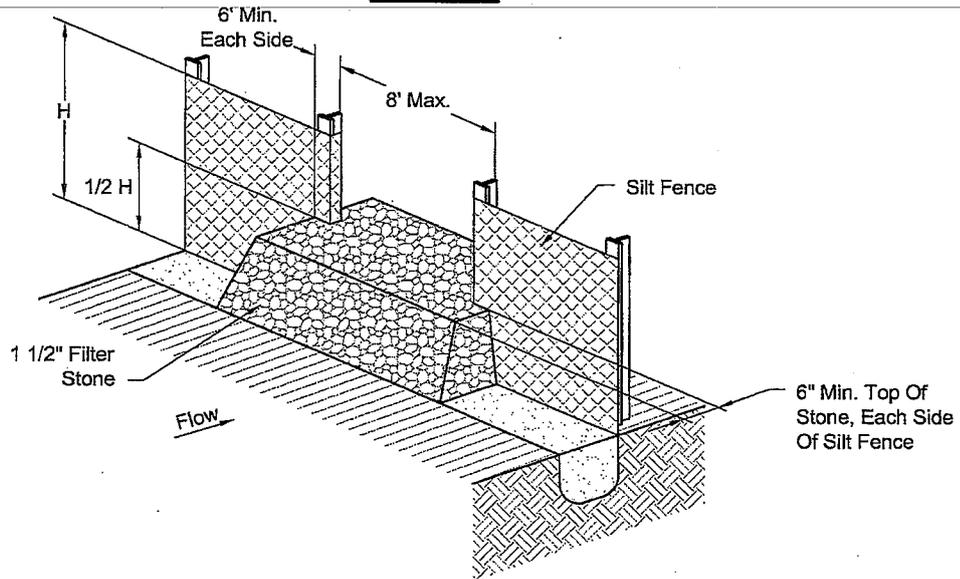
SPECIFICATION

Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.5 Silt Fence.

Silt Fence & Stone Overflow Structure



Silt Fence

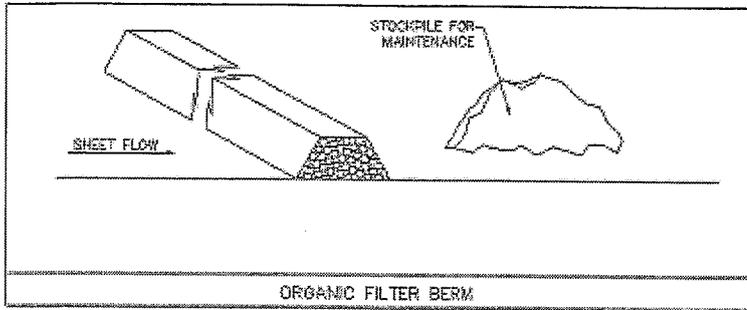


Stone Overflow Structure

December 2003

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Organic Filter Berm



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

Organic filter berms are linear berms constructed of a mix of compost and mulch and placed on a contour to control runoff and filter sediment. The organic filter berm provides both filtration and time for sediment settling by reducing the velocity of the runoff.

PRIMARY USE

Organic filter berms are very well suited to sites with small disturbed drainage areas that are not subjected to concentrated flows and that will ultimately be seeded, sodded, or landscaped.

APPLICATIONS

Properly designed, the organic filter berm is economical due to the ease of emplacement and because it can be tilled into the soil at the end of project, limiting the cost of removal and adding to the organic content of the soil. The berms are used as perimeter control devices for both development sites and linear (roadway) type projects. They are most effective with coarse to silty soil types.

DESIGN CRITERIA

- Filter berms are to be constructed along a line of constant elevation (along a contour line) where possible.
- Maximum drainage area shall be 0.25 acre per 100 linear feet of filter berm.
- Maximum flow to any 20 foot section of filter berm shall be 1 CFS.
- Maximum distance of flow to berm shall be 200 feet or less. If the slope exceeds 10 percent the flow distance shall be less than 50 feet.
- Maximum slope adjacent to the filter berm shall be 2:1.
- Trapezoidal shaped berms should be 1-1/2 to 3 feet high with a top width of 2 to 3 feet and a base of 3 to 5 feet wide.
- Windrow (triangular) shaped berms should be 1 to 2 feet high and 2 to 4 feet wide.
- Organic filter berms shall be constructed of a mixture of 50% compost and 50% wood mulch. The compost shall meet the Physical Requirements specified in Table 1 of TxDOT Special Specification 1058, Compost, which can be found in Appendix F. Mulch shall be untreated wood chips less than or equal to 5 inches in length with 95% passing a 2-inch screen and less than 30% passing a 1-inch screen.
- Organic filter berms may be seeded with a seed loading of 1 lb. per 10 linear feet for small berms (1ft. by 2 ft.) or 2.25 lbs per 10 linear ft. for larger berms (1.5 ft. by 3 ft.)

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

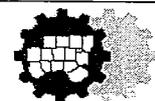
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.75

S-2



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Organic Filter Berm

LIMITATIONS

Minor ponding will likely occur at the upstream side of the organic filter berm that could result in minor localized flooding.

Berms should not be constructed in swales or low areas since they will be subject to concentrated flow and may be overtopped resulting in failure of the filter berm.

Berms can interfere with construction operations; therefore planning of access routes onto the site is critical. Typically excess material is stockpiled on site for repairs to berms disturbed by construction activity.

MAINTENANCE REQUIREMENTS

Filter berms should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) for buildup of excess sediment, undercutting, and other failures. Silt must be removed when it reaches $\frac{1}{2}$ the height of the berm. Silt may be raked from the disturbed side of the device to clean side the berm for the first few times that it becomes clogged to prevent ponding. Repeated clogging of the berm at one location will require replacement of the organic filter material or may require installation of another BMP to prevent failure of the berm.

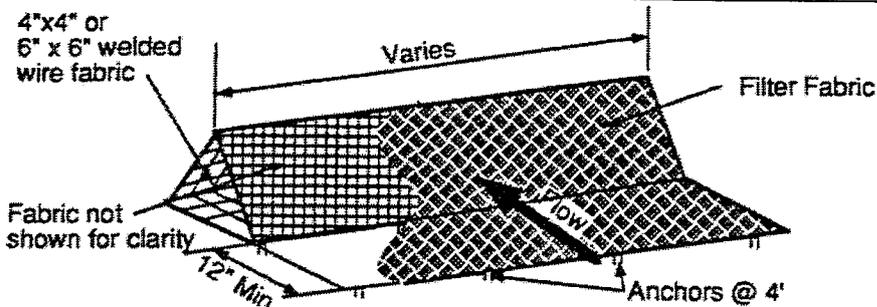
Dimensions of the berm must be maintained by replacing organic filter material when necessary.

There shall be no signs of erosion, breaching or runoff around or under the berm.

SPECIFICATION

No specification for construction of this item is currently available in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments.

Triangular Sediment Filter Dike



Applications

- | |
|--------------------|
| Perimeter Control |
| Slope Protection |
| Sediment Trapping |
| Channel Protection |
- Temporary Stabilization
Permanent Stabilization
Waste Management
Housekeeping Practices

DESCRIPTION

A Triangular Sediment Filter Dike is a self-contained silt fence consisting of filter fabric wrapped around welded wire fabric shaped into a triangular cross section. While similar in use to a silt fence, the dike is reusable, sturdier, transportable, and can be used on paved areas or in situations where it is impractical to install embedded posts for support.

PRIMARY USE

Triangular filter dikes are used in place of silt fence, treating sediment flow at the perimeter of construction areas and at the perimeter of the site. Also, the dikes can serve as stream protection devices by preventing sediment from entering the streams or as check dams in small swales.

Triangular sediment filter dikes are especially useful for construction areas surrounded by pavement, where silt fence, filter berm, or other BMP installation is impractical.

APPLICATIONS

Triangular dikes are used to provide perimeter control by detaining sediment on a disturbed site with drainage that would otherwise flow onto adjacent properties. Triangular dikes also serve as sediment trapping devices when used in areas of sheet flow across disturbed areas or are placed along stream banks to prevent sediment-laden sheet flow from entering the stream. The dikes can be subjected to more concentrated flows and a higher flow rate than silt fence.

DESIGN CRITERIA

- Dikes can be used on a variety of surfaces ranging from disturbed earth to pavement.
- Dikes are to be installed along a line of constant elevation (along a contour line).
- Maximum drainage area shall be 0.25 acre per 100 linear feet of dike.
- Maximum flow to any 20 foot section of dike shall be 1 CFS.
- Maximum distance of flow to dike shall be 200 feet or less. If the slope exceeds 10 percent the flow distance shall be less than 50 feet.
- Maximum slope adjacent to the dike shall be 2:1.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.75

S-3



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Triangular Sediment Filter Dike

- If 50% or less of soil, by weight, passes the U.S. Standard sieve No. 200, select the apparent opening size (A.O.S.) to retain 85% of the soil.
- If 85% or more of soil, by weight, passes the U.S. Standard Sieve No. 200, triangular sediment dike shall not be used due to clogging.
- The filter fabric shall meet the material requirements specified in BMP Fact Sheet S-1, Silt Fence.
- The internal support for the dike structure shall be 6 gauge 6" x 6" wire mesh folded into triangular form eighteen (18) inches on each side.
- Filter material shall lap over ends six (6) inches to cover dike-to-dike junction; each junction shall be secured by shoat rings.
- Tie-in to the existing grade should be accomplished by (i) embedding the fabric six-inches below the top of ground on the upslope side, (ii) extending the fabric to form a 12-inch skirt on the upstream slope and covering it with 3 to 5 inches of crushed rock, or (iii) entrenching the base of the triangular dike four-inches below ground. For (ii) above, the skirt and the upslope portion of the triangular dike skeleton should be anchored by metal staples on two-foot centers, driven a minimum of six inches into the ground (except where crossing pavement or exposed limestone).
- Sand bags or large rock should be used as ballast inside the triangular dike section to stabilize the dike against the effects of high flows.
- Sufficient room for the operation of sediment removal equipment shall be provided between the dike and other obstructions in order to properly remove sediment.
- The ends of the dike shall be turned up grade to prevent bypass of storm water.

LIMITATIONS

Effects of ponding caused by the dikes should be evaluated for effects on adjacent areas.

Triangular sediment filter dikes are not effective for conditions where there are substantial concentrated flows or when they are not constructed along a contour line due to the potential for flow concentration and overtopping.

MAINTENANCE REQUIREMENTS

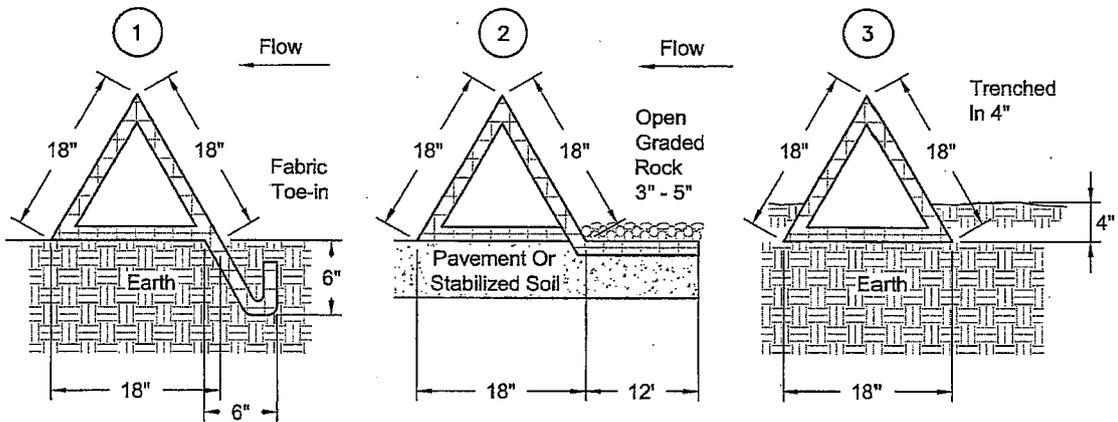
Triangular sediment filter dikes should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A). Sediment should be removed when it reaches approximately 6 inches in depth. If the fabric becomes clogged, it should be cleaned or, if necessary, replaced. If structural deficiencies are found, the dike should be immediately repaired or replaced.

As with silt fence, integrity of the filter fabric is important to the effectiveness of the dike. Overlap between dike sections must be checked on a regular basis and repaired if deficient.

SPECIFICATION

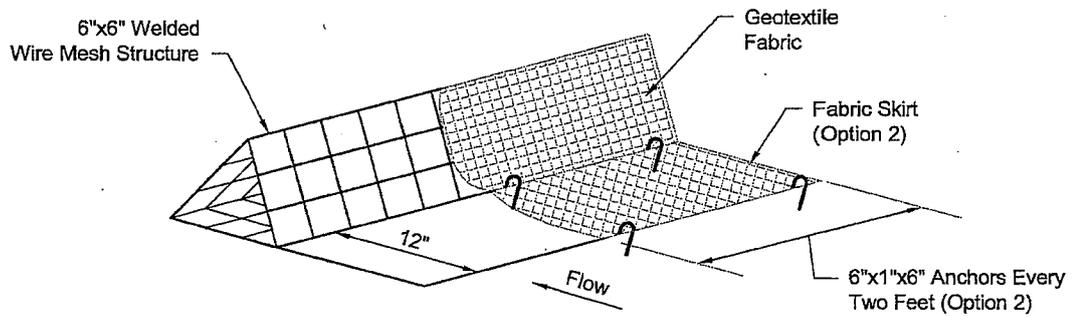
Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.8 Triangular Sediment Filter Dike.

Triangular Sediment Filter Dike



Cross Section Of Installation Options

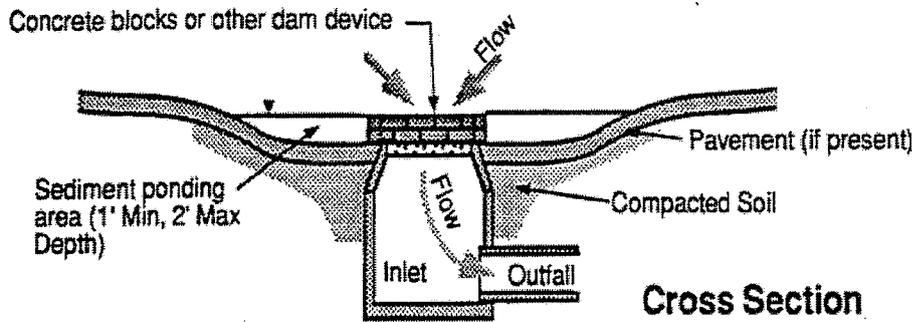
1. Toe-in 6" Min.
2. Fabric Skirt Weighted With Rock
3. Trenched In 4"



December 2003

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Inlet Protection



DESCRIPTION

Inlet protection consists of a variety of methods of intercepting sediment at low point inlets through the use of stone, filter fabric, inlet inserts, and other materials. This is normally located at the inlet, providing either detention or filtration to reduce sediment and floatable materials in storm water.

PRIMARY USE

Inlet protection should be considered a secondary defense in site erosion control due to the limited effectiveness and applicability of the technique. It is normally used in new developments that include new inlets or roads with new curb inlets or during major repairs to existing roadways.

Inlet protection has limited use in developed areas due to the potential for flooding, traffic safety, pedestrian safety, and maintenance problems. Inlet protection can reduce sediment in storm sewer systems by serving as a back up system to onsite controls or by reducing sediment loads from controls with limited effectiveness.

APPLICATIONS

Different inlet protection variations are used for different conditions as follows:

- Filter barrier protection (similar to a silt fence barrier around the inlet) is appropriate when the drainage area is less than one acre and the basin slope is less than five (5) percent. This type of protection is not applicable in paved areas.
- Block and gravel (crushed stone, recycled concrete is also appropriate) protection is used when flows exceed 0.5 c.f.s. and it is necessary to allow for overtopping to prevent flooding.
- Excavated impoundment protection around a drop inlet may be used for protection against sediment entering a storm drain system. With this method, it is necessary to install weep holes to allow the impoundment to drain completely. The impoundment shall be sized such that the volume of excavation shall be equal to 1800 to 3600 cubic feet per acre of disturbed area entering the inlet for full effectiveness.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

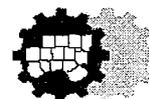
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Varies

S-4



North Central Texas
Council of Governments

Inlet Protection

DESIGN CRITERIA

- Special caution must be exercised when installing inlet protection on publicly traveled streets or in developed areas. Ensure that inlet protection is properly designed, installed and maintained to avoid flooding of the roadway or adjacent properties and structures.
- Filter fabric protection shall be designed and maintained in a manner similar to silt fence.
- Where applicable, filter fabric, posts, and wire backing shall meet the material requirements specified in BMP Fact Sheet S-1, Silt Fence.
- Filter gravel shall be ¾ inch (Block and Gravel Protection) or 1-1/2 to 2 inch (Excavated Impoundment Protection) washed stone containing no fines. Angular shaped stone is preferable to rounded shapes.
- Concrete blocks shall be standard 8" x 8" x 16" concrete masonry units.
- Maximum depth of flow shall be eight (8) inches or less.
- Positive drainage is critical in the design of inlet protection. If overflow is not provided for at the inlet, excess flows shall be routed through established swales, streets, or other watercourses to minimize damage due to flooding.
- Filter Barrier Protection
Silt Fence shall consist of nylon geotextile supported by wire mesh, W1.4 X W1.4, and galvanized steel posts set a minimum of 1 foot depth and spaced not more than 6 feet on center. A 6 inch wide trench is to be cut 6 inches deep at the toe of the fence to allow the fabric to be laid below the surface and backfilled with compacted earth or gravel. This entrenchment prevents any bypass of runoff under the fence.
- Block and Gravel Protection (Curb and Drop Inlets)
Concrete blocks are to be placed on their sides in a single row around the perimeter of the inlet, with ends abutting. Openings in the blocks should face outward, not upward. ½" x ½" wire mesh shall then be placed over the outside face of the blocks covering the holes. Filter stone shall then be piled against the wire mesh to the top of the blocks with the base of the stone being a minimum of 18 inches from the blocks. Alternatively, where loose stone is a concern (streets, etc.), the filter stone may be placed in appropriately sized geotextile fabric bags. Periodically, when the stone filter becomes clogged, the stone must be removed and cleaned in a proper manner or replaced with new stone and piled back against the wire mesh.
- Excavated Impoundment Protection
An excavated impoundment shall be sized to provide a storage volume of between 1800 and 3600 cubic feet per acre of disturbed area. The trap shall have a minimum depth of one foot and a maximum depth of 2 feet as measured from the top of the inlet and shall have sideslopes of 2:1 or flatter. Weep holes are to be installed in the inlet walls to allow for the complete dewatering of the the trap. When the storage capacity of the impoundment has been reduced by one-half, the silt shall be removed and disposed in a proper manner.
- Inlet inserts are commercially available to remove sediment, constituents (pollutants) adsorbed to sediment, and oil and grease. Maintenance is required to remove sediment and debris that could clog the filters. Inlet inserts must have a bypass function to prevent flooding from clogging or high flows.

LIMITATIONS

Special caution must be exercised when installing inlet protection on publicly traveled streets or in developed areas. Ensure that inlet protection is properly designed, installed and maintained to avoid flooding of the roadway or adjacent properties and structures.

