Erosion and Sediment Control Program Manual

City of Lenexa
Community Development
Stormwater Management Division

Revised February 2013

Lenexa
KANSAS

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Introduction

Purpose

This manual is intended to provide guidance for the implementation of Lenexa's Erosion and Sediment Control (ESC) Program. It compiles and summarizes ESC related information, policies, procedures, and documents. The manual is intended to be a "living document" and will be updated and revised as the program is implemented.

Program Background

The mission of the Watershed Management Division is to reduce flooding, protect water and environmental quality and create recreational opportunities for the citizens of Lenexa through a proactive, integrated, watershed-based approach to storm water management. Lenexa's Watershed Management Division was established in the summer of 2000 to implement the city's innovative new storm water management program. Building on Lenexa's Vision 2020, the city adopted Stomwater Management Policies, which laid the groundwork for the City's new Erosion and Sediment Control (ESC) Program.

- For more information about the City's ESC program, contact Tom Jacobs, Stormwater Engineer, at 913-477-7644 or email at tjacobs@lenexa.com
- For information about construction site erosion controls and field inspections contact Dale Clark, Stormwater Technician II, at 913-477-7685 or email at dclark@lenexa.com .

Regulatory History

In 1987, the Clean Water Act (CWA) was expanded to govern storm water discharges from municipal separate storm sewer systems (MS4s). EPA's Storm Water Program prohibited discharges from an MS4 without a National Pollution Discharge Elimination System (NPDES) permit. Storm water was regulated under the NPDES program using a phased approach. Phase I regulated discharges from large and medium MS4s (Population > 100,000), various industrial activities, and construction sites greater than 5 acres. Phase II expanded the program to regulate discharges from small MS4s (located in urbanized areas) and construction sites greater than 1 acre. Since Lenexa is located in an urbanized area, the Kansas Department of Health and Environment (KDHE) designated the City of Lenexa as a Phase II-regulated small MS4.

On October 1, 2004, the City of Lenexa was issued a Phase II NPDES permit which required best management practices (BMPs) to be implemented in six program areas. These program areas include: public education and outreach, illicit discharge detection and elimination, control of construction site runoff, post-construction storm water management, and pollution prevention/good housekeeping. As required by the

Phase II NPDES permit, the City of Lenexa developed a Storm Water Management Plan which addressed the six required program elements.

The Storm Water Management Plan required the City of Lenexa to develop an Erosion and Sediment Control ordinance. This requirement had already been met through the Land Disturbance Provisions (Article 4-1-N) which were adopted by the City of Lenexa on July 1, 2001. The Land Disturbance Provisions are intended to: control storm water runoff from construction activities; protect property from damage due to flooding and erosion; reduce water pollution and improve water quality; and, protect stream assets and valuable natural resources. These provisions are the cornerstone of the City's Erosion and Sediment Control Program and will be discussed in detail throughout this manual. A copy of the Land Disturbance Provisions is included in Appendix A.

Erosion and Sediment Control Principles

Erosion

Erosion is caused by the action of wind, rainfall, and runoff on bare soil. This manual deals specifically with erosion caused by rainfall and storm water runoff. The force of raindrops and surface runoff can detach soil particles from bare soil, making them available for transportation as sediment. A sites' erosion potential is influenced by several factors including soil type, vegetative cover, slope, and climate. Construction site clearing, grading, and other activities remove vegetation and expose bare soil, which can increase storm water runoff and erosion. Excessive runoff from construction sites can cause gully erosion, stream bank instability, and poor water quality. The following construction storm water best management practices (BMPs) are commonly used to control soil erosion:

- Erosion control blankets
- Diversion ditches
- Seeding/mulching
- Stabilized traffic areas and stream crossings
- Work phasing

Sedimentation

Sediment deposition occurs when the storm water runoff flows are insufficient for the transportation of soil particles. Heavier soil particles (sand and gravel) are deposited first as flow decreases. Lighter soil particles (silt and clay) are transported more easily and may travel significant distances from sources of erosion. Excess sediment from construction sites can plug storm water infrastructure, create hazardous driving conditions, and degrade water quality and aquatic habitats. There are many BMPs that are designed to reduce construction storm water runoff flows and keep sediment onsite. The following BMPs are commonly used to control sediment:

- Silt fence

- Mulch berms
- Triangular silt dikes
- Terracing
- Rock check dams
- Sediment basins
- Storm sewer inlet protection

BMP Design Criteria

In August 2003, the Kansas City Metropolitan Chapter of the American Public Works Association adopted Division 5100 Erosion and Sediment Control Design Criteria (APWA 5100). APWA 5100 establishes uniform erosion and sediment control standards for the proper design and implementation of construction storm water BMPs. The City of Lenexa has adopted APWA 5100 by reference in Section 4-1-N-12 of the Land Disturbance Provisions. A copy of APWA 5100 is included in Appendix B.

Land Disturbance Provisions

Summary

On July 1, 2001, the City of Lenexa expanded Chapter 4-1 (Zoning) of the Unified Development Code by adopting Article 4-1-N, Land Disturbance Provision. These provisions are intended to: control storm water runoff from construction activities; protect property from damage due to flooding and erosion; reduce water pollution and improve water quality; and, protect stream assets and valuable natural resources. These provisions are also intended to encourage responsible, high quality development that protects and enhances the quality of life for those who visit, reside, and work in the City. Article 4-1-N, Land Disturbance Provision is included as Appendix A.

The Land Disturbance Provisions (LDP) require that a permit be obtained for any land disturbance activity that disturbs more than 100 cubic yards of soil and/or disturbs greater than 5,000 square feet of surface area. Agricultural farming, landscaping/home gardening, reestablishment of lawn areas, and emergency activities are exempt from this requirement. The following process should be followed to obtain a Land Disturbance Permit:

- Submit completed application form, review fee ($100) and engineered plans to the Lenexa Planning Department. Contact the Development Engineering Division with questions regarding plan requirements or submittal package.
- Initial review and comment by the City (10 working day review timeframe for Land Disturbance Permit – review time is longer for Building Permit).
- Applicant revises plans to address City comments and questions and submits revised plan set (this process may occur more than once).
- City approves plans (typically applicant is notified by phone).