Inlet protection is only viable at low point inlets. Inlets that are on a slope cannot be effectively protected because storm water will bypass the inlet and continue downstream, causing an overload condition at inlets downstream.

Inlet Protection

MAINTENANCE REQUIREMENTS

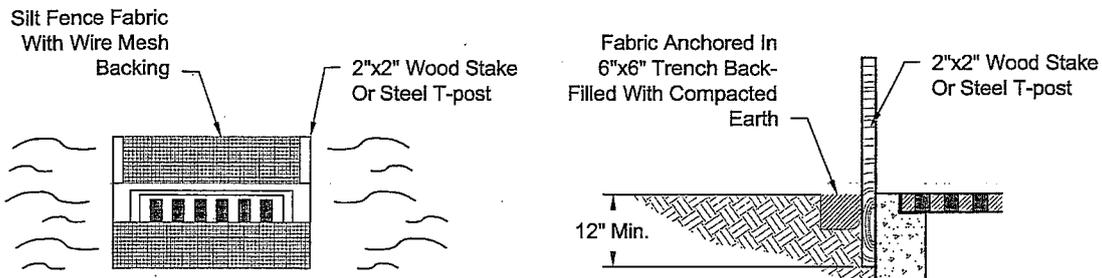
Inlet protection should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A). When silt fence is used and the fabric becomes clogged, it should be cleaned or, if necessary, replaced. Also, sediment should be removed when it reaches approximately one-half the height of the inlet protection device. If a sump is used, sediment should be removed when the volume of the basin is reduced by 50%.

For systems using filter stone, when the filter stone becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of stone at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill material and put new stone around the inlet.

SPECIFICATION

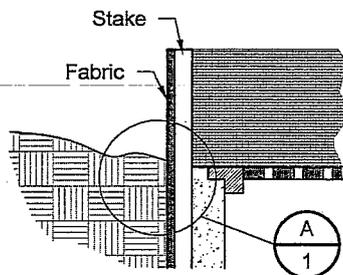
Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.15 Inlet Protection.

Inlet Protection - Filter Barrier

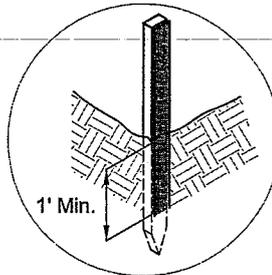


Perspective View

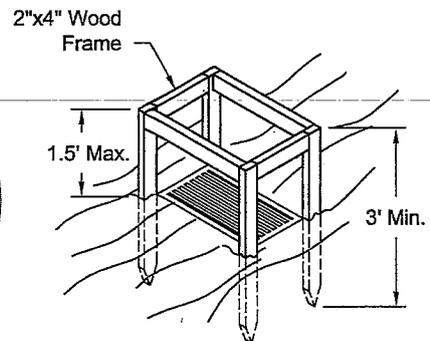
I. Standard Installation



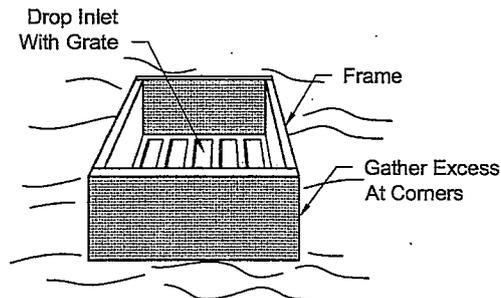
Elevation Of Stake And Fabric Orientation



Detail A



Perspective View

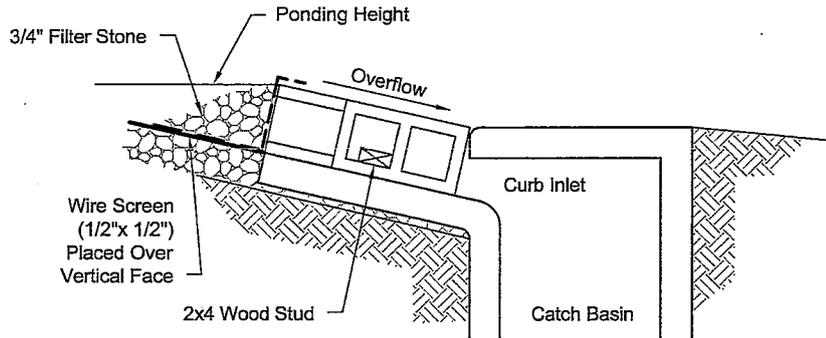


Perspective View

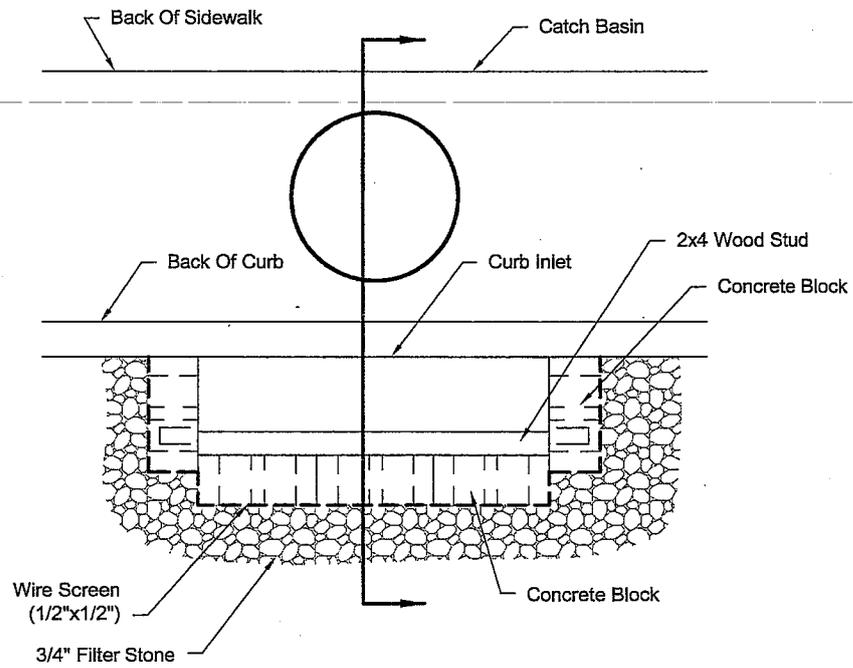
Specific application:

This method of inlet protection is applicable where the inlet drains a relatively flat area (slope no greater than 5%) where the inlet sheet or over-land flows (not to exceed 1 c.F.S.) are typical. The method shall not apply to inlets receiving concentrated flows such as in streets or highway medians.

Inlet Protection - Curb

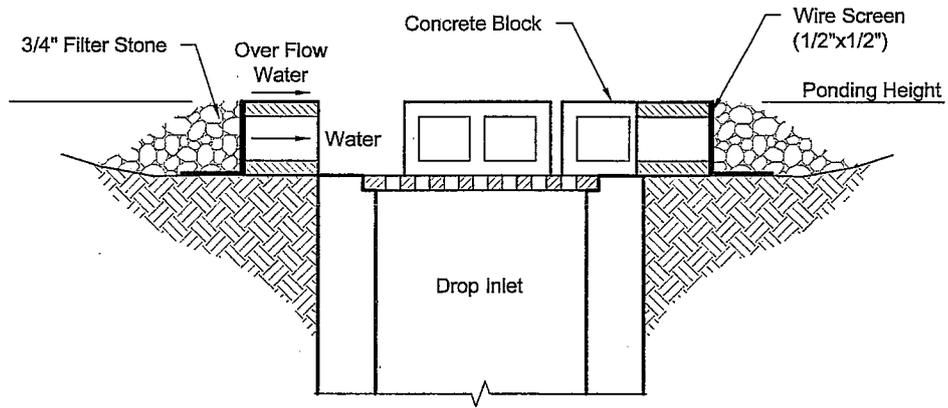


Cross Section

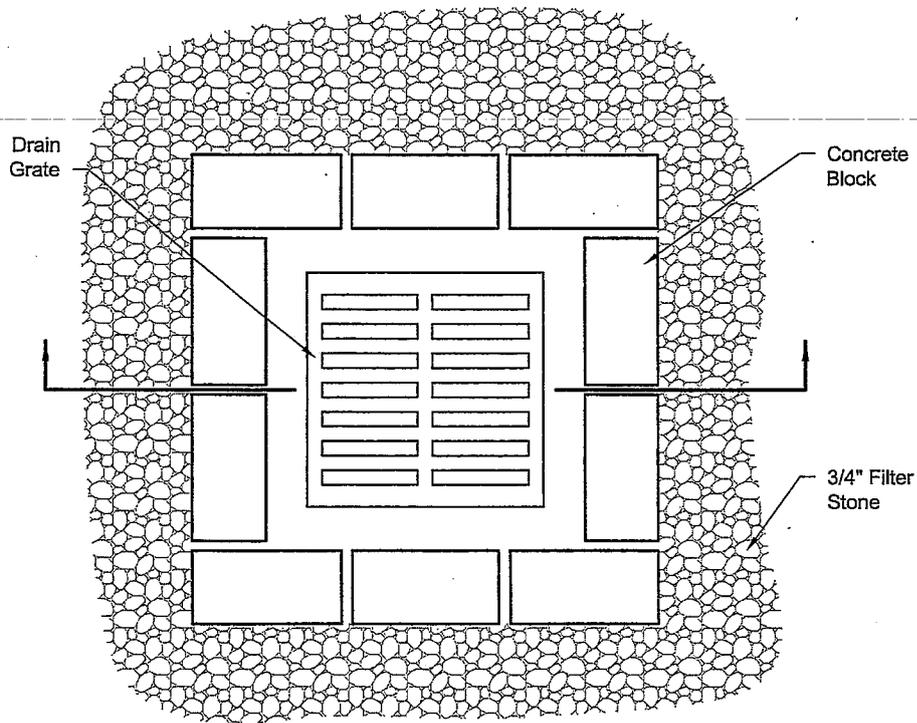


Plan View

Inlet Protection – Drop Inlet

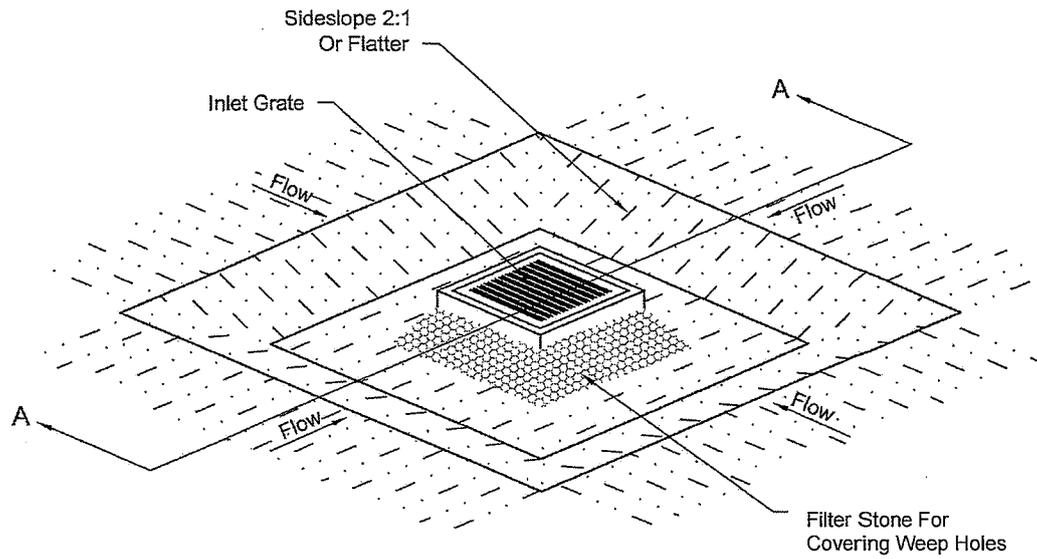


Cross Section

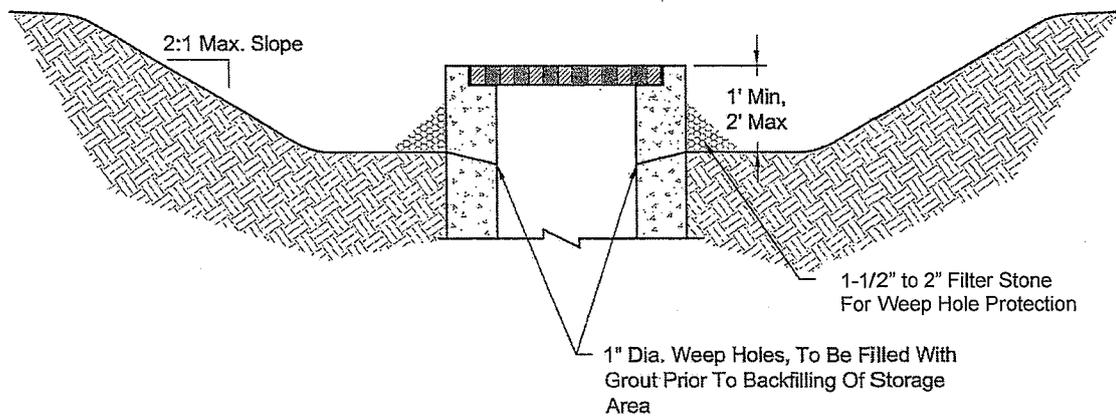


Plan View

Inlet Protection - Excavated Impoundment



Isometric Plan View

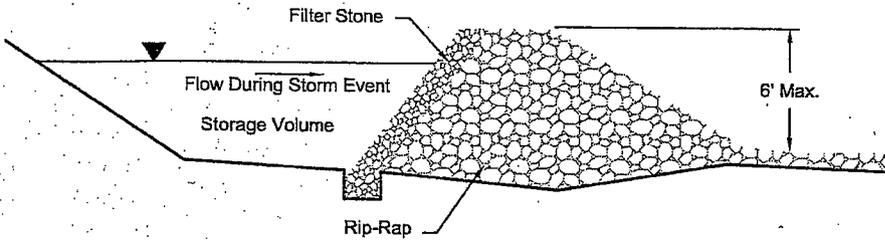


Section A-A

December 2003

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Stone Outlet Sediment Trap



DESCRIPTION

A stone outlet sediment trap is a small ponding area formed by placing a stone embankment with an integral stone filter outlet across a drainage swale for the purpose of detaining sediment-laden runoff generated by construction activities. The sediment trap detains runoff long enough to allow most of the suspended sediment to settle while still allowing for diffused flow of runoff.

PRIMARY USE

A sediment trap is used in situations where flows are concentrated in a drainage swale or channel. The sediment trap reduces velocities and allows for settling of sediment while allowing the area behind the trap to de-water. This is normally used for long term (18 months or less) applications in which a sediment basin is not feasible due to site or construction method restrictions.

APPLICATIONS

Temporary stone outlet sediment traps are installed at locations where concentrated flows require a protected outlet to contain sediment or spread flow prior to discharge.

DESIGN CRITERIA

- The maximum drainage area contributing to the trap shall be 10 acres. For larger drainage areas a sediment basin should be used.
- The minimum storage volume shall be 1800 cubic feet per acre of disturbed land draining to the device.
- The surface area of the design storage area shall be 1% of the area draining to the device.
- The maximum embankment height shall be 6 feet as measured from the toe of the slope on the downstream side
- Minimum width of the embankment at the top shall be 2 feet.
- Embankment slope shall be 1.5:1 or flatter.
- The embankment shall have a depressed area to serve as the outlet with a minimum width of 4 feet.
- A six inch minimum thickness layer of ¾ to 2 inch (1-½ inch nominal) well graded filter stone shall be placed on the face of the embankment.
- The embankment shall be comprised of well graded stone with a size range of 6 to 12 inches in diameter. The stone may be enclosed in wire mesh or gabion basket and anchored to the channel bottom to prevent washing away.
- The outlet shall be designed to have a minimum freeboard of 6" at design flow.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

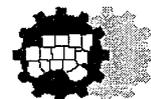
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.85

S-5



North Central Texas
Council of Governments

Stone Outlet Sediment Trap

- ❑ The embankment shall be placed on geotextile fabric meeting the following minimum criteria:
 - Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 250-lbs
 - Puncture Rating, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 135-lbs.
 - Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 420-psi.
 - Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 20 (max).
- ❑ The geotextile fabric, covered with a layer of stone, shall extend past the base of the embankment on the downstream side a minimum of 2 feet.

LIMITATIONS

Limited applications due to cost of construction, availability of materials, and the amount of land required.

Can cause minor upstream flooding, possibly impacting construction operations.

MAINTENANCE REQUIREMENTS

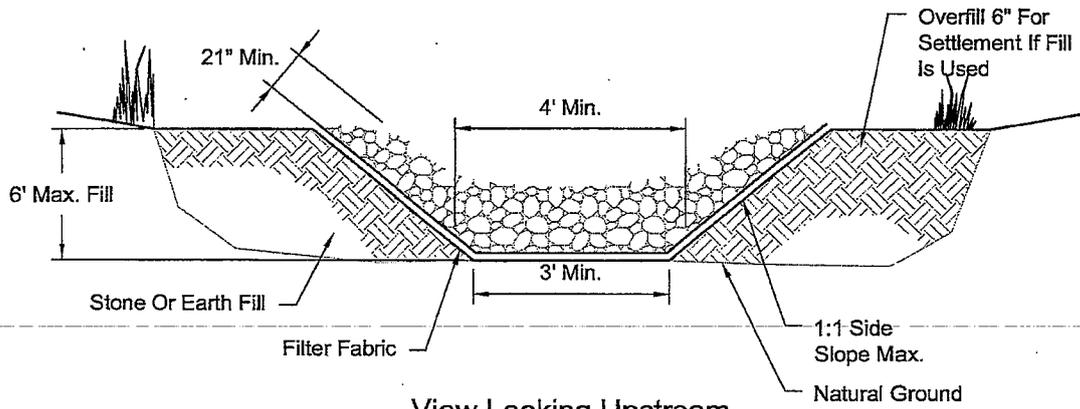
The stone outlet structure should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) to check for clogging of the void spaces between stones. If the aggregate appears to be silted in such that efficiency is diminished, the stone should be replaced.

Deposited sediment shall be removed when the depth of sediment is equal to one-third of the height of the embankment as measured from the original toe of slope to the crest of the outlet, or has reached a depth of one foot, whichever is less. The removed sediment shall be stockpiled or redistributed in areas that are protected from erosion.

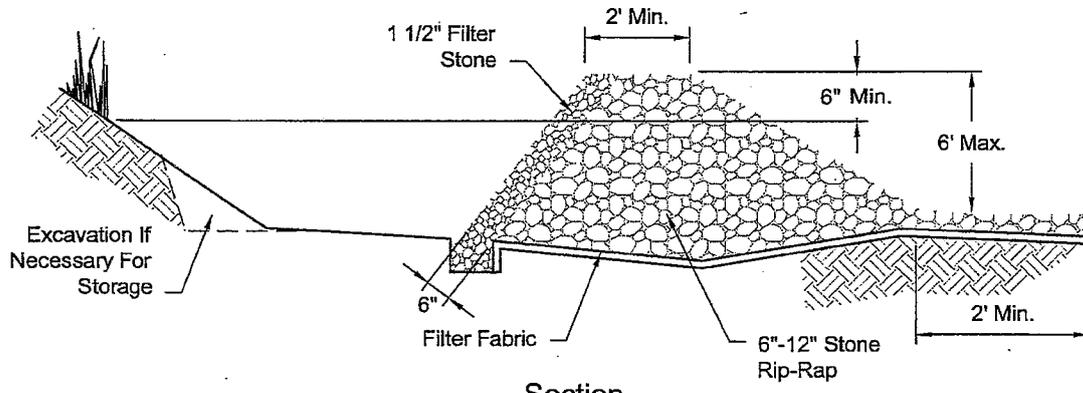
SPECIFICATION

Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.12 Stone Outlet Sediment Trap.

Stone Outlet Sediment Trap



View Looking Upstream

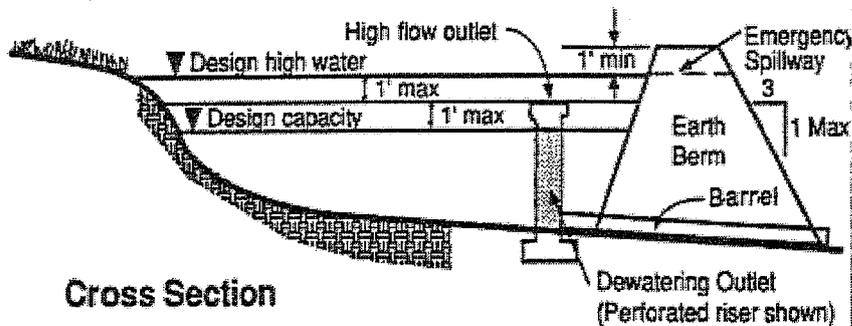


Section

December 2003

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Sediment Basin



Cross Section

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping**
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

A sediment basin is a pond area with a controlled outlet in which sediment-laden runoff is directed to allow settling of suspended sediment from the runoff. It provides treatment for the runoff as well as detention and controlled release of runoff, minimizing flood impacts downstream.

PRIMARY USE

Sediment basins should be used for all sites with adequate open space to locate the basin and where the site topography directs a majority of the site drainage into the basin. For sites with disturbed areas of 10 acres and larger that are part of a common drainage area, sediment basins are necessary as either temporary or permanent controls, unless specific site conditions limit their use.

APPLICATIONS

Sediment basins serve as treatment devices which can be used on a variety of project types. They are normally used in site development projects in which large areas of land are available for the basin, a minor stream or off-line drainage way crosses the site, or a specific water feature is planned for the site. Sediment basins are highly effective at reducing sediment and other pollutants for design storm conditions. Sediment basins are typically easier to maintain than other structural controls (e.g. silt fences, etc).

DESIGN CRITERIA

- Refer to Appendix D of this manual for specific design guidance on temporary sediment basins.
- The iSWM Design Manual for Development/ Redevelopment should be used for guidance on the design of permanent sediment basins
- Minimum capacity of the basin shall be the calculated volume of runoff from a 2-year, 24-hour duration storm event.
- Deposited sediment shall be removed when the storage capacity of the basin has been reduced by 20%.
- Minimum width of the embankment at the top shall be 8 feet.
- Embankment slope shall be 3:1 or flatter.
- Maximum embankment height shall be 6 feet as measured from the toe of slope on the downstream side. Sediment basins with embankments exceeding 6 feet are regulated by the Texas Commission on Environmental Quality and must meet specific requirements for dam safety.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

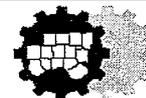
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.90

S-6



North Central Texas
Council of Governments

Sediment Basin

- The basin outlet shall be designed to accommodate a 25-year design storm without causing damage to the containment structure.
- The sediment basin shall have minimum design dewatering time of 36 hours.
- The basin must be laid out such that the effective flow length of the basin should be at least twice the effective flow width.
- The outlet of the outfall pipe (barrel) shall be stabilized with riprap or other form of stabilization with design flows and velocities based on 25-year design storm peak flows. For velocities in excess of 5 feet per second, velocity dissipation measures should be used to reduce outfall velocities.
- The effectiveness of sediment basins may be increased by using baffles to prevent short-circuiting of flow through the basin.

SPECIAL CONSIDERATION

Sediment basins must be designed, constructed, and maintained to minimize mosquito breeding habitats by minimizing the creation of standing water. Whenever possible, water should be held less than 72 hours.

LIMITATIONS

Sediment basins can be rather large depending on site conditions, requiring the use of expensive development area and comprehensive planning for construction phasing prior to implementation.

Storm events which exceed the design storm event can cause damage to the spillway structure of the basin and may impact downstream concerns.

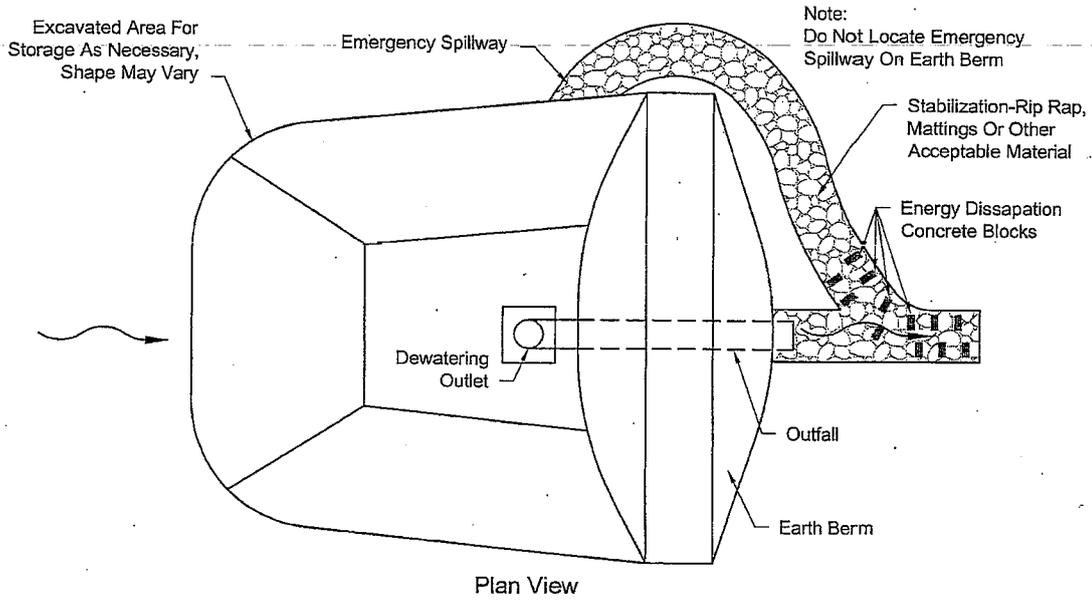
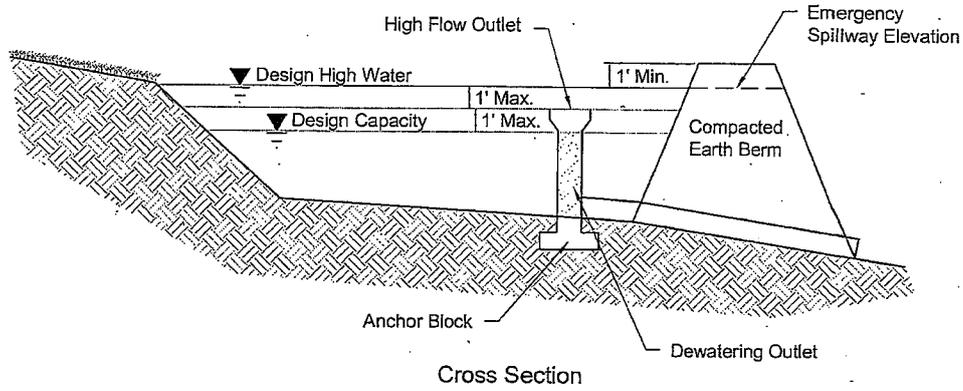
MAINTENANCE REQUIREMENTS

Sediment basins should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A) to check for damage and to insure that obstructions are not diminishing the effectiveness of the structure. Sediment shall be removed and the basin shall be regraded to its original dimensions at such point that the capacity of the impoundment has been reduced to 20% of its original storage capacity. The removed sediment shall be stockpiled or redistributed in areas that are protected by erosion and sediment controls.

SPECIFICATION

No specification for construction of this item is currently available in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments.

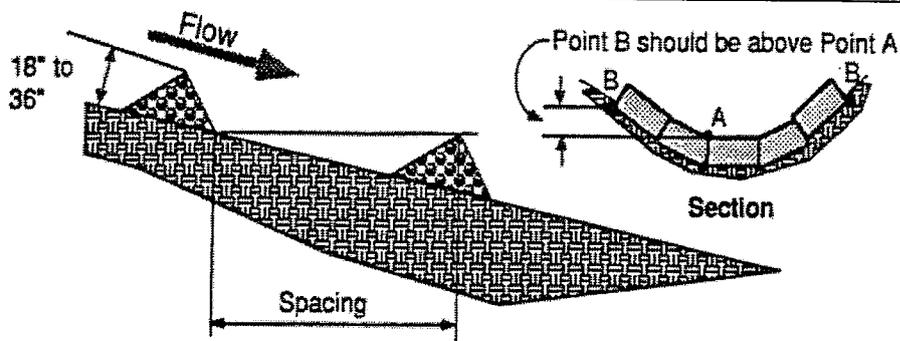
Sediment Basin



December 2003

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Check Dams



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

Check dams are small barriers consisting of rock, sand bag or earth berms placed across a drainage swale or ditch. They reduce the velocity of small concentrated flows, provide a limited barrier for sediment and help disperse concentrated flows, reducing potential erosion.

PRIMARY USE

Check dams are used for long drainage swales or ditches to reduce erosive velocities. They are typically used in conjunction with other channel protection techniques such as vegetation lining and turf reinforcement mats. Check dams provide limited treatment to sediment-laden flows. They are more useful in reducing flow to acceptable levels for other techniques.

APPLICATIONS

Check dams are typically used early in construction in swales for long linear projects such as roadways. They can also be used in short swales with a steep slope to reduce unacceptable velocities. Check dams shall not be used in live stream channels

DESIGN CRITERIA

- Check dams should be placed at a distance and height to allow small pools to form between each one. Typically, dam height should be between 18" and 36". Dams should be spaced such that the top of the downstream dam should be at the same elevation as the toe of the upstream dam.
- Major flows (greater than 2 year design storm) must pass the check dam without causing excessive upstream flooding.
- Check dams should be used in conjunction with other sediment reduction techniques prior to releasing flow offsite.
- Use geotextile filter fabric under check dams exceeding 18 inches in height. The fabric shall meet the material specified for the Stone Outlet Sediment Trap, S-5.

Rock Check Dams

- Stone shall be well graded with size range from 1-1/2 to 3-1/2 inches in diameter depending on expected flows.
- Rock check dams should be triangular in cross section with side slopes of 1:1 or flatter on the upstream side and 2:1 or flatter on the downstream side.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

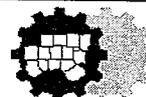
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.40

S-7



North Central Texas
Council of Governments

Check Dams

Sand Bag Dams

- Sand bag check dams should have a maximum flow through rate of 0.1 cfs per square foot of surface with a minimum top width of 16 inches and bottom width of 48 inches. Bags should be filled with coarse sand, pea gravel, or filter stone that is clean and free of deleterious material.
- Bag length shall be 24-inches to 30-inches, width shall be 16-inches to 18-inches and thickness shall be 6-inches to 8-inches and having an approximate weight of 40-pounds.
- Bag material shall be polypropylene, polyethylene, polyamide or cotton burlap woven fabric, minimum unit weight 4-ounces-per-square-yard, Mullen burst strength exceeding 300-psi as determined by ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, and ultraviolet stability exceeding 70-percent.
- PVC pipes may be installed through the sand bag dam near the top to allow for controlled flow through the dam. Pipe should be schedule 40 or heavier polyvinyl chloride (PVC) having a nominal internal diameter of 4 inches.

LIMITATIONS

Minor ponding will occur upstream of the check dams. For heavy flows or high velocity flows, extensive maintenance or replacement of the dams will be required.

Care must be used when taking out rock check dams in order to remove as much rock as possible. Loose rock can create an extreme hazard during mowing operations once the area has been stabilized.

MAINTENANCE REQUIREMENTS

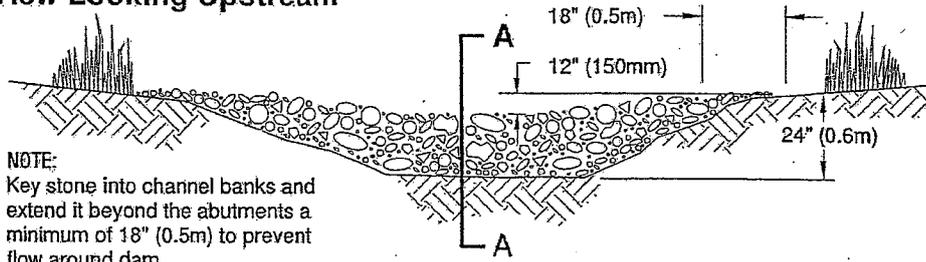
Check dams should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A). Silt must be removed when it reaches approximately 1/3 the height of the dam or 12", whichever is less.

SPECIFICATION

Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.9 Rock Dam and Item 201.11 Sand Bag Dam.

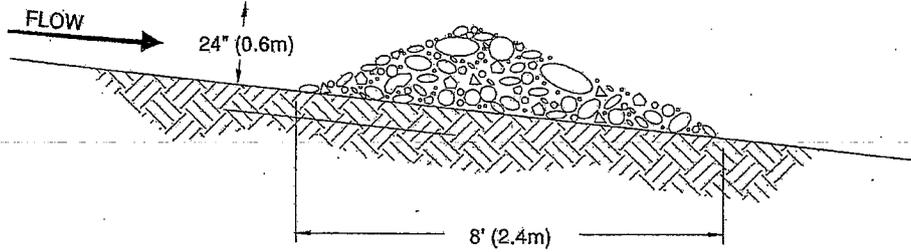
Check Dams

View Looking Upstream



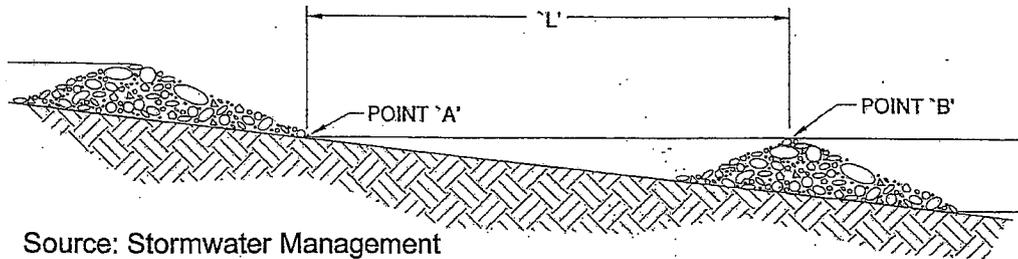
NOTE:
Key stone into channel banks and extend it beyond the abutments a minimum of 18" (0.5m) to prevent flow around dam.

Section A - A



Spacing Between Check Dams

'L' = the distance such that points 'A' and 'B' are of equal elevation.

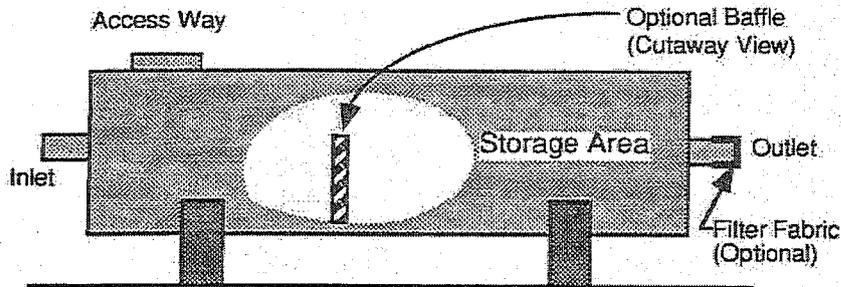


Source: Stormwater Management
Manual for Western Washington.

December 2003

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Temporary Sediment Tank



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

A temporary sediment tank (TST) is a large tank used to hold sediment-laden water to provide for sedimentation and filtration. For smaller applications, 55-gallon drums or other watertight container can be used for storage. Water is pumped into the tank where it is detained. If desired an outlet with a geofabric filter can be provided to release the flow after a period of detention.

PRIMARY USE

A TST is typically used at construction sites in urban areas where conventional methods of sediment removal (e. g., sediment traps, and sediment basins) are not practical.

APPLICATIONS

Applications for a TST include utility construction in confined areas (such as a business district or large developed area) or localized construction in which other BMPs are not required such as small, depressed construction areas (tank farms). This includes pumpage from excavation in heavily developed areas, such as a central business district, with flows due to groundwater or runoff entering the trench or excavated area.

DESIGN CRITERIA

- A TST can be used as either a sedimentation or filtration device. If an oil sheen is present in the runoff, additional treatment will be required before release of runoff.
- For use as a small scale sedimentation basin, de-watering discharge is directed into the TST to a level below the tank midpoint and held for a minimum of 2 hours to allow settlement of a majority of the suspended particles. The tank should be designed for a controlled release when the contents of the tank reach a level higher than the midpoint. When sediment occupies 1/3 the capacity of the TST, it should be removed from the tank.
- As a filtration device, a TST is used for collecting de-watering discharge and passing it through a filtered opening at the outlet of the tank to reduce suspended sediment volume. The filter opening in the TST should have an Apparent Opening Size (AOS) (see Silt Fence BMP) of 70 or smaller.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

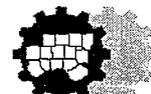
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe=0.70

S-8



North Central Texas
Council of Governments

Temporary Sediment Tank

LIMITATIONS

This is a specialized technique for the situations listed. It is not cost effective for normal sediment removal conditions.

The use of a temporary sediment tank is limited by the capacity of the tank, the time required for settlement of suspended material, and disposal of the water and the sediment.

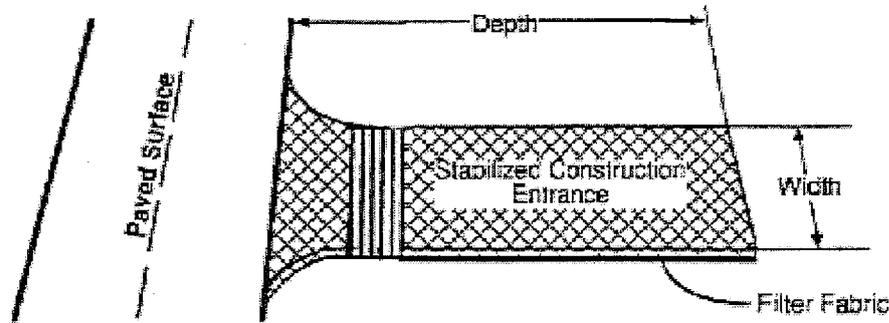
MAINTENANCE REQUIREMENTS

Sediment tanks should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A). The tank should be cleaned out when it becomes 1/3 full of sediment.

SPECIFICATION

No specification for construction of this item is currently available in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments.