- Applicant schedules and holds pre-construction meeting with City planning staff, construction contractors, superintendent, and Erosion and Sediment Control Inspector.
- Pay fee and obtain Land Disturbance Permit. The permit fee is $165 per acre for commercial and subdivision. The fees and performance guaranty are required at issuance.

Engineered Plans

If not otherwise included in a separate development application, the following information must be submitted to the Planning Director:

- a vicinity map showing the location of the site in relation to the surrounding area's water courses, water bodies, significant geographic and natural features, streets, and other significant structures;
- a site map including information specified in Section 4-1-N-8;
- Erosion and Sediment Control Plan & details including information specified in Section 4-1-N-9 (see Appendix C for an Erosion and Sediment Control Plan review checklist);
- a work schedule meeting the requirements of Section 4-1-N-10;
- the permit fee as set forth in Section 4-1-N-16;
- a performance guaranty as required by Section 4-1-N-22; and
- an engineering soils report in compliance with Section 4-1-N-11, only when specifically requested by the City.

See Appendix A: Land Disturbance Provisions for specific requirements described above.

Inspections/Meetings

After the Engineered Plans are approved, the applicant schedules and holds a pre-construction meeting with construction contractors, site superintendents, City planning staff, and the City's Erosion and Sediment Control Inspector. During this meeting, the applicant must provide a point of contact for erosion and sediment control activities. This person will be contacted as needed regarding any deficiencies in erosion and sediment controls, complaints, etc.

LDP Section 4-1-N-6, E states that by applying for a Land Disturbance Permit, the applicant or landowner performing or allowing the work consents to the City's right to enter the site for the purpose of inspecting compliance with the approved plan or for performing any work necessary to bring the site into compliance with the approved plan. Each site will be inspected as necessary to ensure that erosion and sediment control measures are installed and effectively maintained. At the discretion of the Community Development Director, inspections may occur at any or all of the following stages:

- upon installation of perimeter erosion and sediment controls, prior to proceeding with any other land disturbance activity;
- during the construction of sediment basins or storm water management structures, at the inspection points required by the permit;
- during rough grading, including hauling of imported or wasted materials;
- prior to the removal or substantial modification of any erosion and sediment control measure or practices; and
- upon completion of final grading, including establishment of ground covers and planting, installation of all vegetative measures, and all other work in accordance with the approved plan.

Requests for inspections shall be made at least twenty-four (24) hours in advance (exclusive of Saturdays, Sundays, and holidays) of the time of inspection desired.

Enforcement

In the event that work does not conform to the permit or conditions of approval or to the approved plan or to any instructions of the City, notice to comply shall be given to the permittee in writing. After a notice to comply is given, the permittee or the permittee's contractor (s) shall be required to make the corrections within the time period determined by the City. If an imminent hazard exists, the City shall require that the corrective work begin immediately.

Any permit may be suspended by the City, after notice, if the Community Development Director determines that:

- the site is not in substantial compliance with the approved plan or any permit condition;
- a violation of any provision of the Land Disturbance Ordinance or any other applicable law, ordinance, rule, or regulation relating to the work exists;
- a condition exists or any act being done that constitutes or will create a nuisance or hazard or endangers or will endanger human life or the property of others; or
- the approved plan is failing to achieve required erosion and sediment control objectives due to improper control feature installation or maintenance, improper control feature material specification, or failure of said control features to perform anticipated erosion and sediment control functions successfully.

Additionally, the City may post a stop work order directing that all land disturbance activity cease immediately, provided that:

- the Community Development Director determines that the land disturbance activity violates a condition or requirement of the

permit or approved plan or any Land Disturbance Provisions or regulations;

- written warning notice has been furnished to the permittee or the permittee's representative that lists corrective measures required and the time within which corrections must be made; and
- the permittee fails to comply with the warning notice within the specified time.

A stop work order may be issued without warning notice where the Community Development Director determines that:

- land disturbance is taking place that requires a permit and one has not been approved;
- required erosion and sediment control measures are not installed, inspected, and approved before the land disturbance;
- the limits of disturbance are being violated; or
- inspection reveals the existence of any condition or any act that may create a nuisance, hazard, or endangers human life or the property of others.

A person must not continue or permit the continuance of work in an area covered by a stop work order, except to correct the deficiencies with respect to an erosion and sediment control measure.

Ten (10) working days after posting a stop work order, the Community Development Director, if the conditions specified in the stop work order to resume work, have not been satisfied, may issue a notice to appear in court to the permittee, owner, or land user and or the City's intent to perform work necessary to comply with the Land Disturbance Provisions. The City may go on the land and commence work after fourteen (14) working days from issuing the notice of intent. The costs incurred by the City to perform this work shall be paid by the owner or permittee out of the performance guaranty required by Section 4-1-N-22 of the Land Disturbance Provisions. In any event the amount due is not paid, the City Clerk shall certify the amount due to the Clerk of Johnson County, Kansas, and it shall become a lien upon all property. This amount shall be listed on the tax bill and be collected in the manner of ordinary taxes as authorized by law.

The City shall have the enforcement and remedial actions set forth in Section 4-2-I-2 of the City Code if any person allows or performs a land disturbance activity without obtaining a permit, as required by the Land Disturbance Provisions, allows or performs a land disturbance activity in a manner that does not comply with an approved plan or a permit, or works with a revoked or suspended permit.

Performance Guaranty

Prior to issuance of a Land Disturbance Permit, the applicant must submit a performance guaranty that meets the requirements of Section 4-1-N-22 of the Land Disturbance Provisions. The required performance guaranty shall be in the amount of $5,000 per acre up to a maximum guaranty of 25 acres or $125,000 (acreage amount is determined by rounding up to the next whole acre).

BMP Maintenance Responsibilities

The permittee or the owner of the property must inspect, maintain, and promptly repair all grade surfaces, walls, drains, dams, structures, plantings, vegetation, and other erosion and sediment control measures and devices. The permittee, owner, or their contractor shall provide daily maintenance and repair of all erosion and sediment control structures and measures. Daily inspection activities should be documented and kept on site in the Storm Water Pollution Prevention Plan. After construction is complete, the permittee, owner, or their agent shall continue to regularly inspect the vegetation on site until adequate turf or other suitable vegetative cover is established.

Any person who performs utility related work is responsible for the repair or maintenance of all erosion and sediment control measures affected by the utility construction; however, the site owner or permittee is ultimately responsible for erosion and sediment control throughout the life of the project or until a certificate of completion is issued by the City.

Storm Water Pollution Prevention Plan (SWPPP)

Regulatory Summary

The Kansas Department of Health and Environment (KDHE), Bureau of Water, Industrial Section has established a program to protect waters of the State from construction site storm water runoff. The storm water program requires owners or operators of any project, or combination of projects, who engages in construction activities disturbing one (1) or more acres to have authorization to discharge storm water runoff under the construction storm water general permit #S-MCST-0110-1. Owners or operators must submit a Notice of Intent (NOI) to comply with the general permit at least sixty (60) days before starting construction. A copy of the NOI form is attached in Appendix D. In addition to the NOI form and fee, the owner operator must send KDHE a copy of the Site Map and Erosion and Sediment Control Plan, which are also required by the City, per the Land Disturbance Ordinance. When the soil disturbing activity is completed and final stabilization of the site is achieved, the permittee must notify KDHE to terminate the authorization to discharge.

Required Elements

The primary requirement of KDHE's general construction storm water permit is for the permittee to develop and implement a Storm Water Pollution Prevention Plan

(SWPPP). A model SWPPP is included in Appendix D. EPA requires the SWPPP to address 12 elements:

1) demarcation of clearing (land disturbance) limits;
2) establishment of stabilized construction access;
3) control of runoff flow rates;
4) soil stabilization;
5) installation of sediment controls;
6) slope protection;
7) storm sewer inlet protection;
8) channel and outlet stabilization;
9) control of on-site pollutants;
10) dewatering control;
11) BMP maintenance; and
12) management of the project.

To address the required elements, the SWPP should include the following:

- Narrative description of:
  - regulatory background;
  - site location and existing conditions;
  - proposed construction and land disturbance activities;
  - work schedule/project phasing;
  - potential storm water contaminants;
  - storm water controls and best management practices (BMPs);
  - coordination of BMPs with construction activities;
  - BMP inspection and maintenance procedures; and
  - project contacts and coordination.
- Drawings
  - Vicinity Map
  - Site Map
  - Erosion and Sediment Control Plan
- Permits
  - Local (City land disturbance or building permits)
  - State (KDHE NOI approvals)
  - Federal (Corp of Engineers 404 permits)
- Signatures
  - Erosion and Sediment Control Plan and SWPPP must be prepared by a licensed engineer or a Certified Professional in Erosion and Sediment Control (CPESC).
- Site Inspection Forms/Logs (see Appendix E for an example erosion and sediment control inspection form)

KDHE requires the SWPPP to be kept on-site during the duration of the construction project and made available during an inspection. The City Erosion and Sediment Control Inspector will ask to see a copy of the SWPPP during site inspections. All inspection notes and plan revisions must be documented in the SWPPP.

Project Completion

Immediately upon completion of the project and after the site has been permanently stabilized, the permittee must notify the Public Works Director and schedule a final inspection. If, upon final inspection of the project, the Director finds that all work subject to the inspection has been satisfactorily completed in accordance with any Land Disturbance Provision, the permit, and the approved plan, rules and regulations, and that any supporting documents required under Section 4-1-N-19-G are accepted, a completion certificate covering the work must be issued to the permittee by the City.

Appendix A
Land Disturbance Provisions

Article 4-1-N LAND DISTURBANCE PROVISIONS

Sections:

Section 4-1-N-1 PURPOSE OF ARTICLE.
The purpose of this Article is to establish a regulatory scheme to protect and further the public interest by: promoting the coexistence of the natural environment and quality, planned development; assisting in the City's efforts to comply with the National Pollutant Discharge Elimination System Phase 2 regulations issued by the U. S. Environmental Protection Agency and administered by the Kansas Department of Health and Environment; providing effective storm water management; protecting property from damage due to flooding and erosion; improving water quality and reducing water pollution; controlling construction site impact on storm water; minimizing non-storm water discharges into the storm sewer system; protecting natural stream assets; and protecting, and, where possible, enhancing valuable natural water resources. These public interests are furthered by regulating land disturbance, filling, stripping and soil storage in connection with the clearing and grading of land for construction related or other purposes. It is also the purpose of this Article to encourage responsible development and minimize the negative environmental impacts that can be associated with development.

This Article establishes substantive and procedural requirements to protect and enhance the water quality of watercourses, water bodies, and wetlands by controlling erosion, sedimentation, and related environmental damage caused by construction related or other soil disturbing activities; and to encourage creative approaches to development that are designed and implemented to be sensitive to the natural environment thereby resulting in high quality development for those who visit, reside, and work in the City.

Section 4-1-N-2 OTHER LAWS.
Neither this Article nor any decision made with respect hereto exempts the applicant or any other person from other requirements of the City Code, or from state and federal laws, or from procuring other required permits, nor do they limit the right of any person to maintain, at any time, any appropriate action, at law or in equity, for relief or damages against the applicant or any person arising from the activity regulated by this Article.

Section 4-1-N-3 DEFINITIONS.
In this Article, these words and phrases have the following meanings:

APPROVED PLAN: A set of representational drawings or other documents that have been approved by the City as complying with the provisions of this Article submitted by an applicant (either as an independent submittal or a part of another development application(s) required by the City Code) as a prerequisite to obtaining a building or land disturbance permit and that contain the information and specifications required by the City to minimize erosion and off-site sedimentation from land disturbance activities.

APPLICANT: Any person who makes application for an approved plan or for a building permit for an activity involving building or development that results in land disturbance or for a land disturbance permit, as required by this Article.

CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL: A recognized specialist in soil and erosion control that has met the certification requirements of CPESC, Inc.

CLEARING: Any act by which vegetative cover, structures or surface material are removed, including, but not limited to, surface layer, root mat or topsoil removal.