Stabilized Construction Entrance



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization**
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

A stabilized construction entrance consists of a pad consisting of crushed stone, recycled concrete or other rock like material on top of geotextile filter cloth to facilitate the removal of sediment and other debris from construction equipment prior to exiting the construction site. This directly addresses the problem of silt and mud deposition in roadways used for construction site access. For added effectiveness, a wash rack area can be incorporated into the design to further reduce sediment tracking (See Wheel Wash, Fact Sheet S-10).

PRIMARY USE

Stabilized construction entrances are used primarily for sites in which significant truck traffic occurs on a daily basis. It reduces the need to remove sediment from streets. If used properly, it also directs the majority of traffic to a single location, reducing the number and quantity of disturbed areas on the site and providing protection for other structural controls through traffic control.

APPLICATIONS

Stabilized construction entrances are a required part of the erosion control plan for all site developments larger than one acre and a recommended practice for all construction sites. If possible, controlled entrances should be incorporated into small lot construction due to the large percentage of disturbed area on the site and the high potential for offsite tracking of silt and mud.

DESIGN CRITERIA

- Stabilized construction entrances are to be constructed such that drainage across the entrance is directed to a controlled, stabilized outlet on site with provisions for storage, proper filtration, and removal of wash water.
- The entrance must be sloped away from the paved surface so that storm water is not allowed to leave the site onto roadways.
- Minimum width of entrance shall be 15 feet.
- Stone shall be placed in a layer of at least 12-inches thickness. The stone shall be a minimum of 3 to 5 inch coarse aggregate.
- Prevent shortcutting of the full length of the construction entrance by installing barriers as necessary.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

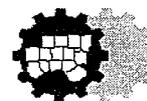
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe = N/A

S-9



North Central Texas
Council of Governments

Stabilized Construction Entrance

- ❑ The geotextile fabric must meet the following minimum criteria:
 - Tensile Strength, ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles, 300-lbs.
 - Puncture Strength, ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products, 120-lbs.
 - Mullen Burst Rating, ASTM D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method, 600-psi.
 - Apparent Opening Size, ASTM D4751 Test Method for Determining Apparent Opening Size of a Geotextile, U.S. Sieve No. 40 (max).
- ❑ When necessary, vehicles must be cleaned to remove sediment prior to entrance onto paved roads, streets, or parking lots. When washing is required, it shall be done on a constructed wheel wash facility that drains into an approved sediment trap or sediment basin or other sedimentation/filtration device.
- ❑ Minimum dimensions for the entrance shall be as follows:

Tract Area	Avg. Tract Depth	Min. Width of Entrance	Min. Depth of Entrance
< 1 Acre	100 feet	15 feet	20 feet
< 5 Acres	200 feet	20 feet	50 feet
> 5 Acres	> 200 feet	25 feet	75-100 feet

LIMITATIONS

Selection of the construction entrance location is critical. To be effective, it must be used exclusively.

Stabilized entrances are rather expensive considering that it must be installed in combination with one or more other sediment control techniques, but it may be cost effective compared to labor-intensive street cleaning.

MAINTENANCE REQUIREMENTS

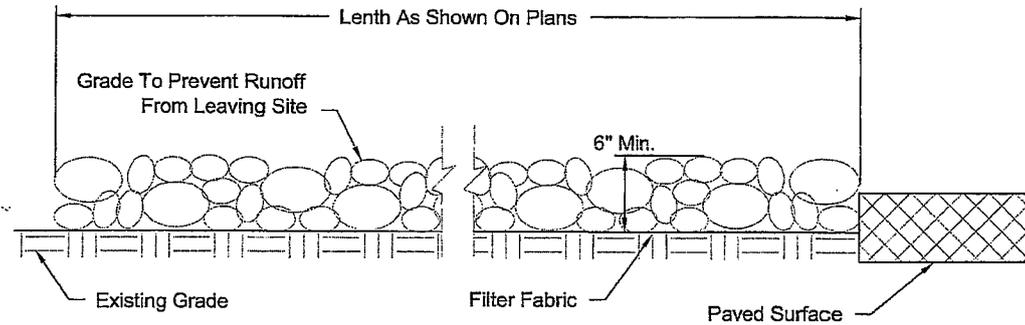
Construction entrances should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A). When sediment has substantially clogged the void area between the rocks, the aggregate mat must be washed down or replaced. Periodic re-grading and top dressing with additional stone must be done to keep the efficiency of the entrance from diminishing.

If the stabilized construction entrance is not effectively removing sediment from wheels then a wheel wash should be considered.

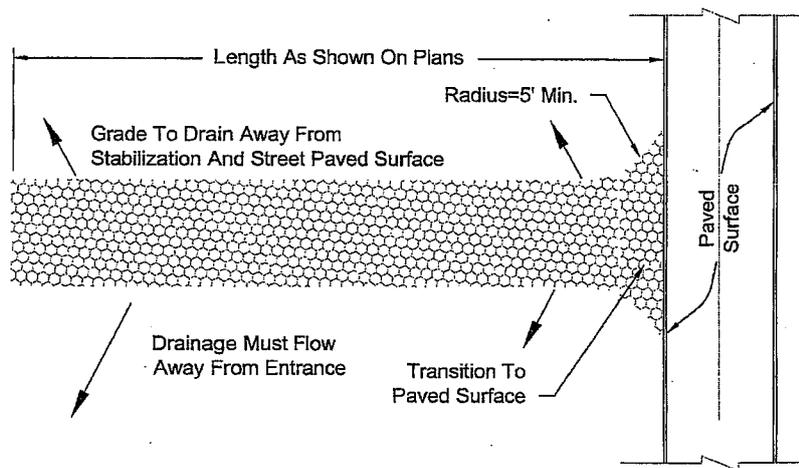
SPECIFICATION

Specifications for construction of this item may be found in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments, Section 201.10 Stabilized Construction Entrance.

Stabilized Construction Entrance



Profile View



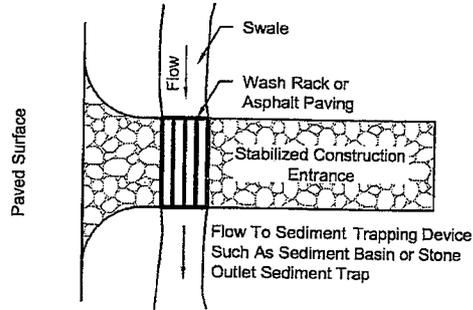
Plan View

Entrance Must Be Sloped So That Storm Water Is Not Allowed To Leave The Site And Enter Roadways.

December 2003

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Wheel Wash



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping**
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

The wheel wash is used in conjunction with a stabilized construction entrance to provide an area where truck wheels and undercarriages can be cleaned prior to traversing the stabilized construction entrance and entering the public road system. A wheel wash may consist of an impervious area or a grate over a swale. Wash water from hand held pressure washers or fixed nozzles is collected and drained to a sediment-trapping device such as a stone outlet sediment trap or sediment basin to provide for removal of sediment prior to discharge.

PRIMARY USE

Wheel washes should be used on large jobs where there is significant truck traffic, on those sites where site conditions cause the stabilized construction entrance to be overloaded with sediment and become ineffective, and in those instances where contaminated solids might be present on site. They provide added protection and reduce the need to remove sediment from streets.

APPLICATIONS

Wheel washes should be considered an ancillary component to the stabilized construction entrance.

DESIGN CRITERIA

- The location should be within the stabilized construction entrance so that the vehicle does not pick up additional sediment load by traversing disturbed areas.
- The size of the wheel wash facility should be sufficient so that all wash water and sediment is collected and drained to a sediment trapping device such as a sediment basin or stone outlet sediment trap.
- Suggested designs:
 - 4-inch thick asphalt pavement on an 8-inch base of crushed rock graded so that wash water drains to a swale; or
 - grate suitably designed to support construction vehicles installed over a swale.
- The facility should be designed so that it can be cleaned between uses.

LIMITATIONS

Sediment trapping BMPs used in conjunction with wheel wash facilities must be carefully designed for the anticipated amount of wash water to be treated.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

Implementation Requirements

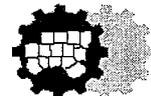
- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

Fe = N/A

S-10



North Central Texas
Council of Governments

Wheel Wash

MAINTENANCE REQUIREMENTS

Wheel wash facilities should be inspected regularly (at least as often as required by the TPDES Construction General Permit, Appendix A). The surface of the wheel wash should be cleaned between vehicles as necessary. Sediment that has accumulated in the wash water sedimentation BMP (sediment trap, sediment basin, etc.) must be removed when it reaches a depth of approximately 1/3 the design depth of the device or 12", whichever is less. The removed sediment shall be stockpiled or redistributed in areas that are protected from erosion.

SPECIFICATION

No specification for construction of this item is currently available in the Standard Specifications for Public Works Construction – North Central Texas Council of Governments.

Debris and Trash Management

DESCRIPTION

Large volumes of debris and trash are often generated at construction sites including: packaging, pallets, wood waste, concrete waste, soil, electrical wiring, cuttings, and a variety of other materials. There are several techniques and procedures to minimize the potential of storm water contamination from solid waste through appropriate storage and disposal practices. Recycling of construction debris also reduces the volume of material to be disposed of and associated costs.

PRIMARY USE

Debris and trash management should be a part of all construction practices. By limiting the trash and debris on site, storm water quality is improved along with reduced clean up requirements at the completion of the project.

APPLICATIONS

Solid waste management for construction sites is based on proper storage and disposal practices by construction workers and supervisors. Key elements of the program are education and modification of improper disposal habits. Cooperation and vigilance is required on the part of supervisors and workers to ensure that the recommendations and procedures are followed. Following are lists describing the targeted materials and recommended procedures:

- Construction (and Demolition) Debris
 - Dimensional lumber
 - Miscellaneous wood (pallets, plywood, etc)
 - Copper (pipe and electrical wiring)
 - Miscellaneous metal (studs, pipe, conduit, sheathing, nails, etc)
 - Insulation
 - Concrete, brick, and mortar
 - Shingles
 - Roofing materials
 - Gypsum board
- Trash
 - Paper and cardboard (packaging, containers, wrappers)
 - Plastic (packaging, bottles, containers)
 - Styrofoam (cups, packing, and forms)
 - Food and beverage containers
 - Food waste

Storage Procedures

- Wherever possible, minimize production of debris and trash.
- Designate a foreman or supervisor to oversee and enforce proper debris and trash procedures.
- Instruct construction workers in proper debris and trash storage and handling procedures.
- Segregate potentially hazardous waste from non-hazardous construction site debris.
- Segregate recyclable construction debris from other non-recyclable materials.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization

- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

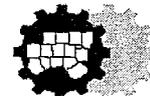
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

M-1



North Central Texas
Council of Governments

Debris and Trash Management

- Keep debris and trash under cover in either a closed dumpster or other enclosed trash container that limits contact with rain and runoff and prevents light materials from blowing out.
- Store waste materials away from drainage ditches, swales and catch basins.
- Do not allow trash containers to overflow.
- Do not allow waste materials to accumulate on the ground.
- Prohibit littering by workers and visitors.
- Police site daily for litter and debris.
- Enforce solid waste handling and storage procedures.

Disposal Procedures

- If feasible, recycle construction and demolition debris such as wood, metal, and concrete.
- General construction debris may be hauled to a licensed construction debris landfill (typically less expensive than a sanitary landfill).
- Use waste and recycling haulers/facilities approved by the local jurisdiction.

Education

- Educate all workers on solid waste storage and disposal procedures.
- Instruct workers in identification of solid waste and hazardous waste.
- Have regular meetings to discuss and reinforce disposal procedures (incorporate in regular safety seminars).
- Clearly mark on all debris and trash containers which materials are acceptable.

Quality Control

- Foreman and/or construction supervisor shall monitor on-site solid waste storage and disposal procedures.
- Discipline workers who repeatedly violate procedures.

Requirements

- Job-site waste handling and disposal education and awareness program.
- Compliance by workers.
- Sufficient and appropriate waste storage containers.
- Timely removal of stored solid waste materials.
- Training workers and monitoring compliance.

LIMITATIONS

Only addresses non-hazardous solid waste.

One part of a comprehensive construction site management program.

Chemical Management

DESCRIPTION

Chemical management addresses the problem of storm water polluted with chemical pollutants through spills or other forms of contact. The objective of the chemical management is to minimize the potential of storm water contamination from construction chemicals through appropriate recognition, handling, storage, and disposal practices.

It is not the intent of chemical management to supersede or replace normal site assessment and remediation procedures. Significant spills and/or contamination warrant immediate response by trained professionals. Suspected job-site contamination should be immediately reported to regulatory authorities and protective actions taken. Significant spills should be reported to the National Response Center (NRC) at (800) 424-8802.

PRIMARY USE

These management practices along with applicable OSHA and EPA guidelines should be incorporated at all construction sites that use or generate hazardous wastes. Many chemicals such as fuel, oil, grease, fertilizer, and pesticide are present at most construction sites.

INSTALLATION, APPLICATION AND DISPOSAL CRITERIA

The chemical management techniques presented here are based on proper recognition, handling, and disposal practices by construction workers and supervisors. Key elements are education, proper disposal practices, as well as provisions for safe storage and disposal. Following are lists describing the targeted materials and recommended procedures:

- Targeted Chemical Materials
 - Paints
 - Solvents
 - Stains
 - Wood preservatives
 - Cutting oils
 - Greases
 - Roofing tar
 - Pesticides, herbicides, & fertilizer
 - Fuels & lube oils
 - Antifreeze

Storage Procedures

- Wherever possible, minimize use of hazardous materials.
- Minimize generation of hazardous wastes on the job-site.
- Segregate potentially hazardous waste from non-hazardous construction site debris.
- Designate a foreman or supervisor to oversee hazardous materials handling procedures.
- Keep chemicals in appropriate containers (closed drums or similar) and under cover.
- Store chemicals away from drainage ditches, swales and catch basins.
- Use containment berms in fueling and maintenance areas and where the potential for spills is high.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

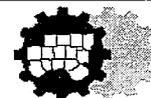
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

M-2



North Central Texas
Council of Governments

Chemical Management

Waste Handling

- Ensure that adequate hazardous waste storage volume is available.
- Ensure that hazardous waste collection containers are conveniently located.
- Do not allow potentially hazardous waste materials to accumulate.
- Enforce hazardous waste handling and disposal procedures.
- Clearly mark on all hazardous waste containers which materials are acceptable for the container.

Disposal Procedures

- Ensure that adequate cleanup and containment materials are available onsite.
- Regularly schedule hazardous waste removal to minimize on-site storage.
- Use only licensed hazardous waste haulers.

Education

- Instruct workers on safety procedures for construction site chemical storage.
- Instruct workers in identification of chemical pollutants.
- Ensure that workers are trained in procedures for spill prevention and response.
- Educate workers of potential dangers to humans and the environment from chemical pollutants.
- Educate all workers on chemical storage and disposal procedures.
- Have regular meetings to discuss and reinforce identification, handling, and disposal procedures (incorporate in regular safety seminars).
- Establish a continuing education program to indoctrinate new employees.

Quality Assurance

- Foreman and/or construction supervisor shall monitor on-site chemical storage and disposal procedures.
- Educate and if necessary, discipline workers who violate procedures.
- Ensure that the hazardous waste disposal contractor is reputable and licensed.

Requirements

- Job-site chemical and hazardous waste handling and disposal education and awareness program.
- Commitment by management to implement chemical storage and hazardous waste management practices.
- Compliance by workers.
- Sufficient and appropriate chemical and hazardous waste storage containers.
- Timely removal of stored hazardous waste materials.

Cost

- Possible modest cost impact for additional chemical storage containers.
- Small cost impact for training and monitoring.
- Potential cost impact for hazardous waste collection and disposal by licensed hauler - actual cost depends on type of material and volume.

LIMITATIONS

This practice is not intended to address site-assessments and pre-existing contamination. Major contamination, large spills and other serious hazardous waste incidents require immediate response from specialists.

Demolition activities and potential pre-existing materials, such as lead and asbestos, are not addressed by this program. Site-specific information on plans is necessary.

Contaminated soils are not addressed.

Concrete Waste Management

DESCRIPTION

Concrete waste at construction sites comes in two forms: 1) excess fresh concrete mix including truck and equipment washing, and 2) concrete dust and concrete debris resulting from demolition. Both forms have the potential to impact water quality through storm water runoff contact with the waste.

PRIMARY USE

Concrete waste is present at most construction sites. This BMP should be utilized at sites in which concrete waste is present.

APPLICATIONS

A number of water quality parameters can be affected by introduction of concrete - especially fresh concrete. Concrete affects the pH of runoff, causing significant chemical changes in water bodies and harming aquatic life. Suspended solids in the form of both cement and aggregate dust are also generated from both fresh and demolished concrete waste.

Unacceptable Waste Concrete Disposal Practices

- Dumping in vacant areas on the job-site.
- Illicit dumping off-jobsite.
- Dumping into ditches or drainage facilities.

Recommended Disposal Practices

- Avoid unacceptable disposal practices listed above.
- Develop pre-determined, safe concrete disposal areas.
- Provide a washout area with a minimum of 6 cubic feet of containment area volume for every 10 cubic yards of concrete poured.
- Never dump waste concrete illicitly or without property owner's knowledge and consent.
- Overflow of washdown water shall be discharged in an area protected by one or more sediment removal BMPs and shall be done in a manner that does not result in a violation of groundwater or surface water quality standards.

Education

- Drivers and equipment operators should be instructed on proper disposal and equipment washing practices (see above).
- Supervisors must be made aware of the potential environmental consequences of improperly handled concrete waste.

Enforcement

- The construction site manager or foreman must ensure that employees and pre-mix companies follow proper procedures for concrete disposal and equipment washing.
- Employees violating disposal or equipment cleaning directives must be re-educated or disciplined if necessary.

Demolition Practices

- Monitor weather and wind direction to ensure concrete dust is not entering drainage structures and surface waters.
- Where appropriate, construct sediment traps or other types of sediment detention devices downstream of demolition activities.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

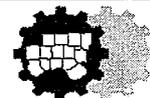
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

M-3



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Council of Governments

Concrete Waste Management

Requirements

- Use pre-determined disposal sites for waste concrete.
- Prohibit dumping waste concrete anywhere but pre-determined areas.
- Assign pre-determined truck and equipment washing areas.
- Educate drivers and operators on proper disposal and equipment cleaning procedures.

Costs

- Minimal cost impact for training and monitoring.
- Concrete disposal cost depends on availability and distance to suitable disposal areas
- Additional costs involved in equipment washing could be significant.

LIMITATIONS

Concrete waste management is one part of a comprehensive construction site waste management program.

Concrete Sawcutting Waste Management

DESCRIPTION

Sawcutting of concrete pavement is a routine practice, necessary to control shrinkage cracking immediately following placement of plastic concrete. It is also used to remove curb sections and pavement sections for pavement repairs, utility trenches, and driveways. Sawcutting for joints involves sawing a narrow, shallow groove in the concrete, while sawcutting for removals is usually done full depth through the slab. Water is used to control saw blade temperature and to flush the detritus from the sawed groove. The resulting slurry of process water and fine particles and high pH must be properly managed.