DEVELOPMENT APPLICATION: All applications required by the City Code as a prerequisite to initiation of development, including, but not limited to, a building permit application.

EROSION: The process by which the ground surface is worn away by the action of the wind, water, ice, gravity, or artificial means, and/or land disturbance activities.

EROSION AND SEDIMENT CONTROL DESIGN CRITERIA: The erosion and sediment control design criteria adopted in writing, as authorized by *Section 4-1-N-12*.

EXCAVATING: Any act by which soil is cut into, dug, quarried, uncovered, removed, displaced, relocated, or bulldozed, and includes the conditions that result from that act.

FILLING: Any act by which soil is deposited, placed, pushed, pulled, or transported and includes the conditions that result from that act.

FLOODPLAIN: The floodway and floodway fringe as identified by the Federal Insurance Administration through its report entitled "*The Flood Insurance Study for the City of Lenexa, Kansas,*" dated February 1, 1977and updated June 17, 2002, or such other designation of the floodplain as is subsequently adopted by the City, and representing the regulated 100-year water surface and corresponding elevations.

GRADING: Any act by which soil is cleared, stripped, moved, leveled, stockpiled, or any combination thereof, and includes the conditions that result from that act.

LAND DISTURBANCE ACTIVITY: Any act by which soil is moved and land changed that may result in erosion or the movement of sediments, and may include tilling, clearing, grading, excavating, stripping, stockpiling, filling and related activities, and the covering of land surfaces with an impermeable material.

LANDSCAPE ARCHITECT: A landscape architect duly licensed by the Kansas State Board of Technical Professions, pursuant to K.S.A. 74-7001 *et seq.* to practice landscape architecture.

LICENSED LAND SURVEYOR: An individual who is duly licensed by the Kansas State Board of Technical Professions, pursuant to K.S.A. 74-7001 *et seq.* to practice surveying.

MAXIMUM EXTENT PRACTICABLE: The use of those best management practices, which, based on sound engineering and hydro-geological principles, will, to the greatest degree possible, given all relevant considerations, including technology, climate and site conditions, minimize erosion and sedimentation from a site during and after development.

OPEN RECREATIONAL SPACE: Any land, under single ownership, which is dedicated to open, outdoor recreational uses such as golf courses or ball fields, and which is submitted for City development approval as a single plan and developed pursuant to one grading plan.

PERMIT: A building permit for activities involving building or development resulting in land disturbance or a land disturbance permit for activities resulting in land disturbance, that does not involve building or development.

PERMITTEE: Any person to whom a building permit is issued with respect to activities involving building or development resulting in land disturbance or for purposes of this Article only, any person to whom a land disturbance permit is issued.

PLANNING DIRECTOR: The individual appointed by the City as the Planning Director or his/her designee.

PROFESSIONAL ENGINEER: An engineer duly licensed by the Kansas State Board of Technical Professions, pursuant to K.S.A. 74-7001 *et seq.* to practice engineering.

PUBLIC WORKS DIRECTOR: The individual appointed by the City as the Public Works Director or his/her designee.

RESPONSIBLE PERSONNEL: Any foreman, superintendent, or project engineer designated in the permit or in an approved plan, as the person in charge of on-site land disturbance activities or erosion and sediment control associated with land disturbance activities.

SEDIMENT: Soils or other materials transported or deposited by the action of wind, water, ice, gravity, or artificial means.

SITE: Any lot or parcel of land or a series of lots or parcels of land adjoining or contiguous or joined together under one (1) ownership on which land disturbance activity is proposed.

SLOPE: The inclined surface of a fill, excavation, or natural terrain expressed as a ratio of horizontal distance to vertical distance over a measured inclined surface.

SOIL: The unconsolidated mineral and organic material (*i.e.*, earth, sand, gravel, rock or other similar material) on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

STORMWATER POLLUTION PREVENTION PLAN (SWPPP): A plan required by and and for which contents are specified int he State of Kansas General Permit for Stormwater Discharges Associated with Industrial Activities, and the General Permit for Stormwater Discharges Associated with Construction Activities. The purpose of the plan is to help identify the sources of pollution that affect the quality of stormwater discharges from a site and to describe and ensure the implementation of practices to reduce pollutants in stromwater discharges.

STRIPPING: Any activity by which the vegetative cover is removed or significantly disturbed, including tree removal, clearing, grubbing and storage, or removal of topsoil.

VEGETATIVE COVER: Any grasses, shrubs, trees and other vegetation that protects and stabilizes soils.

WATERCOURSE OR DRAINAGEWAY: Any natural or artificial watercourse, including but not limited to streams, rivers, creeks, ditches, channels, canals, conduits, culverts, drains, waterways, gullies, ravines, or washes in which water flows in a definite direction or course, either continuously or intermittently; and including any area adjacent to it that is subject to inundation by reason of overflow or floodwater.

WETLANDS: Those areas that have a predominance of hydric soils and that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. This does not include the following surface waters intentionally constructed from sites, including but not limited to: drainage ditches, grass-lined swales, and landscape amenities.

Section 4-1-N-4 PERMITS REQUIRED.

A. No person may engage in any land disturbance activity, including the installation of sanitary sewers, without first obtaining a permit from the City, accordance with Sections 4-1-N-5 and 4-1-N-6.

B. This Article shall not be construed to be in conflict with any state law intended to control erosion and sedimentation. In those instances where state law imposes a duty or requirement with respect to a matter covered by this Article, the more environmentally stringent duty or requirement shall control.

C. Neither a permit nor an approved erosion and sediment control plan is required under this Article solely for:

    1. any land disturbance activity that:

a. involves less than 100 cubic yards of earth movement; or

b. disturbs less than 5,000 square feet of surface area;

2. land farming operations, including plowing or tilling of land for the purpose of crop production or the harvesting of crops on land located in the AG District;

3. home landscaping or gardening;

4. reestablishment of lawn areas for residential lots; or

5. any emergency activity that is immediately necessary for the protection of life, property, or natural resources;

provided that, if one or more of the above activities is undertaken as a part of or in conjunction with an activity involving building or development that otherwise requires issuance of a building permit, pursuant to Title 4, Chapter 1, Article I or any other provision of the City Code, this Section does not alter the requirement that a building permit shall be obtained for that activity or activities.

A. The issuance of a permit shall constitute authorization to do only that work described or shown on the approved plan, all in strict compliance with the requirements of this Article, unless each and every modification or waiver is specifically listed and approved as required by *Section 4-1-N-15* of this Article. Reasonable field modifications can be made pursuant to *Section 4-1-N-15* of this Article.

B. The permittee and/or the permittee's agent, contractors and employees shall carry out the proposed work in accordance with the approved plan, and the permit, and in compliance with all applicable requirements or conditions.

Section 4-1-N-5 AUTHORIZATION TO UNDERTAKE LAND DISTURBANCE ACTIVITIES AS A COMPONENT OF BUILDING PERMITS.

A. A building permit must be obtained before any activity involving building or development resulting in land disturbance is initiated, except as provided in *Section 4-1-N-4*-C. The authority to undertake any of these activities shall be evidenced only by a valid building permit. Before a building permit is issued for these activities, the engineered plans specified in *Section 4-1-N-7* must be submitted to the City and must contain the information and be in the form required therein, subject to the provisions of *Section 4-1-N-6*-E. In effect, *Section 4-1-N-7* sets forth application submission requirements for activities involving building or development resulting in land disturbance that are in addition to the application submission requirements specified in *Section 4-4-D-1* and Title 4, Chapter 1, Article I of the City Code.

B. If an individual proposes to undertake a land disturbance activity that does not, pursuant to any other section of the Code, require issuance of a building permit (such as, but not limited to, installation of sanitary sewers), the individual shall not, except as provided in *Section 4-1-N-4*-C, initiate land disturbance activities until a land disturbance permit is obtained.

Section 4-1-N-6 PERMIT OR PLAN; GENERALLY.

A. Where activities involving building or development resulting in land disturbance are to be performed, the owner of a site, or the site owner's authorized representative shall submit a complete building permit application in writing upon forms furnished by the City, which application shall include the engineered plans specified in *Section 4-1-N-7.*

B. Where land disturbance activity is to be performed and the City Code does not otherwise require issuance of a building permit, the owner of the site or the site owner's authorized representative shall submit the engineered plans specified in *Section 4-1-N-7* to the Planning Director.

C. A permit must be issued in the name of the current property owner or the property owner's authorized representative.

D. No permit for activities that are not permitted by existing zoning, variances or

other valid development approvals applicable to the land, shall be approved.

E. In making an application covered by this Article, the applicant or the landowner performing or allowing the work consents to the City's right to enter the site for the purpose of inspecting compliance with the approved plan or for performing any work necessary to bring the site into compliance with the approved plan.

F. The engineered plans required by *Section 4-1-N-7* are not intended to be duplicative of other provisions of this Title or Code. Accordingly, the required engineered plans may be included in or with any other development application (s) or submission(s) otherwise required by this Title or Code; provided that, all the information required therein is in a form that can reasonably be evaluated by the Planning Director. The decision concerning the form of the information submitted shall be made in the Planning Director's sole discretion. In addition, the Planning Director is authorized to waive submission requirements determined not to be necessary to the evaluations that are required by this Article.

Section 4-1-N-7 ENGINEERED PLANS.

A. If not otherwise included in a separate development application or applications that seek approval of the specific activity that will result in land disturbance, as provided by Subsection 4-1-N-6-F above, the following information shall be submitted to the Planning Director:

1. a vicinity map and site map in compliance with *Section 4-1-N-8*;
2. an erosion and sediment control plan in compliance with *Section 4-1-N-9*;
3. a work schedule in compliance with *Section 4-1-N-10*;
4. the permit fee as set forth in *Section 4-1-N-16*;
5. a performance guaranty as required by *Section 4-1-N-22*;
6. an engineering soils report in compliance with *Section 4-1-N-11*, when required by the City.

B. The erosion and sediment control plan must be prepared and certified by a Professional Engineer, a Landscape Architect, or a Certified Professional in Erosion and Sediment Control.

C. The City may require any additional information or data deemed appropriate and/or may impose conditions thereto as the Planning Director may deem necessary to ensure compliance with the provisions of this Article and to preserve public health and safety.

D. The Planning Director may waive the requirements for maps, plans, reports or drawings, if the Planning Director finds that the information otherwise submitted or to be submitted will be sufficient to show that the proposed work will conform to the requirements of this Article.

E. The applicant is bound by information submitted under this Section.

F. Failure to comply with these requirements may result in the City requiring submission and approval of a plan and the issuance of a permit.

G. Land disturbance activity may not take place in the City until a permit has been issued, as described in *Section 4-1-N-5*, and an acceptable performance guaranty, as required by 4-1-N-22, has been obtained.

H. In addition to obtaining a City Land Disturbance Permit, permittee and responsible personnel disturbing one ace or greater must comply with State and Federal Construction Stormwater NPDES requirements, including, but not limited to, the development of a Stormwater Pollution Prevention plan (SWPPP), as required by the Kansas Department of health and Environment (KDHE). The engineered plans and Land Disturbance permit required by the City's Land Disturbance Ordinance should be included int he SWPPP. the SWPPP must be kept on site during the duration of the construction project and made available during an inspection.

Section 4-1-N-8 SITE MAP/EXISTING CONDITIONS.

In accordance with Section 4-1-N-7-A, the applicant shall submit a site map that

contains the following information;

A. An attached vicinity map showing the location of the site in relation to the surrounding area's watercourses, water bodies and other significant geographic and natural features, and street and other significant structures.

B. Existing and proposed topography of the entire site with contour lines drawn with one chosen interval in accordance with the following table:

Ground Slope	Contour Interval (in feet)
Flat: 0-2%	0.5 or 1
Rolling: 2-8%	1 or 2
Steep: 8% +	2, 5 or 10

C. Show on/off-site drainage, including the subwatershed as well as the entire drainage basin;

D. Site's property lines shown in true location with respect to the plan's topographic information;

E. Graphic representation of the location of all existing and proposed natural and man-made drainage facilities;

F. Graphic representation of the location of and legend of soil types (including source of information);

G. A clear and definite delineation of any wetlands, natural or artificial water storage detention areas, and drainage ditches on the site, or a statement that there are no wetlands, detention areas or drainage ditches located on the site.