A number of water quality parameters can be affected by introduction of concrete fines. Concrete affects the pH of runoff, causing significant chemical changes in water bodies and harming aquatic life. Suspended solids in the form of saw fines are also generated from sawcutting operations.

DESIGN CRITERIA

Slurry Collection

- During saw cutting operations, the slurry and cuttings shall be continuously vacuumed to control the flow of water from the operations site.
- The slurry and cuttings shall not be allowed to drain to the storm drain system, swale, stream or other water body.
- The slurry and cuttings shall not be allowed to remain on the pavement to dry out.

Slurry Disposal

- Develop pre-determined, safe slurry disposal areas.
- Collected slurry and cuttings shall be discharged in an area protected by one or more sediment removal BMPs and shall be done in a manner that does not result in a violation of groundwater or surface water quality standards.
- Never dump waste illicitly or without property owner's knowledge and consent.
- Slurry may be disposed of in facilities designated for washdown of concrete trucks (see M-3, Concrete Waste Management).

MAINTENANCE

Project personnel should inspect the operations to assure that operators are diligent in controlling the water produced by the saw cutting activities. Following operations the pavement should be inspected to ensure that waste removal has been adequately performed.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

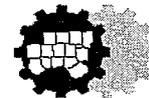
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

M-4



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Council of Governments

December 2003

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Sandblasting Waste Management

DESCRIPTION

The objective of sandblasting waste management is to minimize the potential of storm water quality degradation from sandblasting activities at construction sites. The key issues in this program are prudent handling and storage of sandblast media, dust suppression, and proper collection and disposal of spent media. It is not the intent of this BMP to outline all of the worker safety issues pertinent to this practice. Safety issues should be addressed by construction safety programs as well as local, state, and federal regulations.

INSTALLATION/APPLICATION CRITERIA

Since the sandblasting media consists of fine abrasive granules, it can be easily transported by running water. Sandblasting activities typically create a significant dust problem that must be contained and collected to prevent off-site migration of fines. Particular attention must be paid to sandblasting work on bridges, box culverts, and headwalls that span or are immediately adjacent to streams and waterways.

Operational Procedures

- Use only inert, non-degradable sandblast media.
- Use appropriate equipment for the job; do not over-blast.
- Wherever possible, blast in a downward direction.
- Install a windsock or other wind direction instrument.
- Cease blasting activities in high winds or if wind direction could transport grit to drainage facilities.
- Install dust shielding around sandblasting areas.
- Collect and dispose of all spent sandblast grit, use dust containment fabrics and dust collection hoppers and barrels.
- Non-hazardous sandblast grit may be disposed in permitted construction debris landfills or permitted sanitary landfills.
- If sandblast media cannot be fully contained, construct sediment traps downstream from blasting area where appropriate.
- Use sand fencing where appropriate in areas where blast media cannot be fully contained.
- If necessary, install misting equipment to remove sandblast grit from the air prevent runoff from misting operations from entering drainage systems.
- Use vacuum grit collection systems where possible.
- Keep records of sandblasting materials, procedures, and weather conditions on a daily basis.
- Take all reasonable precautions to ensure that sandblasting grit is contained and kept away from drainage structures.

Educational Issues

- Educate all on-site employees of potential dangers to humans and the environment from sandblast grit.
- Instruct all on-site employees of the potential hazardous nature of sandblast grit and the possible symptoms of over-exposure to sandblast grit.
- Instruct operators of sandblasting equipment on safety procedures and personal protection equipment.
- Instruct operators on proper procedures regarding storage, handling and containment of sandblast grit.

Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization

Waste Management

Housekeeping Practices

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

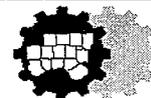
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

M-5



North Central Texas
Council of Governments

Sandblasting Waste Management

- Instruct operators to recognize unfavorable weather conditions regarding sandblasting activities.
- Instruct operators and supervisors on current local, state and federal regulations regarding fugitive dust and hazardous waste from sandblast grit.
- Have weekly meetings with operators to discuss and reinforce proper operational procedures.
- Establish a continuing education program to indoctrinate new employees.

Materials Handling Recommendations

- Sandblast media should always be stored under cover away from drainage structures.
- Ensure that stored media or grit is not subject to transport by wind.
- Ensure that all sandblasting equipment as well as storage containers comply with current local, state and federal regulations.
- Refer to Hazardous Waste BMP fact sheet if sandblast grit is known or suspected to contain hazardous components.
- Capture and treat runoff, which comes into contact with sandblasting material or waste.

Quality Assurance

- Foremen and/or construction supervisor should monitor all sandblasting activities and safety procedures.
- Educate and if necessary, discipline workers who violate procedures.
- Take all reasonable precautions to ensure that sandblast grit is not transported off-site or into drainage facilities.

Requirements

- Education and awareness program for all employees regarding control of sandblasting and potential dangers to humans and the environment.
- Operator and supervisor education program for those directly involved in sandblasting activities - instructions on material handling, proper equipment operation, personal protective equipment, fugitive dust control, record keeping and reporting.
- Proper sandblast equipment for the job.
- Site-specific fugitive dust control and containment equipment.
- Site-specific fugitive dust control procedures.
- Compliance by supervisors and workers.

Costs

- Minimal cost for training and monitoring.
- Potential for significant cost for containment procedures on large jobs.
- Potential for significant costs associated with cleanup, correction and remediation if contamination occurs.

LIMITATIONS

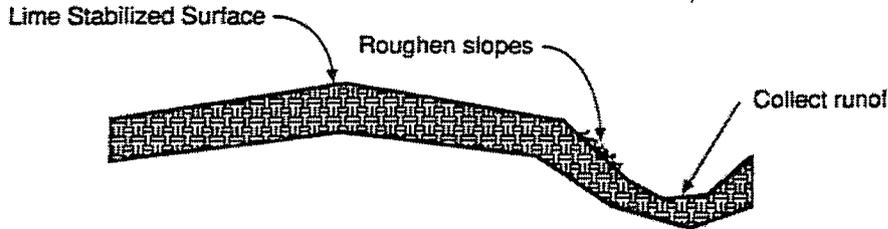
Site-specific solutions to sandblasting problems may be required.

Sandblasting operations on structures known to contain hazardous materials require special procedures not specifically outlined above including professional hazardous waste specialists.

Where hazardous materials are known or suspected, a site assessment and remediation plan may be necessary.

Sandblasting waste management is one part of a comprehensive construction site waste management program.

Lime Stabilization Management



Applications

- Perimeter Control
- Slope Protection
- Sediment Trapping
- Channel Protection
- Temporary Stabilization
- Permanent Stabilization
- Waste Management
- Housekeeping Practices

DESCRIPTION

Lime stabilization is used extensively in the North Central Texas region to stabilize pavement subbases for roadways, parking lots, and other paved surfaces, and as a subgrade amendment for building pad sites. Hydrated lime is applied to the soil and mixed through diking and other techniques, then allowed to cure. This practice will reduce the potential for runoff to carry lime offsite, where it may impact aquatic life by changing the pH balance of streams, ponds, and other water bodies.

PRIMARY USE

This BMP should be implemented when lime is required for soil stabilization.

APPLICATIONS

Lime stabilization can be used under a variety of conditions. The engineer should determine the applicability of lime stabilization based on site conditions such as available open space, quantity of area to be stabilized, proximity of nearby water courses and other BMPs employed at the site. The use of diversion dikes and interceptor swales (see appropriate fact sheets) to divert runoff away from areas to be stabilized can be used in conjunction with these techniques to reduce the impact of the lime.

DESIGN CRITERIA

- The contractor shall limit lime operations to that which can be thoroughly mixed and compacted by the end of each workday.
- No traffic other than water trucks and mixing equipment shall be allowed to pass over the spread lime until after completion of mixing.
- Areas adjacent and downstream of stabilized areas shall be roughened to intercept lime from runoff and reduce runoff velocity.
- Geotextile fabrics such as those used for silt fence should not be used to address lime since the grain size of lime is significantly smaller than the apparent opening size of the fabric.
- For areas for which phasing of lime operations is impractical, use of a curing seal such as Liquid Asphalt, Grade MC-250 or MC-800 applied at a rate of 0.15 gallons per sq. yd. of surface can be used to protect the base.
- Use of sediment basins with a significant (>36 hour) drawdown time is encouraged for large areas to be stabilized (see S-6, Sediment Basin).
- Provide containment around lime storage, loading, and dispensing areas.

LIMITATIONS

Lime stabilization can be part of an overall plan to reduce pollutants from an active construction site. In the case of pollution due to lime, prevention of contamination is the only effective method to address this pollutant. Proper application and mixing along with avoiding applications when there is a significant probability of rain will reduce lime runoff.

Targeted Constituents

- Sediment
- Nutrients Toxic Materials
- Oil & Grease
- Floatable Materials
- Other Construction Wastes

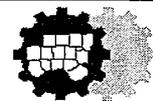
Implementation Requirements

- Capital Costs
- Maintenance
- Training
- Suitability for Slopes > 5%

Legend

- Significant Impact
- Medium Impact
- Low Impact
- ? Unknown or Questionable Impact

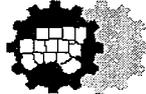
M-6



North Central Texas
Council of Governments

December 2003

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<h1 style="margin: 0;">Sanitary Facilities</h1>	<p style="text-align: center;">Applications</p>
<p>DESCRIPTION Facilities for collection and disposal of sanitary waste must be provided and properly managed to minimize the potential contamination of surface water with septic wastes. Location of portable facilities away from storm drain systems and surface waters or containment is necessary in case of spills.</p>	<p>Perimeter Control Slope Protection Sediment Trapping Channel Protection Temporary Stabilization Permanent Stabilization</p>
<p>PROCEDURES</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sanitary facilities must be provided on the site in close proximity to areas where people are working. <input type="checkbox"/> Portable toilets must be provided if no permanent facilities are available. <input type="checkbox"/> Locate portable toilets a minimum of 20 feet away from storm drain inlets, conveyance channels, or surface waters <input type="checkbox"/> If unable to meet 20-foot distance requirement, provide containment for portable toilets. <input type="checkbox"/> Portable toilets should be regularly serviced. 	<div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; text-align: center;">Waste Management</div> <div style="border: 1px solid black; padding: 2px; text-align: center;">Housekeeping Practices</div>
	<p>Targeted Constituents</p> <ul style="list-style-type: none"> <input type="radio"/> Sediment <input checked="" type="radio"/> Nutrients Toxic Materials <input type="radio"/> Oil & Grease <input type="radio"/> Floatable Materials <input checked="" type="radio"/> Other Construction Wastes
	<p>Implementation Requirements</p> <ul style="list-style-type: none"> <input type="radio"/> Capital Costs <input checked="" type="radio"/> Maintenance <input checked="" type="radio"/> Training <input type="radio"/> Suitability for Slopes > 5%
	<p>Legend</p> <ul style="list-style-type: none"> <input checked="" type="radio"/> Significant Impact <input checked="" type="radio"/> Medium Impact <input type="radio"/> Low Impact ? Unknown or Questionable Impact
	<h2 style="margin: 0;">M-7</h2>
	 <p style="margin: 0;">North Central Texas Council of Governments</p>

December 2003

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5.0 INSPECTIONS AND ENFORCEMENT

5.1 GENERAL

The primary responsibility for inspecting and maintaining the erosion control BMPs found at any given site within the City of Cibolo rests with the Responsible Party as defined by the Erosion Control Ordinance. This will usually be the Contractor that actually constructed the BMPs. The erosion control plan for any site shall list a BMP Maintenance Schedule for the devices used. Each device specified in Chapter 5 listed the maintenance requirements for that device and City of Cibolo staff will do follow-up inspections on all permitted sites and as requested on sites without permits.

5.2 INSPECTION PROCEDURE

The following procedure can be used on most construction sites to ensure that the erosion control plan and devices are effectively controlling sediment runoff from the site:

1. Does the site topography match what is shown on the construction plans?
2. Does the site work comply with the erosion control plan?
3. Does the erosion control plan appear reasonable for the site?
4. Has the construction phasing of the project been taken into account on the erosion control plan and is the Contractor following the plan?
5. Check all erosion control BMPs for proper installation, dimensions & materials.
6. Are required BMP's properly located to control sediment?
7. Do the BMPs require repair?
8. Do the BMPs require cleanout?
9. Check the perimeter of the site for evidence of off-site sedimentation, particularly at gutters, streams, inlets, and swales.
10. Are additional erosion control devices required to control sediment runoff?

5.3 ENFORCEMENT PROCEDURE

The intent of the enforcement procedure is to correct insufficient erosion and sedimentation controls as early as possible. It also is meant to place emphasis on the repair and maintenance of inadequate BMPs by not allowing inspections and approvals of other on-site work items until corrections to BMPs have been accomplished. The following summarizes the enforcement process that will normally be followed by the City of Cibolo:

Follow-up of a citizen's complaint or a regularly scheduled City inspection of the site.

An inspection report is completed by the City's authorized representative and delivered to the Responsible Party for the site.

1. If violations of the UDC are discovered, a Notice of Violation is issued.
2. Corrections are completed by the Responsible Party.
3. If corrections are not completed within the time allocated, a stop work order is issued.
4. Corrections completed by the responsible and all fees are paid prior to release of the stop work order.
5. If corrections are not completed, the City initiates court action against the Responsible Party.

APPENDIX A

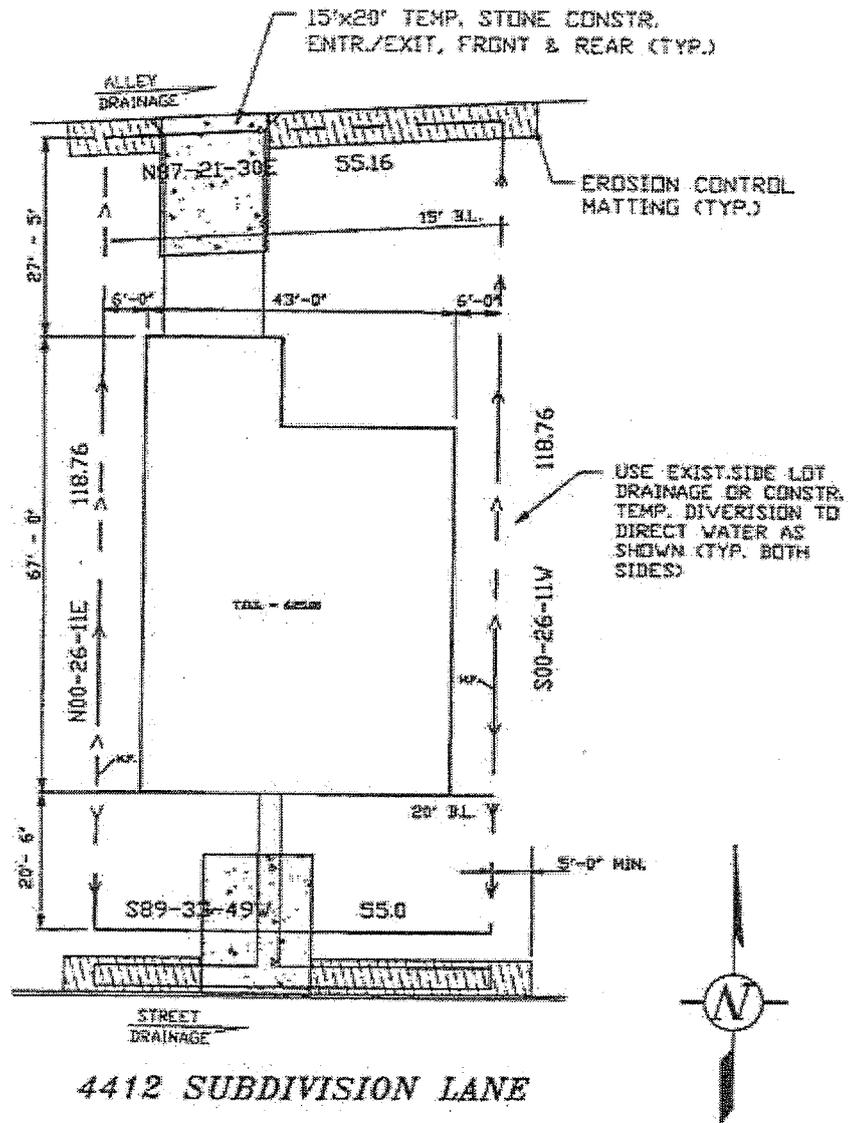
GLOSSARY OF TERMS

- **BARREL** - A pipe placed through a dam, levee or dike to control the release of water.
- **BMP** - Best Management Practices. Consist of practices, procedures, and devices used to prevent or reduce pollutants, including sediment, from polluting the waters of the United States.
- **BORROW AREA** - A source of earth fill material used in the construction of embankments or other earth fill structures.
- **CHANNEL** - A natural stream or excavated ditch that conveys water.
- **CHANNELIZATION** - Alteration of a stream channel by widening, deepening, straightening, or paving certain areas to improve flow characteristics.
- **CHECK DAM** - A small, temporary dam constructed across a drainage ditch, swale or channel to lower the speed of concentrated flows and promote sediment deposition.
- **CONTOUR** - An imaginary line on the surface of the earth connecting points of the same elevation.
- **CUT** - Portion of land surface or area from which earth has been removed or will be removed by excavating; the depth below the original ground surface to the excavated ground surface.
- **DAM** - A barrier to confine or impound water or for the retention of soil, sediment or debris.
- **DESIGN STORM** - A selected rainfall pattern of specified amount, intensity, duration, and frequency that is used as a basis for design.
- **DISCHARGE** - Usually the rate of water flow commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day.
- **DIVERSION** - A channel with a supporting ridge on the lower side constructed at the top, across, or at the bottom of a slope for the purpose of controlling surface runoff.
- **DIVERSION DIKE** - A barrier built to divert surface runoff.
- **DIVIDE, DRAINAGE** - The boundary between watersheds.
- **DRAINAGEWAY** - A natural or artificial depression that carries surface water to a larger watercourse or outlet such as a river or lake.
- **DROP INLET** - Overall structure in which the water drops through a vertical riser connected to a discharge conduit or storm sewer.
- **EARTH DAM** - Dam constructed of compacted suitable soil materials.
- **ENERGY DISSIPATOR** - A device used to reduce the energy of flowing water to prevent erosion.
- **EPA** - The Environmental Protection Agency. The federal agency responsible for Administering the NPDES permit program.
- **ERODIBILITY** - Susceptibility to erosion.
- **EROSION** - The wearing away of the land surface by water, wind, ice, gravity, or other geological agents.
- **EROSION CONTROL PLAN** - A site plan with necessary details, showing the property where land disturbing activity will take place and showing the locations and types of BMPs to be used to control erosion and sedimentation.
- **FILTER FABRIC** - A woven or non-woven, water-permeable material generally made of synthetic products such as polypropylene and used in erosion and sediment control applications to trap sediment or prevent the movement of fine soil particles.