H. A clear and definite delineation of any drainage, sanitary, utility, or other easement(s) on or near the site;

I. A clear and definite delineation of applicant's determination, based on the best available information and sound engineering principles, of the existance of a regulatory 100-year floodplain, as defined in 4-1-N-3 and of any fully urbanized floodplain on or near the site as determined by a Johnson County watershed study or a statement that there are no such floodplains located on the property;

J. Graphic representation of the location of proposed excavations and fills, of on-site storage of soil and other earthen material, and of on-site disposal or spoil areas;

K. Location and legend of existing vegetative cover and the location and legend of vegetative cover to be left undisturbed;

L. Location of existing surface runoff and erosion and sediment control measures;

M. Quantity of soil in cubic yards to be excavated, filled, stored, or otherwise utilized on-site;

N. Proposed sequence of excavation, filling and soil or earthen material storage and disposal.

O. Graphic representation of stream setbacks, including inner, middle and outer zones. If no stream corridors subject to Section 4-1-O of this Code are present on the site, then applicant must provide a statement indicating such on site map or cover sheet; and

P. The signature and seal of a Professional Engineer, a Landscape Architect, or a Certified Professional in Erosion and Sediment Control.

Section 4-1-N-9 EROSION AND SEDIMENT CONTROL PLAN.
In accordance with *Section 4-1-N-7*-A, an applicant shall submit an erosion and sediment control plan that is drawn to an appropriate scale, with a minimum of 1 inch equals 100 feet (1:100). This plan must include sufficient information to: evaluate the environmental characteristics of the affected area; assess the potential impacts of the proposed land disturbance on water resources; and, assess proposed methods to minimize on-site soil erosion and prevent off-site sedimentation to the maximum extent practicable, including disturbance of topsoil and limitation of disturbance. The erosion and sediment control plan shall meet all the erosion and sediment control specifications established by the Erosion and Sediment Control Design Criteria required by Section 4-1-N-12 of this Article and contain the following information:

A. A letter of transmittal that includes a project narrative.

B. Copies of NPDES, 404, and other applicable state and federal permit applications for the site or activity.

C. A description of and specifications for the measures undertaken to reduce surface runoff and erosion control including, but not limited to, types and methods of applying soil protection blankets, mulches, designs and specifications for diversions, dikes, drain protection, and a schedule for their maintenance and upkeep;

D. A description of, and specifications for, the measures undertaken to retain sediment, waste materials, and chemicals on the site, including, but not limited to, designs and specifications for silt fences, berms, sediment detention facilities, other best management practices, and a schedule for their maintenance and upkeep.

E. A description of the temporary and permanent vegetative measures to be used, including but not limited to seeding mixtures and rates, types of sod, method of seedbed preparation, expected seeding dates, types and rate of lime and fertilizer application, kind and quantity of mulching, the type, location and extent of pre-existing undisturbed vegetation types and vegetation to remain, and a schedule for maintenance and upkeep.

F. Alternative methods of stabilizing the site when either the establishment of vegetative cover is not performed in accordance with the work schedule, or is performed and is not effective in the sole discretion of the Public Works Director.

G. A map depicting the location and description ap, including design details, of each temporary and permanent erosion, surface runoff and sediment control measure and structure.

H. Estimated duration of the permit as defined in Subsection 4-1-N-17-A.

I. A statement noting that the contractor, developer, operator, and/or owner shall request the Public Works Director to inspect and approve work completed in accordance with the approved Plan, and in accordance with this Article. The contractor, developer, or owner shall be required to obtain written approval by the Public Works Director at the stages of development as outlined in Subsection 4-1-N-19-E.

J. A signed statement on the plan by the owner, developer, operator, and/or contractor that any land disturbance activity, construction or development, will be done pursuant to the Plan.

K. Quantity of soil in cubic yards to be excavated, filled, stored, or otherwise utilized on-site.

L. A graphic representation of the storm drainage system, including quantities of

flow and site conditions around all points of surface water discharge from the site.

M. Details of temporary and permanent erosion and sediment control measures, including a construction note on the plan stating: *"Prior to initial soil disturbance or redisturbance, permanent or temporary erosion and sediment control devices shall be completed on all perimeter dikes, swales, ditches, perimeter slopes, and all slopes greater than 3 horizontal to 1 vertical (3:1); embankments of ponds, basins, and traps. Sediment control shall be completed within fourteen (14) calendar days on all other disturbed or graded areas. The requirements of this Section do not apply to those areas that are shown on the plan and are currently being used for material storage or for those areas which actual construction activities are currently being performed."*

Section 4-1-N-10 WORK SCHEDULE.
In accordance with Subsection 4-1-N-7-A, the applicant shall submit a chronological construction schedule and corresponding time-frame for each of the following activities:

A. Identify and mark areas to be protected from disturbance.

B. Clearing and grubbing for those areas necessary for installation of perimeter erosion control devices.

C. Construction of perimeter erosion and sediment control devices.

D. Installation of permanent and temporary stabilization measures.

E. City inspection of erosion and sediment control measures, prior to commencement of excavation.

F. Remaining interior site clearing and grubbing.

G. Street grading.

H. Rough grading for the remainder of the site.

I. Utility installation and statement of whether storm drains will be used or blocked after construction.

J. Building, parking lot, and site construction.

K. City inspection prior to commencement of BMP construction.

L. BMP construction.

M. Final stabilization.

N. Final grading and construction of stormwater BMPs.

O. Removal of temporary erosion control devices.

P. Inspection and maintenance of all erosion and sediment control measures during the course of the project.

Section 4-1-N-11 ENGINEERING SOILS REPORT.
When the Planning Director determines that additional information is required to protect against erosion or other hazards, an engineering soils report shall, in accordance with Subsection 4-1-N-7-A, be submitted by applicant. This report shall be based on adequate and necessary test borings, giving an adequate description of the soils of the site with conclusions and recommendations regarding the effect of soils conditions on the proposed development, and giving opinions and recommendations covering the adequacy of site to be developed by the proposed land disturbance activity with respect to soils conditions. Recommendations included in the report and approved by the Planning Director shall be required in the plan. The engineering soils report shall include:

A. Data regarding the nature, distribution, strength, and erodibility of existing soils;

B. If applicable, data regarding the nature, distribution, strength, and erodibility of soil to be placed on the site;

C. Conclusions and recommendations for grading procedures;

D. Conclusions and recommended designs for interim soil stabilization devices and

measures, and for permanent soil stabilization after construction is completed;

E. Design criteria for corrective measures when necessary;

F. Opinions and recommendations covering the stability of the site;

G. Subsurface conditions;

H. Soil boring results; and

I. Overview of geology of site.

Section 4-1-N-12 EROSION AND SEDIMENT CONTROL DESIGN CRITERIA.

A. Unless otherwise provided herein, Section 5100 Erosion and Sediment Control of the Kansas City Metropolitan Chapter of the American Public Works Association, dated August 13, 2003, is hereby incorporated by reference for the purpose of providing uniform erosion and sediment control standards with respect to land disturbance involving temporary erosion and sediment control (hereinafter "*Erosion and Sediment Control Design Criteria*").

No less than three (3) copies of such document shall be marked or stamped "official copy" as adopted by Ordinance No. 4663 with a copy of the Ordinance codified herein and filed with the City Clerk to be open to inspection and available to the public at all reasonable hours.

The following revisions, deletions and/or exceptions to the *Erosion and Sediment Control Design Criteria* shall apply:

1. Any reference in Section 5100 to Sections 2100, 2101, 2102, 2103, 2150, or 2605 shall mean a reference to the appropriate section of the City of Lenexa Technical Specifications.
2. Any reference in Section 5100 to an ESC shall mean a reference to the City of Lenexa Standard Details.
3. Table 5102-1 in Section 5102.3: Professional Standards is hereby amended as follows: Delete the lines in the table for the roles of Installer and Capital Construction Inspector or Developer Inspector.
4. Section 5103.3 Verification of Design Performance is hereby deleted and a new Section 5103.3 is added to read as follows: 5103.3 Performance Criteria: No visible sediment shall leave the site.
5. Section 5105.1 Matrix, the Best Management Practices table on Pages 5100-40 through 44 is hereby amended as follows:
    a. In the lines for "Sodding", "Mulching and Hydro Mulch", "Tackifiers, Soil Binders and Bonded Fiber Matrix", delete the references under the heading "Design Standard Section", and enter "NA".
    b. Delete the lines designated "Vegetated Buffers (Filter Strips)", "Vegetated Stream Buffers", "Infiltration Basin", and "Infiltration Trench".
    c. In the lines for "Temporary Fill Diversion", "Temporary Diversion Dike", and "Right of Way Diversion", delete the references under the heading "Design Standard Section", and insert 5108.10, 5108.10, and 5108.10 respectively.
    d. Delete the lines titled "Dust Control", "Solid Waste Disposal", "Sanitary Waste Disposal", and "Spill Prevention and Material Management".
6. Section 5106.1 Construction Sequence Schedule is hereby amended as follows: Under Design Criteria, delete the sentence "Immediately after land clearing and grading, apply surface stabilization on graded areas, channels, dikes, and all other disturbed areas where construction activity will not take place for 30 days." And insert the following sentence: "Immediately after land clearing and grading, apply surface stabilization on graded areas, channels, dikes, and all other disturbed areas where construction activity will not take place for 14 days."
7. Section 5106.6 Vegetative Buffers (Filter Strips) is hereby deleted in its entirety.

8. Section 5106.7 Vegetated Stream Buffers is hereby deleted in its entirety.
9. Section 5106.8 Tree Protection is hereby deleted and a new Section 5106.8 is hereby added to read as follows: 5106.8 Tree Protection— Refer to Section 4-1-D-2 of the City Code for Tree Protection Criteria.
10. Sections 5107, 5107.1, 5107.2, 5107.3, 5107.4, 5107.5, and 5107.6 are hereby deleted in their entirety.
11. Section 5108.1 Straw Bale Barrier is hereby deleted in its entirety.
12. Section 5108.4 Sediment Fence Installation Machines is hereby deleted in its entirety.
13. Section 5108.8 Drop or Curb Inlet Protection is hereby amended by deleting items 4a through 4k under Planning Considerations, and inserting new items 4a - 4e as follows:
    a. Curb/Yard Inlet Gravel Filter
    b. Sediment Trap
    c. Gutter Buddy Curb® Inlet
    d. Beaver Dam® or True Dam®
    e. Other measures approved by the Engineer
14. Section 5108.10 Diversions is hereby deleted and a new Section 5108.10 is added to read as follows: 5108.10 Diversions: Diversions shall be designed in accordance with the portion of Section 5600 of the American Public Works Association Kansas City Metropolitan Chapter Standards, Specifications, and Design Criteria regarding Engineered channels, as adopted by the City, except that no easement will be required.
15. Section 5108.15 is hereby amended to delete the subsection entitled Design Criteria, and a new Design Criteria subsection is added to read as follows: Grass-lined Channels shall be designed in accordance with the portion of Section 5600 of the American Public Works Association Kansas City Metropolitan Chapter Standards, Specifications, and Design Criteria regarding open channels, as adopted by the City, except that the channel lining shall not be concrete or riprap.
16. Section 5108.16 Outlet Stabilization Structures is hereby amended to delete item 4 under Design Criteria, and a new item 4 is added to read as follows: The tractive force method shall be used to design the size of rock to be used for riprap, and the length and width of the riprap field. The rock size, field length and field width shall be set so as to be at the point of incipient motion during the design storm. The outlet stabilization structure shall be designed to withstand the 10-year flood with 0.5 feet of freeboard below the emergency spillway, and 3 feet of freeboard below the top of dam, whichever provides greater freeboard below the top of dam.
17. Section 5108.17 Infiltration Basin is hereby deleted in its entirety.
18. Section 5108.18 Infiltration Trench is hereby deleted in its entirety.