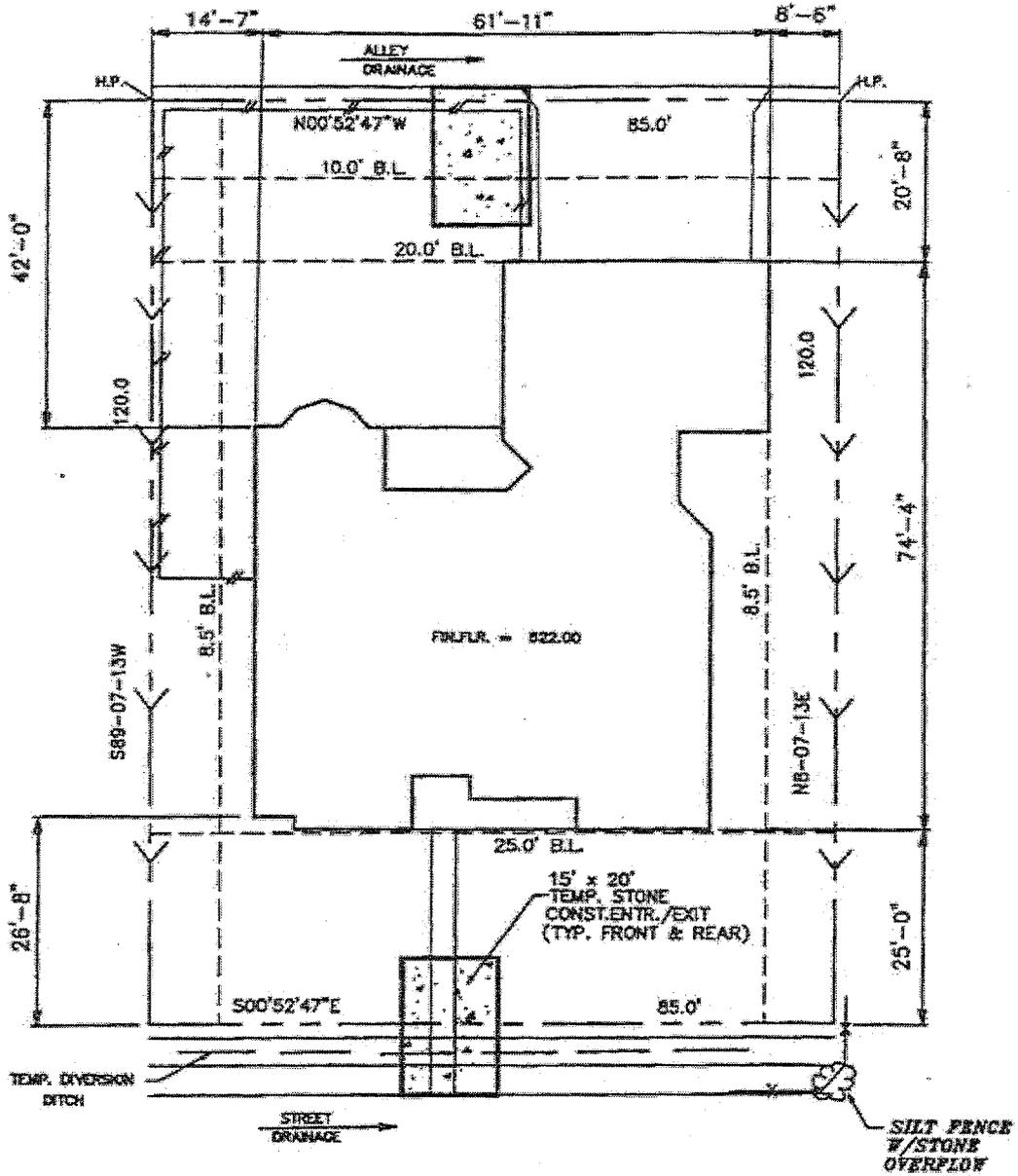
- **FLOOD PLAIN** - The lowland that borders a stream and is subject to flooding when the stream overflows its banks.
- **GABION** - A wire mesh cage, usually rectangular, filled with rock and used to protect channel banks and other sloping areas from erosion.
- **GEOTEXTILES** - See filter fabric.
- **GRADE STABILIZATION STRUCTURE** - A structure for the purpose of stabilizing the grade of a gully or other watercourse, thereby preventing further erosion or lowering of the channel bottom.
- **GRADING** - The cutting and/or filling of the land surface to a desired slope or elevation.
- **GRASSED WATERWAY** - A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to safely conduct surface water from an area.
- **GROUND COVER** - Low-growing, spreading plants (grasses or legumes) useful for low-maintenance landscape areas.
- **INVERT** - The inside bottom of a culvert or other conduit.
- **LEGUME** - Any member of the pea or pulse family which includes peas, beans, peanuts, clovers, alfalfa, sweet clovers, lespedezas, vetches, black locust, and kudzu.
- **NPDES** - National Pollutant Discharge Elimination System. A federal program that requires a permit for storm water discharges to the waters of the U.S.
- **OUTLET PROTECTION** - Stone, rip-rap, concrete or asphalt aprons installed to reduce the speed of concentrated storm water flows, thereby reducing erosion and scouring at storm water outlets.
- **RAINFALL INTENSITY** - The rate at which rain is falling at any given instant, usually expressed in inches per hour.
- **RATIONAL METHOD** - A means of computing storm drainage flow rates by use of the formula $Q = CiA$, where C is a coefficient describing the physical drainage area, " i " is the rainfall intensity, and " A " is the drainage area.
- **RECEIVING STREAM** - The body of water into which runoff or effluent is discharged.
- **RILL** - A small intermittent watercourse with steep sides, usually only a few inches deep, normally caused by erosion.
- **RISER** - A vertical pipe or structure extending from the barrel, storm sewer or bottom of a pond BMP that is used to convey the discharge from the pond or drainage area.
- **RUNOFF** - That portion of precipitation that flows from a drainage area on the land surface, in open channels or in storm water conveyance systems.
- **SCOUR** - The clearing and digging action of flowing water, especially the downward erosion caused by stream water in sweeping away mud and silt from the stream bed.
- **SEDIMENT** - Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice.
- **SEDIMENT BASIN** - A settling pond with a controlled storm water release structure used to collect and store sediment produced by land disturbing activities. The basin detains sediment-laden runoff from larger drainage areas long enough to allow most of the sediment to settle out.
- **SEDIMENT POOL** - The reservoir space allocated for the accumulation of sediment in a sedimentation control device.
- **SEDIMENT TRAP** - A settling basin with a filter outlet designed to retain runoff long enough to allow most of the silt to settle out.
- **SEDIMENTATION** - The deposition of suspended soil particles that have settled out from storm water runoff.

- **SHEETFLOW** - Runoff which flows over the ground surface as a thin, even layer, not concentrated in a channel or a rill.
- **SILT** - Parts of the soil structure consisting of particles between 0.002 & 0.05 mm in diameter.
- **SLOPE** - Degree of deviation of a surface from the horizontal. Slope is measured & shown as a numerical ratio or percent.
- **SOIL** - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.
- **STABILIZATION** - The proper placing, grading and/or covering of soil, rock or earth to ensure its resistance to erosion, sliding, or other movement. Also see Vegetative Stabilization.
- **STORM FREQUENCY** - The time interval between major storms of predetermined intensity and volumes of runoff (e.g. 10-year or 100-year storm).
- **STORM SEWER (DRAIN)** - A sewer that carries storm water, surface drainage, street wash and other wash waters, but excludes sewage and industrial wastes (also called a storm drain).
- **STORM WATER** - Runoff from a rain event or snow melt runoff (also called surface runoff).
- **SWALE** - An elongated, gentle depression in the land surface that conveys storm water into primary drainage channels. Swales are normally without flowing or standing water.
- **SWPPP** - Storm Water Pollution Prevention Plan. A document that is a part of the NPDES permit application and consists of the site erosion control plan, waste management plan, and site narrative as required by the EPA.
- **TEMPORARY SEEDING** - The growing of short-term (less than 1-year) vegetation on disturbed areas to prevent erosion.
- **TOE OF SLOPE** - The base or bottom of a slope at the point where the ground surface abruptly changes to a significantly flatter grade.
- **TOPOGRAPHY** - A general term that includes the physical features of a surface area including relative elevations and the position of natural and manmade features.
- **VEGETATIVE STABILIZATION** - Protection of erodible areas with temporary seeding, permanent seeding, or sodding.
- **WATERSHED** - The region drained by or contributing water to a stream, lake, or other body of water.

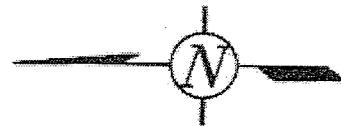
APPENDIX B EXAMPLE OF SINGLE-FAMILY RESIDENTIAL EROSION CONTROL PLAN



APPENDIX C EXAMPLE OF NON-RESIDENTIAL EROSION CONTROL PLAN



8004 SUBDIVISION DRIVE



**APPENDIX D DESIGN PROCEDURE FOR TEMPORARY SEDIMENT
BASINS**

Design Procedure for Temporary Sediment Basins

The following design procedure provides a step-by-step method for the design of a temporary sediment basin with a dam of less than 6 feet. The iSWM Design Manual for Development/Redevelopment should be used for guidance on the design of permanent sediment basins with special consideration for TCEQ requirements if the height of the dam is 6 feet or more. The data sheet found in the back of this Appendix should be used in the erosion and sediment control plan to outline design values calculated.

I. Basin Volume

- A. Determine the required basin volume. The basin volume must be either the calculated volume of runoff from a 2-year, 24-hour storm from each disturbed acre drained or 3600 cubic feet of storage per acre drained.

For a natural basin, the storage volume may be approximated as follows:

$$V_1 = 0.4 \times A_1 \times D_1$$

where,

V1 = the storage volume in cubic feet

A1 = the surface area of the flooded area at the crest of the basin outlet, in square feet

D1 = the maximum depth in feet, measured from the low point in the basin to the crest of the basin riser

Note 1: The volumes may be computed from more precise contour information or other suitable methods.

Note 2: Conversion between cubic feet and cubic yards is as follows:
number of cubic feet \times 0.037 = number of cubic yards

- B. If the volume of the basin is inadequate or embankment height becomes excessive, pursue the use of excavation to obtain the required volume.

II. Basin Shape

- A. The shape of the basin must be such that the length-to-width ratio is at least 2 to 1 according to the following equation:

$$\text{Length-to-width Ratio} = \frac{L}{W_e}$$

where,

$W_e = A/L$ = the effective width

A = the surface area of the normal pool

L = the length of the flow path from the inflow to the outflow. If there is more than one inflow point, any inflow that carries more than 30% of the peak rate of inflow must meet these criteria.

- B. The correct basin shape can be obtained by proper site selection, excavation, or the use of baffles. Baffles increase the flow length by deflecting the flow. The baffles should be placed halfway between the inflow point and the outflow.

III. Embankment

- A. The embankment across the drainageway should have a top width of at least 8 feet.
- B. The side slopes of the embankment should be 3:1 or flatter.
- C. If the height is 6 feet or greater, TCEQ guidelines on dam safety must be followed.
- D. The area under the embankment should be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable materials. The pool area should also be cleared of all brush and trees.
- E. The embankment fill material should be a clay type soil taken from an approved borrow area and should be clean soil, free from roots, woody vegetation, oversized stones, and rocks.
- F. The embankment should be stabilized with temporary vegetation upon completion of the basin.

IV. Spillway Selection

The outlets for the basin may consist of a combination of basin outfall and emergency spillway or a basin outfall alone. In either case, the outlet(s) must pass the peak runoff expected from the drainage area for a 2-year storm without damage to the embankment of the basin.

V. Determine whether the basin will have a separate emergency spillway.

A side channel emergency spillway is required for sediment basins draining more than 10 acres.

VI. Determine the elevation of the crest of the basin outfall riser for the required volume.

VII. Estimate the elevation of the design high water and the required height of the dam.

- A. If an emergency spillway is included, the crest of the basin outfall riser must be at least 1.0 foot below the crest of the emergency spillway.
- B. If an emergency spillway is included, the elevation of the peak flow through the emergency spillway (which will be the design high water for the 25-year storm) must be at least 1.0 foot below the top of embankment.
- C. If an emergency spillway is not included, the crest of the basin outfall riser must be at least 3 feet below the top of the embankment.
- D. If an emergency spillway is not included, the elevation of the design high water for the 25-year storm must be 2.0 feet below the top of the embankment.

VIII. Using SCS TR 55 Urban Hydrology For Small Watersheds or other methods, determine the peak rate of runoff expected from the drainage area of the basin for a 25-year storm. The "C" factor or "CN" value used in the runoff calculation should be derived from analysis of the contributing drainage area at the peak of land disturbance (condition which will create greatest peak runoff).

IX. Basin Outlet Design

- A. If an emergency spillway is included, the basin outfall must at least pass the peak rate of runoff from the basin drainage area for a 2-year storm.
 Q_p = the 2-year peak rate of runoff.
- B. If an emergency spillway is not included, the basin outfall must pass the peak rate of runoff from the basin drainage area for a 25-year storm.
 Q_p = the 25-year peak rate of runoff.
- C. Refer to Figure D-1, where h is the difference between the elevation of the crest of the basin outfall riser and the elevation of the crest of the emergency spillway.
- D. Enter D-2 with Q_p . Choose the smallest riser which will pass the required flow with the available head, h .
- E. Refer to Figure D-1, where H is the difference in elevation of the centerline of the outlet of the

outfall and the crest of the emergency spillway. L is the length of the barrel through the embankment.

- F. Enter Table D-1 or Table D-2 with H . Choose the smallest size outfall that will pass the flow provided by the riser. If L is other than 70 feet, make the necessary correction.
- G. The basin riser shall consist of a solid (non-perforated), vertical pipe or box of corrugated metal joined by a watertight connection to a horizontal pipe (outfall) extending through the embankment and outletting beyond the downstream toe of the fill. Another approach is to utilize a perforated vertical riser section surrounded by filter stone.
- H. The basin outfall, which extends through the embankment, shall be designed to carry the flow provided by the riser with the water level at the crest of the emergency spillway. The connection between the riser and the outfall must be watertight. The outlet of the outfall must be protected to prevent erosion or scour of downstream areas.

IX. Emergency Spillway Design

- A. The emergency spillway must pass the remainder of the 25-year peak rate of runoff not carried by the basin outlet.
- B. Compute, $Q_e = Q_{25} - Q_p$
- C. Refer to Figure D-3 and Table D-3.
- D. Determine approximate permissible values for b , the bottom width; s , the slope of the exit channel; and X , minimum length of the exit channel.
- E. Enter Table D-3 and choose the exit channel cross-section which passes the required flow and meets the other constraints of the site.
- F. Notes:
 - 1. The maximum permissible velocity for vegetated waterways must be considered when designing an exit channel.
 - 2. For a give H_p , a decrease in the exit slope from S as given in the table decreases spillway discharge, but increasing the exit slope from S does not increase discharge. If an exit slope (S_e) steeper than S is used, then the exit should be considered an open channel and analyzed using Mannings Equation.
 - 3. Data to the right of heavy vertical lines should be used with caution, as the resulting sections will be either poorly proportioned or have excessive velocities.
- G. The emergency spillway should not be constructed over fill material.
- H. The emergency spillway should be stabilized with temporary vegetation upon completion of the basin.

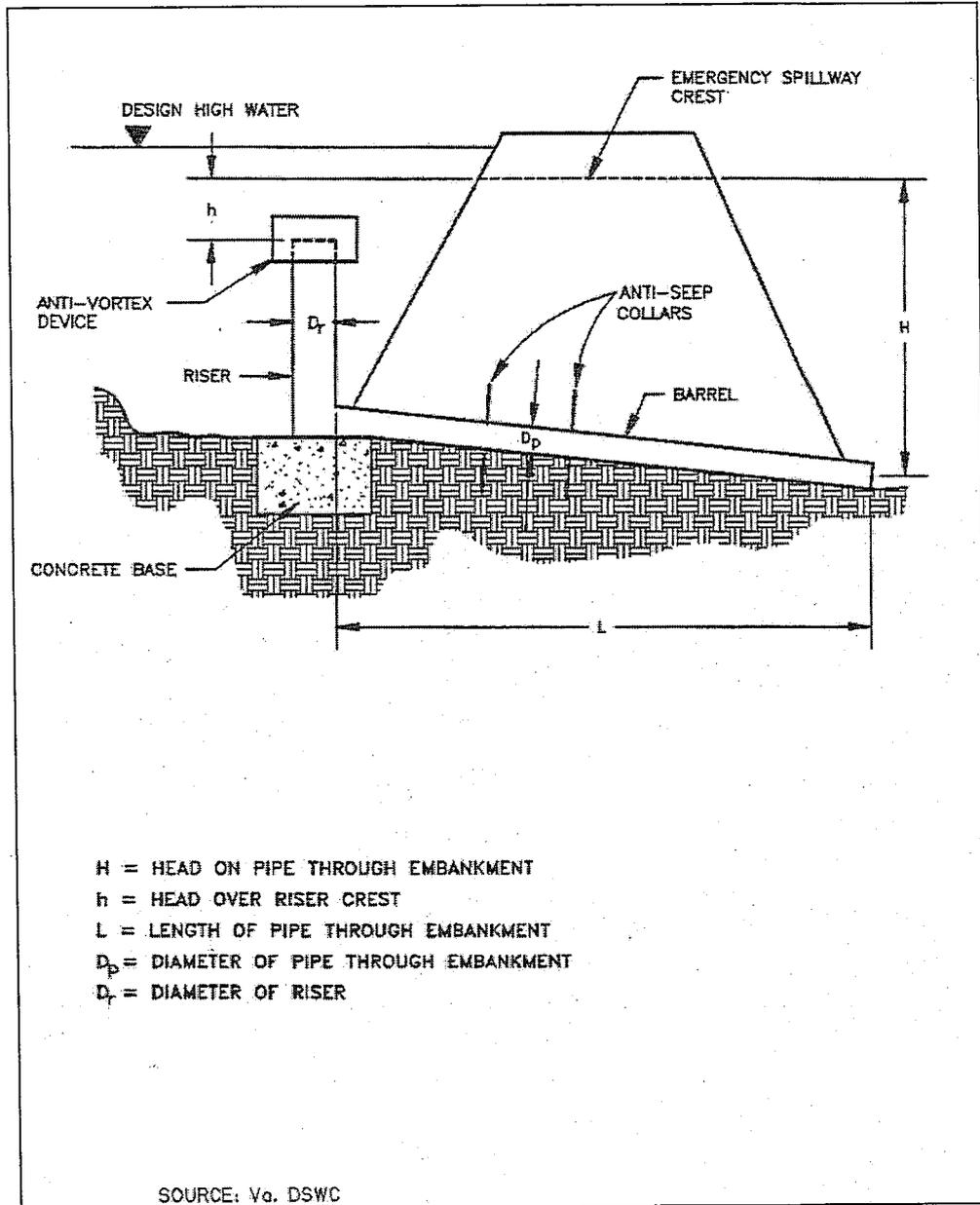


Figure D – 1. Basin Outlet Design

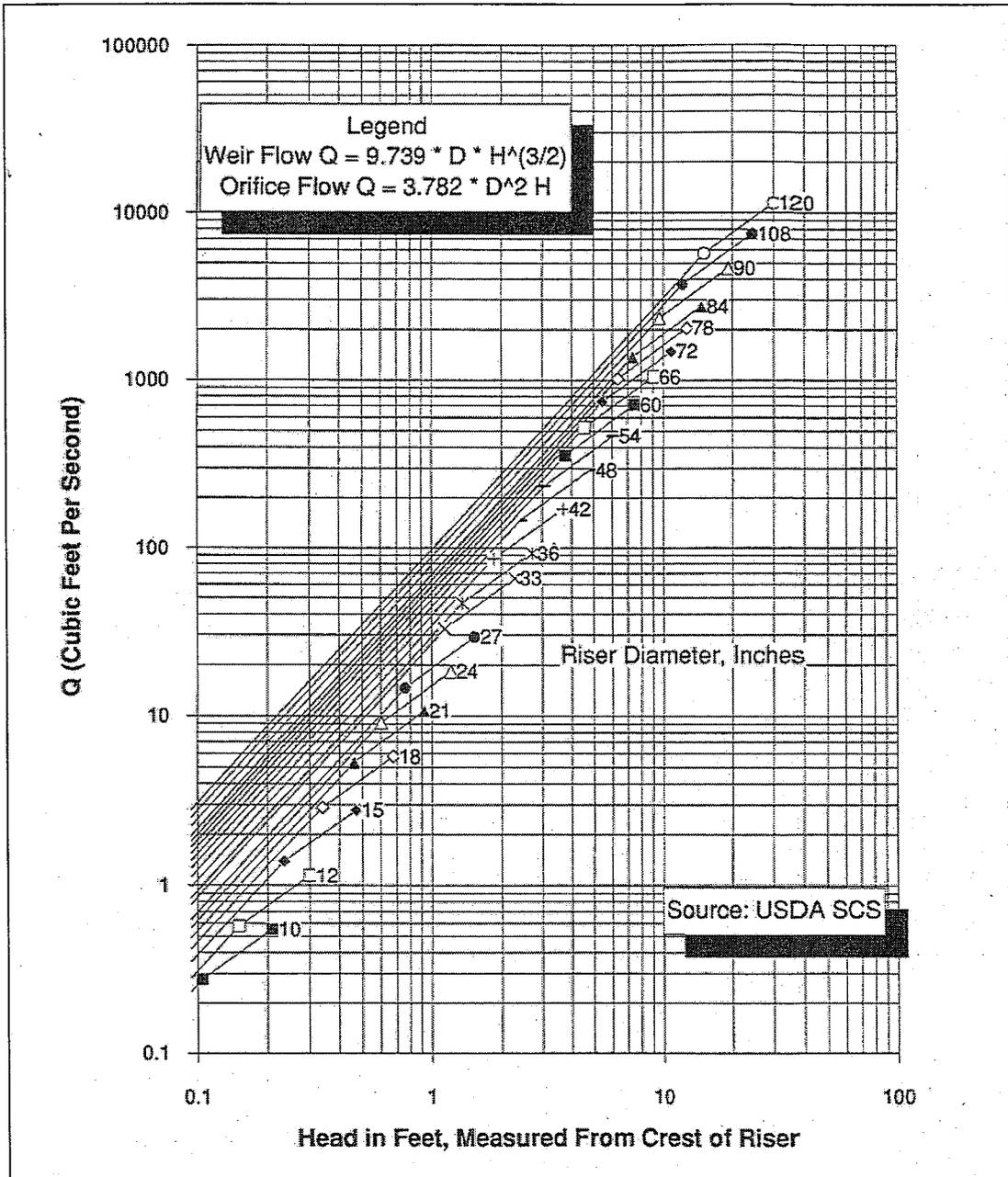


Figure D-2. Riser Inflow Curves

For Reinforced Concrete Pipe Inlet Km = Ke + Kb = 0.65 and 70 Feet of Reinforced Concrete Pipe Conduit (Full Flow Assumed)
 Note: Correction Factors for pipe lengths other than 70 feet

Head (in feet)	Pipe Diameter in Inches																	
	12	15	18	21	24	30	36	42	48	54	60	66	72	78	84	90	96	102
1	3.22	5.44	8.29	11.9	15.9	26	38.6	53.8	71.4	91.5	114	139	167	197	229	264	302	342
2	4.55	7.69	11.7	16.7	22.5	36.8	54.6	76	101	129	161	197	236	276	324	374	427	483
3	5.57	9.42	14.4	20.4	27.5	45	66.9	93.1	124	159	198	241	289	341	397	459	523	592
4	6.43	10.9	16.6	23.5	31.8	52	77.3	106	143	183	228	278	334	394	440	513	591	674
5	7.19	12.2	18.5	26.3	35.5	58.1	86.4	120	160	205	255	311	373	440	513	591	675	764
6	7.89	13.3	20.3	28.8	38.9	63.7	94.6	132	175	224	280	341	409	482	562	647	739	837
7	8.51	14.4	21.9	31.1	42	68.6	102	142	189	242	302	368	441	521	607	699	798	904
8	9.1	15.4	23.5	33.3	44.9	73.5	109	152	202	259	323	394	472	557	645	748	854	966
9	9.65	16.3	24.9	35.3	47.7	78	116	161	214	275	342	418	500	590	688	793	905	1023
10	10.2	17.2	26.2	37.2	50.2	82.2	122	170	226	289	361	440	527	622	725	836	954	1080
11	10.7	18	27.5	39	52.7	86.2	128	178	237	304	379	462	553	653	761	877	1001	1133
12	11.1	18.9	28.7	40.8	55	90.1	134	186	247	317	395	482	578	682	794	916	1045	1194
13	11.6	19.6	29.9	42.4	57.3	93.7	139	194	257	330	411	502	601	710	827	953	1088	1232
14	12	20.4	31	44.1	59.4	97.3	145	201	267	342	427	521	624	736	858	989	1129	1278
15	12.5	21.1	32.1	45.9	61.5	101	150	208	277	354	442	539	646	762	888	1024	1169	1323
16	12.9	21.8	33.2	47.1	63.5	104	155	215	286	366	457	557	667	787	917	1057	1207	1367
17	13.3	22.4	34.2	48.5	65.5	107	159	222	294	377	471	574	688	812	946	1090	1244	1409
18	13.7	23.1	35.2	49.9	67.4	110	164	228	303	388	484	591	709	835	973	1121	1280	1450
19	14	23.7	36.1	51.3	69.2	113	168	234	311	399	497	607	727	858	1000	1152	1315	1489
20	14.4	24.3	37.1	52.8	71	116	173	240	319	409	510	623	746	880	1026	1182	1350	1528
21	14.7	24.9	38	53.9	72.8	119	177	246	327	419	523	638	764	902	1051	1211	1363	1566
22	15.1	25.5	38.9	55.2	74.5	122	181	252	335	429	535	653	782	923	1076	1240	1415	1603
23	15.4	26.1	39.8	56.5	76.2	125	186	258	342	439	547	668	800	944	1100	1268	1447	1639
24	15.8	26.7	40.6	57.7	77.8	127	189	263	350	448	559	682	817	964	1123	1295	1478	1674
25	16.1	27.2	41.5	58.9	79.4	130	193	269	357	458	571	696	834	984	1147	1322	1509	1708
26	16.4	27.7	42.3	60	81	133	197	274	364	467	582	710	850	1004	1169	1348	1539	1742
27	16.7	28.3	43.1	61.2	82.5	135	201	279	371	476	593	723	867	1023	1192	1373	1568	1775
28	17	28.8	43.9	62.3	84.1	138	204	285	378	484	604	737	883	1041	1214	1399	1597	1808
29	17.3	29.3	44.7	63.4	85.5	140	208	290	384	493	615	750	898	1060	1235	1423	1625	1840
30	17.6	29.8	45.4	64.5	87	142	212	294	391	501	625	763	913	1079	1256	1448	1653	1871

Correction Factors for Other Pipe Lengths	
Head (ft)	Factor
20	1.08
30	1.07
40	1.05
50	1.03
60	1.02
70	1.01
80	0.99
90	0.98
100	0.97
120	0.94
140	0.91
160	0.88

Source: USDA SCS

Table D-1. Pipe Flow Chart, n= 0.013

For Corrugated Metal Pipe Inlet Km = $K_e + K_b = 0.65$ and 70 Feet of Corrugated Metal Pipe Conduit (Full Flow Assumed)
 Note: Correction Factors for pipe lengths other than 70 feet

Head (In feet)	Pipe Diameter in Inches																				Correction Factors for Other Pipe Lengths
	6	8	10	12	15	18	21	24	30	36	42	48	54	60	66	72	78	84	90	96	
1	0.33	0.7	1.25	1.98	3.48	5.47	7.99	11	18.8	28.8	41.1	56.7	75.8	91.8	113	137	163	191	222	255	290
2	0.47	0.99	1.76	2.8	4.92	7.74	11.3	15.6	26.6	40.8	59.2	78.8	103	130	160	194	231	271	314	360	410
3	0.58	1.22	2.16	3.43	6.02	9.48	13.8	19.1	32.6	49.9	71.2	98.5	126	159	196	237	282	331	384	441	502
4	0.67	1.4	2.49	3.97	6.96	10.9	16	22.1	37.6	57.4	82.3	111	145	184	226	274	326	383	444	510	580
5	0.74	1.57	2.79	4.43	7.78	12.2	17.9	24.7	43.1	64.5	92	125	162	205	253	305	365	428	496	570	648
6	0.82	1.72	3.05	4.86	8.52	13.4	19.6	27	46.1	70.6	101	136	178	229	277	336	399	469	544	624	710
7	0.88	1.86	3.3	5.25	9.2	14.5	21.1	29.2	49.8	76.3	109	147	192	243	300	362	431	506	587	674	767
8	0.94	1.99	3.53	5.61	9.84	15.5	22.6	31.2	53.2	81.5	116	158	205	260	320	388	461	541	628	721	820
9	1	2.11	3.74	5.95	10.4	16.4	24	33.1	58.4	86.5	123	167	218	275	340	411	489	574	666	764	870
10	1.05	2.22	3.94	6.27	11	17.3	25.3	34.9	59.5	91.2	130	176	230	290	358	433	516	605	702	806	917
11	1.1	2.33	4.13	6.58	11.5	18.2	26.5	36.6	62.4	95.6	136	185	241	304	376	454	541	635	736	845	962
12	1.15	2.43	4.32	6.87	12.1	19	27.7	38.2	65.2	99.9	142	193	252	316	392	475	565	663	769	883	1004
13	1.2	2.53	4.49	7.15	12.6	19.7	28.8	39.8	67.8	104	148	201	262	331	408	494	588	690	800	919	1045
14	1.25	2.63	4.66	7.42	13	20.5	29.9	41.3	70.4	108	154	208	272	343	424	513	610	716	830	953	1085
15	1.29	2.72	4.83	7.68	13.5	21.2	30.9	42.8	72.8	112	159	216	281	355	438	531	631	741	860	987	1123
16	1.33	2.81	4.99	7.93	13.9	21.9	32	44.2	75.2	119	165	223	290	367	453	548	652	765	888	1019	1160
17	1.37	2.9	5.14	8.18	14.3	22.6	32.9	45.5	77.5	119	170	230	300	378	467	565	672	789	915	1051	1195
18	1.41	2.98	5.29	8.41	14.6	23.2	33.9	46.8	79.8	120	174	235	308	389	480	581	692	812	942	1081	1230
19	1.45	3.06	5.43	8.64	15.2	23.9	34.8	48.1	82	126	179	243	318	400	494	597	711	834	967	1111	1264
20	1.49	3.14	5.57	8.87	15.6	24.5	35.7	49.4	84.1	129	184	249	325	410	506	613	729	856	993	1139	1297
21	1.53	3.22	5.71	9.09	15.9	25.1	36.6	50.6	86.2	132	188	255	333	421	519	628	747	877	1017	1168	1329
22	1.56	3.29	5.85	9.3	16.3	25.7	37.5	51.8	88.2	135	193	261	341	430	531	643	765	899	1041	1193	1350
23	1.6	3.37	5.98	9.51	16.7	26.2	38.3	53	90.2	138	197	267	348	440	543	657	782	918	1064	1222	1390
24	1.63	3.44	6.11	9.72	17	26.8	39.1	54.1	92.1	141	201	273	356	450	555	671	798	937	1087	1248	1420
25	1.66	3.51	6.23	9.92	17.4	27.4	39.9	55.2	94	144	206	279	363	459	565	685	815	967	1110	1274	1450
26	1.7	3.58	6.36	10.1	17.7	27.9	40.7	56.3	95.9	147	210	284	370	468	577	699	831	976	1132	1299	1478
27	1.73	3.65	6.48	10.3	18.1	28.4	41.5	57.4	97.7	150	214	290	377	477	588	712	847	994	1153	1324	1507
28	1.76	3.72	6.6	10.5	18.4	28.9	42.3	58.4	99.5	153	218	296	384	486	599	725	863	1013	1174	1348	1534
29	1.79	3.78	6.71	10.7	18.7	29.5	43	59.5	101	155	221	300	391	494	610	738	878	1030	1195	1372	1561
30	1.82	3.85	6.83	10.9	19.1	30	43.7	60.5	103	156	225	305	396	503	620	750	893	1048	1216	1396	1589
20	1.69	1.63	1.58	1.53	1.47	1.42	1.37	1.34	1.28	1.24	1.2	1.18	1.16	1.14	1.13	1.11	1.1	1.1	1.09	1.08	1.00
30	1.44	1.41	1.39	1.36	1.32	1.29	1.27	1.24	1.21	1.18	1.15	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.07	1.06	1.06
40	1.28	1.27	1.25	1.23	1.21	1.2	1.18	1.17	1.14	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.05	1.05	1.05	1.05	1.04
50	1.16	1.16	1.15	1.14	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.03	1.03	1.03
60	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01
70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
80	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99
90	0.89	0.89	0.9	0.9	0.91	0.91	0.92	0.92	0.92	0.93	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.97	0.97	0.97	0.94
100	0.85	0.85	0.86	0.87	0.87	0.88	0.89	0.89	0.9	0.91	0.92	0.93	0.93	0.93	0.94	0.94	0.95	0.95	0.95	0.95	0.94
120	0.78	0.79	0.8	0.81	0.82	0.83	0.83	0.85	0.85	0.86	0.87	0.88	0.89	0.89	0.9	0.91	0.91	0.92	0.93	0.93	0.94
140	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.81	0.82	0.84	0.85	0.86	0.87	0.88	0.88	0.89	0.9	0.91	0.91	0.92
160	0.68	0.69	0.69	0.7	0.71	0.73	0.74	0.75	0.77	0.79	0.8	0.82	0.83	0.84	0.85	0.85	0.87	0.88	0.89	0.89	0.9

Source: USDA SCS

Table D-2. Pipe Flow Chart, n=0.025

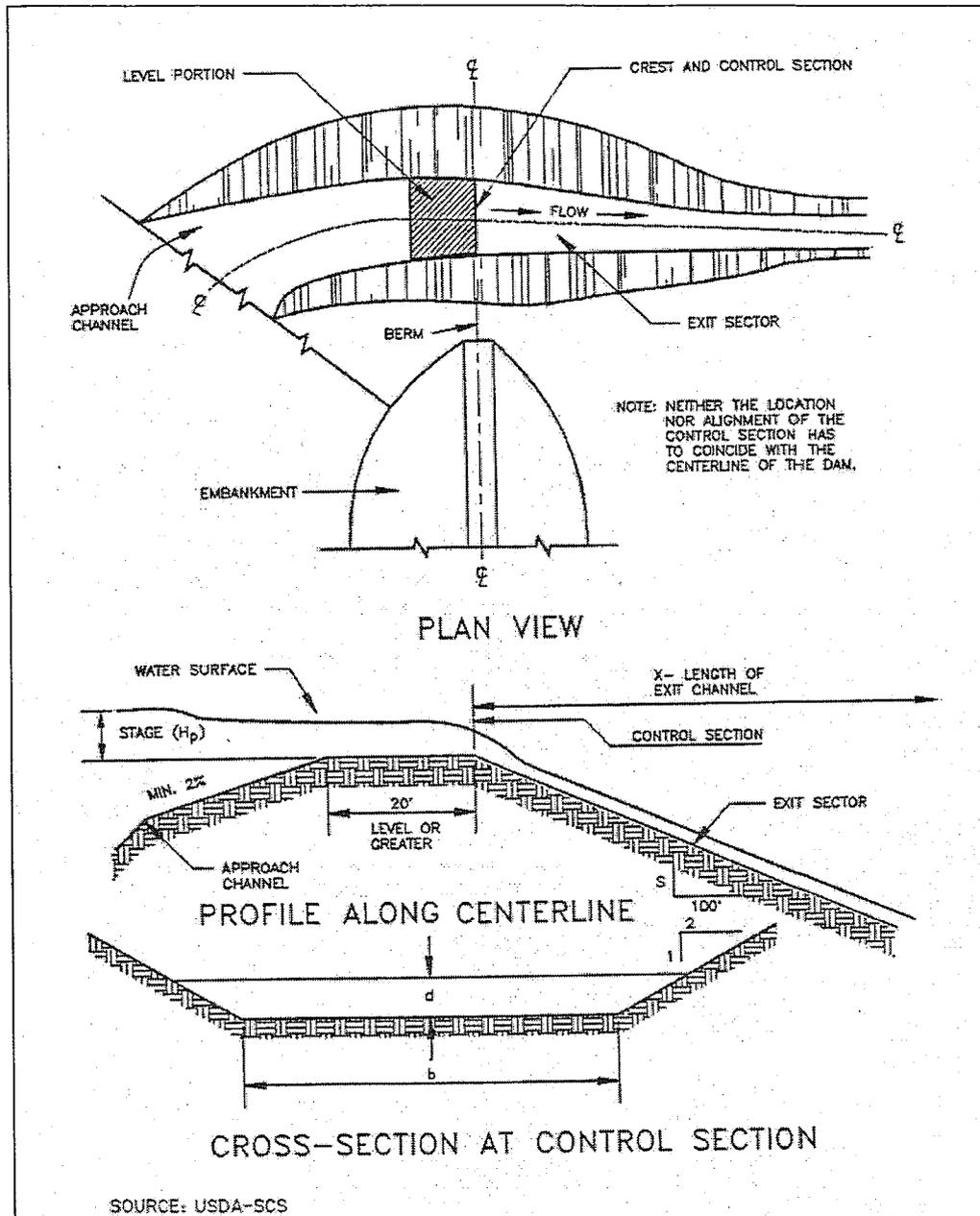


Figure D-3. Excavated Earth Spillway

Stage (Hp) In Feet	Spillway Variables	Bottom Width (b) in Feet																
		8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
0.5	Q	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28
	V	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	S	3.9	3.9	3.9	3.9	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
	X	32	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
0.6	Q	8	10	12	14	16	18	20	22	24	26	28	30	32	34	35	37	39
	V	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	S	3.7	3.7	3.7	3.7	3.6	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	X	36	36	36	36	36	36	37	37	37	37	37	37	37	37	37	37	37
0.7	Q	11	13	16	18	20	23	25	28	30	33	35	38	41	43	44	46	48
	V	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
	S	3.5	3.5	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
	X	39	40	40	40	41	41	41	41	41	41	41	41	41	41	41	41	41
0.8	Q	13	16	19	22	26	29	32	35	38	42	45	46	48	51	54	57	60
	V	3.5	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
	S	3.3	3.3	3.3	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
	X	44	44	44	44	44	45	45	45	45	45	45	45	45	45	45	45	45
0.9	Q	17	20	24	28	32	35	39	43	47	51	53	57	60	64	68	71	75
	V	3.7	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
	S	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
	X	47	47	48	48	48	48	48	48	48	48	48	49	49	49	49	49	49
1	Q	20	24	29	33	38	42	47	51	56	61	63	68	72	77	81	86	90
	V	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	S	3.1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	X	51	51	51	51	52	52	52	52	52	52	52	52	52	52	52	52	52
1.1	Q	23	28	34	39	44	49	54	60	65	70	74	79	84	89	95	100	105
	V	4.2	4.2	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
	S	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
	X	55	55	55	55	55	55	55	56	56	56	56	56	56	56	56	56	56
1.2	Q	28	33	40	45	51	58	64	69	76	80	86	92	98	104	110	116	122
	V	4.4	4.4	4.4	4.4	4.4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
	S	2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
	X	58	58	59	59	59	59	59	59	60	60	60	60	60	60	60	60	60
1.3	Q	32	38	46	53	58	65	73	80	86	91	99	106	112	119	125	133	140
	V	4.5	4.6	4.6	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
	S	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	X	62	62	62	63	63	63	63	63	63	63	63	64	64	64	64	64	64
1.4	Q	37	44	51	59	66	74	82	90	96	103	111	119	127	134	143	150	158
	V	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
	S	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
	X	65	66	66	66	66	67	67	67	67	67	67	68	68	68	68	68	69

Table D-3. Design Data for Earth Spillways

Stage (Hp) In Feet	Spillway Variables	Bottom Width (b) In Feet																
		8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
1.5	Q	41	50	58	66	75	85	92	101	108	116	125	133	142	150	160	169	178
	V	4.8	4.9	5	5	5	5	5	5	5	5	5	5	5	5	5.1	5.1	5.1
	S	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.5	2.5	2.5
	X	69	69	70	70	71	71	71	71	71	71	71	71	72	72	72	72	72
1.6	Q	46	56	65	75	84	94	104	112	122	132	142	149	158	168	178	187	197
	V	5	5.1	5.1	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
	S	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	X	72	74	74	75	75	76	76	76	76	76	76	76	76	76	76	76	76
1.7	Q	52	62	72	83	94	105	115	126	135	145	156	167	175	187	196	206	217
	V	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
	S	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	X	76	78	79	80	80	80	80	80	80	80	80	80	80	80	80	80	80
1.8	Q	58	69	81	93	104	116	127	138	150	160	171	182	194	204	214	226	233
	V	5.3	5.4	5.4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.6	5.6	5.6	5.6	5.6	5.6
	S	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	X	80	82	83	84	84	84	84	84	84	84	84	84	84	84	84	84	84
1.9	Q	64	76	88	102	114	127	140	152	164	175	188	201	213	225	235	248	260
	V	5.5	5.5	5.5	5.6	5.6	5.6	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
	S	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
	X	84	85	86	87	88	88	88	88	88	88	88	88	88	88	88	88	88
2	Q	71	83	97	111	125	138	153	164	178	193	204	218	232	245	256	269	283
	V	5.6	5.7	5.7	5.7	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.9	5.9	5.9	5.9	5.9	5.9
	S	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
	X	88	90	91	91	91	91	92	92	92	92	92	92	92	92	92	92	92
2.1	Q	77	91	107	122	135	149	162	177	192	207	220	234	250	267	276	291	305
	V	5.7	5.8	5.9	5.9	5.9	5.9	5.9	6	6	6	6	6	6	6	6	6	6
	S	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
	X	92	93	95	95	95	95	95	95	95	96	96	96	96	96	96	96	96
2.2	Q	84	100	116	131	146	163	177	194	210	224	238	253	269	288	301	314	330
	V	5.9	5.9	6	6	6	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2
	S	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
	X	96	98	99	99	99	99	99	100	100	100	100	100	100	100	100	100	100
2.3	Q	90	108	124	140	158	175	193	208	226	243	258	275	292	306	323	341	354
	V	6	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
	S	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	X	100	102	102	103	103	103	104	104	104	105	105	105	105	105	105	105	105
2.4	Q	99	116	136	152	170	189	206	224	241	260	275	294	312	327	346	364	378
	V	6.1	6.2	6.2	6.3	6.3	6.3	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
	S	2.3	2.3	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
	X	105	105	106	107	107	108	108	108	108	109	109	109	109	109	109	109	109

Source: USDA - SCS

Table D-3. Design Data for Earth Spillways (continued)

- X. Re-estimate the elevation of the design high water and the top of the dam based upon the design of the basin outfall and the emergency spillway.

XI. Anti-Vortex Device and Trash Rack

- A. An anti-vortex device and trash rack shall be attached to the top of the basin riser to improve the flow of water into the spillway and prevent floating debris from being carried out of the basin.
- B. This design procedure for the anti-vortex device and trash rack refers only to riser pipes of corrugated metal. There are numerous ways to provide protection for concrete pipe; these include various hoods and grates and rebar configurations which should be a part of project-specific design and will frequently be a part of a permanent structure.
- C. Refer to Figure D-4 and Table D-4. Choose cylinder size, support bars, and top requirements from Table D-4 based on the diameter of the riser pipe.

XII. Anchoring the Basin Outlet

- A. The basin outlet must be firmly anchored to prevent its floating.
- B. If the riser is over 10 feet high, the forces acting on the spillway must be calculated. A method of anchoring the spillway which provides a safety factor of 1.25 must be used (downward forces = 1.25 x upward forces).
- C. If the riser is 10 feet or less in height, choose one of the two methods in Figure D-5 to anchor the basin outlet.

XIII. Dewatering

- A. Calculation of the diameter of the dewatering orifice:

Use a modified version of the discharge equation for a vertical orifice and a basic equation for the area of a circular orifice.

Naming the variables:

A = flow area of orifice, in square feet

d = diameter of circular orifice, in inches

h = average driving head (maximum possible head measured from radius of orifice to crest of basin outlet divided by 2), in feet

Q = volumetric flow rate through orifice needed to achieve approximate 6-hour drawdown, cubic feet per second

S = total storage available in dry storage area, cubic feet

$Q = S/21,600$ seconds

- B. An alternative approach for dewatering is the use of a perforated riser (0.75" to 1" diameter holes spaced every 12" horizontally and 8" vertically) with 1-1/2" to 2" filter stone stacked around the exterior.

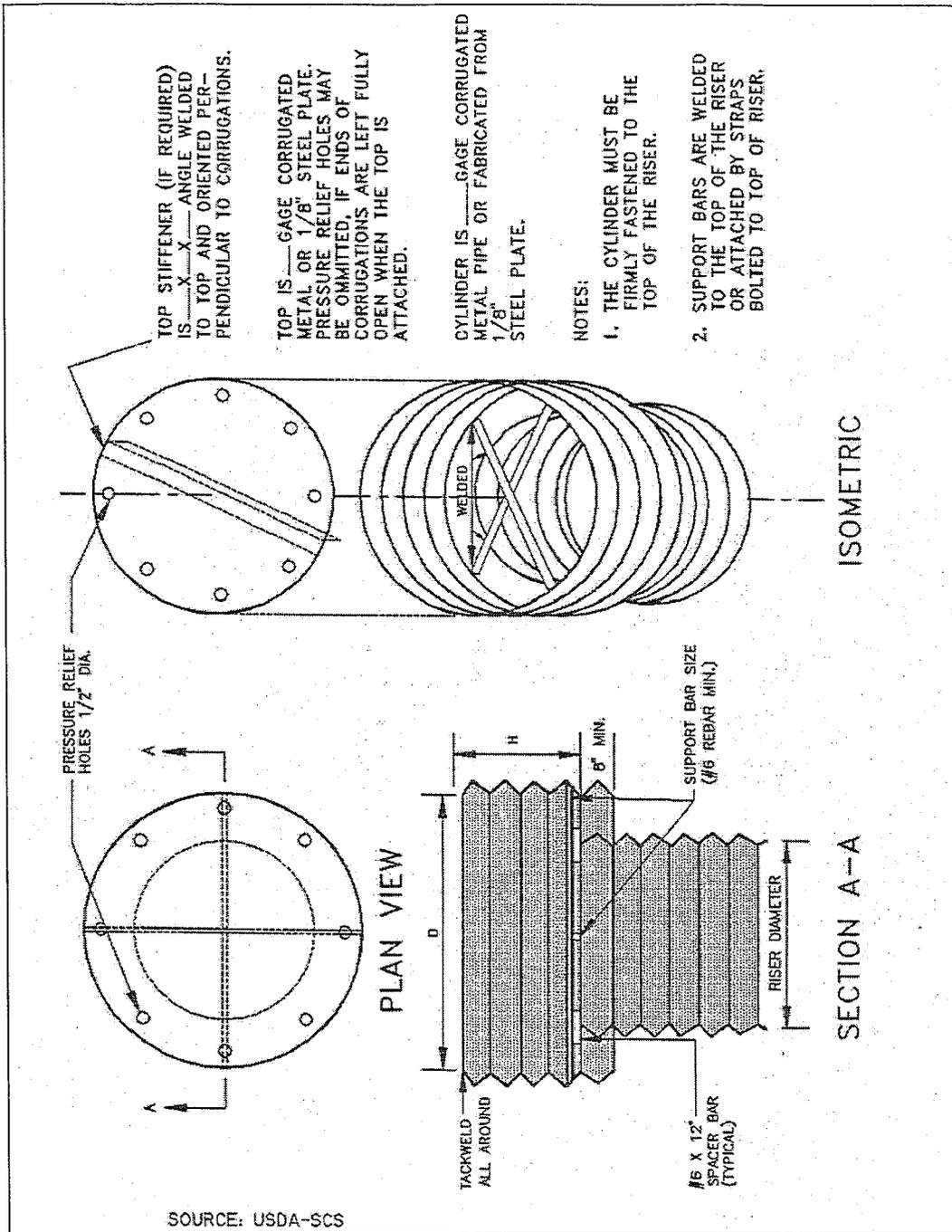


Figure D-4. Anti-Vortex Design

Riser Diam., in.	Cylinder		Height inches	Minimum Size Support Bar	Minimum Top	
	Diameter inches	Thickness gage			Thickness	Stiffener
12	18	16	6	#6 Rebar or 1 ½ x 1 ½ x 3/16 angle	16 ga. (F&C)	-
15	21	16	7	" "	" "	-
18	27	16	8	" "	" "	-
21	30	16	11	" "	16 ga.(C), 14 ga.(F)	-
24	36	16	13	" "	" "	-
27	42	16	13	" "	" "	-
36	54	14	17	#8 Rebar	14 ga.(C), 12 ga.(F)	-
42	60	16	19	" "	" "	-
48	72	16	21	1 ½" pipe or 1 ½ x 1 ½ x ¼ angle	14 ga.(C), 10 ga.(F)	-
54	78	16	25	" "	" "	-
60	90	14	29	1 ½" pipe or 1 ½ x 1 ½ x ¼ angle	12 ga.(C), 8 ga.(F)	-
66	96	14	33	2" pipe or 2 x 2 x 3/16 angle	12 ga.(C), 8	2 x 2 x ¼ angle
72	102	14	36	" "	" "	2 ½ x 2 ½ x ¼ angle
78	114	14	39	2 ½" pipe or 2 ½ x ¼ angle	" "	" "
84	120	12	42	2 ½" pipe or 2 ½ x 2 ½ x ¼ angle	" "	2 ½ x 2 ½ x 5/16 angle

Note₁: The criterion for sizing the cylinder is that the area between the inside of the cylinder and the outside of the riser is equal to or greater than the area inside the riser. Therefore, the above table is invalid for use with concrete pipe risers.

Note₂: Corrugation for 12"-36" pipe measures 2 ¾ x ¼"; for 42"-84" the corrugation measures 5" x 1" or 8" x 1".

Note₃: C = corrugated; F = flat.

Source: Adapted from USDA-SCS and Carl M. Henshaw Drainage Products Information.

Table D-4. Trash Rack and Anti-Vortex Device Design Table

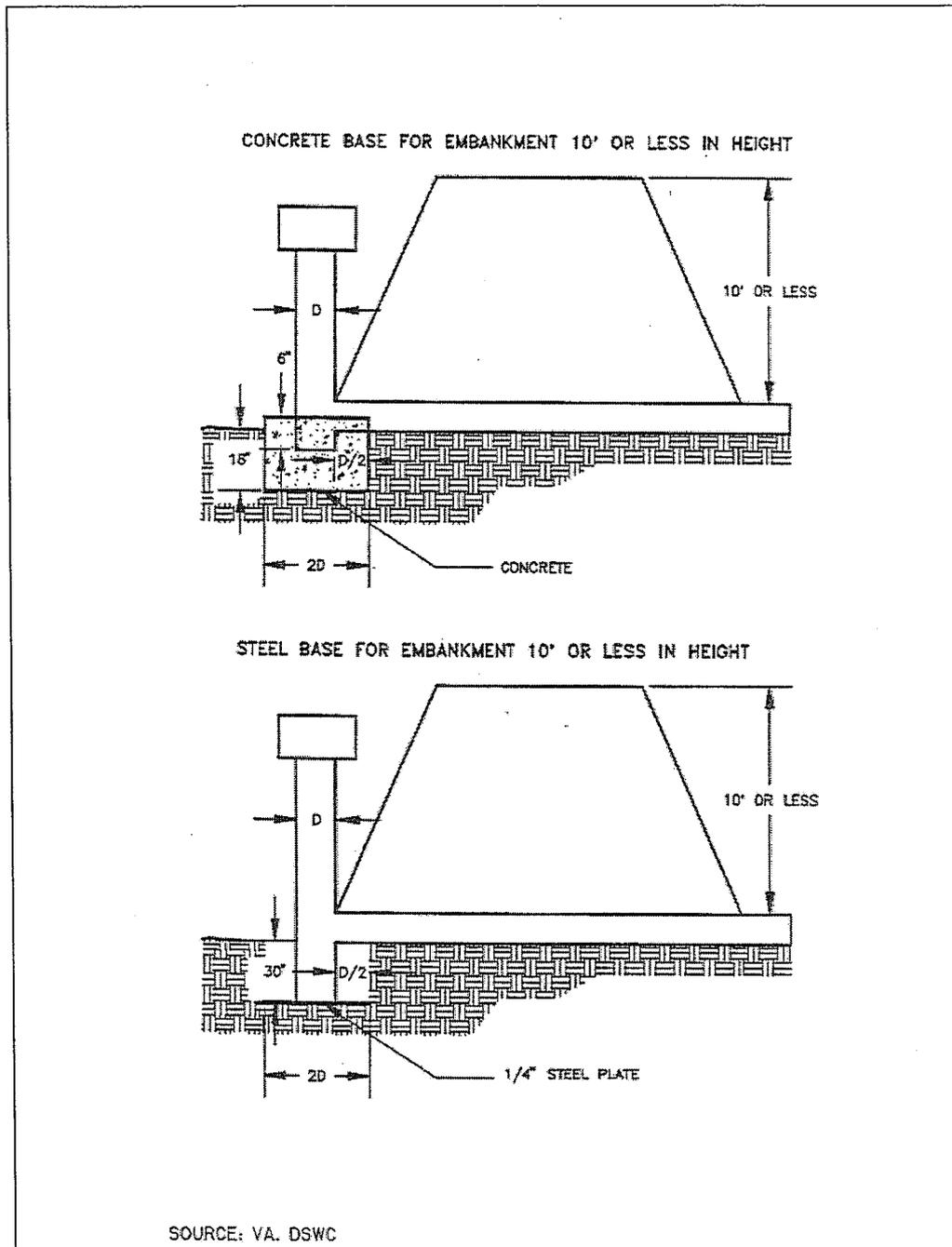


Figure D-5. Riser Pipe Base Design for Embankment Less Than 10' High

Use S for basin and find Q. Then substitute in calculated Q and find A:

$$A = \frac{Q}{(0.6) \times \frac{(64.32 \times h)}{2}}$$

Then, substitute in calculated A and find d:

$$d^* = 2 \times \frac{(A)}{(3.14)}$$

*Diameter of dewatering orifice should never be less than 3 inches in order to help prevent clogging by soil or debris.

Note: Flexible tubing used should be at least 2 inches larger in diameter than the calculated orifice to promote improved flow characteristics.

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

Project _____

Basin # _____ Location _____

Total area draining to basin: _____ acres.

Total disturbed area draining to basin: _____ acres.

Basin Volume Design

1. Minimum required volume is the lesser of
 - a.) $(3600 \text{ cu. ft.} \times \text{_____ total drainage acres}) / 27 = \text{_____ cu. yds.}$
 - b.) $2 \text{ yr, } 24 \text{ hr storm volume in cubic yards} = \text{_____ cu. yds.}$
2. Total available basin volume at crest of riser* = _____ cu. yds. at elevation _____. (From Storage - Elevation Curve)

* Minimum = Lesser of 3600 cubic feet/acre of Total Drainage Area or
2yr. 24 hr. storm volume from Disturbed Area drained

3. Excavate _____ cu. yds. to obtain required volume*.
*Elevation corresponding to required volume = invert of the dewatering orifice.
4. Diameter of dewatering orifice = _____ in.
5. Diameter of flexible tubing = _____ in. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations

6. Crest of Riser = _____
Top of Dam = _____
Design High Water = _____
Upstream Toe of Dam = _____

Basin Shape

7. $\frac{\text{Length of Flow}}{\text{Effective Width}} = \frac{L}{We} = \text{_____}$
If > 2 , baffles are not required _____
If < 2 , baffles are required _____

Runoff

8. $Q_2 =$ _____ cfs (From TR-55)

9. $Q_{25} =$ _____ cfs (From TR-55)

Basin Outlet Design

10. With emergency spillway, required basin outlet capacity $Q_p = Q_2 =$ _____ cfs.
(riser and outfall)

Without emergency spillway, required basin outlet capacity $Q_p = Q_{25} =$ _____ cfs.
(riser and outfall)

11. With emergency spillway:

Assumed available head (h) = _____ ft. (Using Q_2)

$h =$ Crest of Emergency Spillway Elevation - Crest of Riser Elevation

Without emergency spillway:

$h =$ Design High Water Elevation - Crest of Riser Elevation

12. Riser diameter (D_r) = _____ in. Actual head (h) = _____ ft.

(Figure D-2)

Note: Avoid orifice flow conditions.

13. Barrel length (l) = _____ ft.

Head (H) on outfall through embankment = _____ ft.

(Figure D-1)

14. Barrel Diameter = _____ in.

(From Table D-1 [concrete pipe] or Table D-2 [corrugated pipe]).

15. Trash rack and anti-vortex device

Diameter = _____ inches.

Height = _____ inches.

(From Table D-3).

Emergency Spillway Design

16. Required spillway capacity $Q_e = Q_{25} - Q_p =$ _____ cfs.

17. Bottom width (b) = _____ ft.; the slope of the exit channel(s) = _____ ft./foot; and the minimum length of the exit channel (x) = _____ ft.
(From Table D-4).

Final Design Elevations

18. Top of Dam = _____
Design High Water = _____
Emergency Spillway Crest = _____
Basin Riser Crest = _____
Dewatering Orifice Invert = _____

Elevation of Upstream Toe of Dam
(if excavation was performed) = _____