B. Grading, erosion control practices, sediment control practices, and waterway crossings shall comply with the Erosion and Sediment Control Design Criteria, and shall be adequate to minimize erosion and the transportation of sediment from the site to the maximum extent practicable.

C. Cut and fill slopes shall be no greater than 3:1, except as approved by the Planning Director to meet other community or environmental objectives.

D. Clearing and grading of natural resources as previously defined by the City, such as designated natural stream assets, forests and wetlands as previously identified by the City, shall not be permitted, except when in compliance with this and all other Chapters of this Code. Land disturbance activities that retain natural vegetation and drainage patterns, as described in the *Erosion and Sediment Control Design Criteria*, shall be used to the satisfaction of the

Planning Director.

E. Clearing, except that necessary to establish erosion and sediment control devices, shall not begin until all erosion and sediment control devices have been installed and the soil has been stabilized.

F. Construction phasing is recommended for all sites, but shall be required on all sites disturbing greater than twenty-five (25) acres, with the size of each phase to be established at the time of the consideration of the relevant development application or as approved by the Planning Director.

G. Erosion control techniques shall include, but not be limited to the following:

1. Soil stabilization of disturbed areas shall be completed after clearing and after periods of inactivity in construction of greater than 14 calendar days. If the Public Works Director determines that a site has a high potential for erosivity based on previous information submitted, he or she may direct that disturbed soil be stabilized after periods of inactivity in construction of more than forty-eight (48) hours;

2. If seeding or other vegetative erosion control methods are used, it shall have germinated within two (2) weeks; if vegetative measures are not effective within this time frame, the Public Works Director may require the site to be reseeded or require that a non-vegetative option be employed;

3. Special techniques that meet the Erosion and Sediment Control Design Criteria on slopes greater than 3:1 or in drainage ways shall be used to ensure stabilization;

4. Stabilization of soil stockpiles;

5. At the close of the construction season, all disturbed site surfaces must be stabilized, using a vegetative cover or a suitable mulch layer with tackifier or another method that does not require germination to control erosion;

6. Techniques shall be employed to minimize the blowing of dust or sediment from the site; and

7. Techniques that divert upland runoff past disturbed slopes shall be employed.

H. Sediment control requirements shall include, but not be limited to the following:

1. Settling basins, sediment traps, or tanks and perimeter controls;

2. Settling basins that are designed in a manner which allows adaptation to provide long term storm water management, if required by the Planning Director; or

3. Protection for adjacent properties and waterways by the use of a vegetated buffer strip in combination with perimeter controls.

I. Waterway and watercourse protection requirements shall include, but not be limited to:

1. A temporary stream crossing, approved by the Planning Director, shall be installed if a wet watercourse will be crossed regularly during construction, but only if the Planning Director determines that the stream crossing will not cause flooding of adjacent property or damage the riparian corridor in which such a crossing is to be constructed;

2. Stabilization of the watercourse channel before, during, and after any in-channel work;

3. All on-site storm water conveyance channels designed according to the erosion and sediment control design requirements; or

4. Stabilization to prevent erosion at the outlets of all pipes and paved channels.

J. Construction site access requirements shall include, but not be limited to:

1. A temporary access road provided at all sites; or

2. Other measures required by the Planning Director to ensure that sediment is not tracked onto public streets by construction vehicles or washed into storm drains.

Section 4-1-N-13 REVIEW AND APPROVAL.

A. The City will review all submissions required by this Article to determine their conformance with the provisions of this Article and the erosion and sediment control design criteria. Within ten (10) business days after receiving all required submissions, the Planning Director, in writing, shall:

1. If a building permit is otherwise required;

a. Approve the plan and notify the Building Official that all requirements of this Article have been met and that the permit may be issued; or

b. Conditionally approve the plan and notify the Building Official and the Applicant that the requirements of this Article have been met and that the building permit may be issued, subject to conditions as may be necessary to substantially secure the objectives of this Article, prevent the creation of a nuisance or an unreasonable hazard to persons or to a public or private property; or

c. Reject the plan and notify the Building Official that the requirements of this Article have not been met, indicating those requirement(s) that have not been met and the procedure for submitting revised information and/or submittals.

2. If a building permit is not otherwise required:

a. Approve the plan and issue a land disturbance permit; or

b. Conditionally approve the plan and issue a land disturbance permit subject to conditions as may be necessary to substantially secure the objectives of this Article, prevent the creation of a nuisance, or prevent an unreasonable hazard to persons or to a public or a private property; or

c. Reject the plan and inform the applicant in writing of those requirement(s) that have not been met and the procedure for submitting revised information and/or submittals.

B. If the Planning Director fails to act on the original or revised complete submission required by this Article within ten (10) business days of receipt, the applicant shall be authorized to request the Planning Director to expedite its submission. Except as otherwise provided in this Article, an applicant shall not be authorized to proceed with land disturbance activities without a permit.

C. The Planning Director may approve a plan and authorize the Building Official to issue a building permit or may issue a land disturbance permit if all required submittals comply with all the requirements of Sections 4-1-N-2 and 4-1-N-4 through 4-1-N-12 and the Planning Director determines that best management practices will be employed to control erosion and sedimentation to the maximum extent practicable.

D. The Planning Director may require the applicant to attend a preconstruction meeting prior to the issuance of a permit.

Section 4-1-N-14 CONDITIONS OF APPROVAL.

In approving the issuance of any permit, the Planning Director may impose any conditions as may be reasonably necessary to secure the objectives of this Article, prevent the creation of a nuisance, or prevent an unreasonable hazard to persons or to a public or private property. These conditions may include , but need not be limited to:

A. The granting (or securing from others) and the recording in County land records of easements for drainage facilities, including the acceptance of their discharge on the property of others, and for the maintenance of slopes or erosion control facilities;

B. Adequate control of construction related dust by watering, or other control

methods acceptable to the Planning Director;

C. Improvements of any existing grading, ground surface or drainage condition on the site (not to exceed the area as proposed for work or development in the application) to meet the standards required under this Article for land disturbance, drainage, and erosion control;

D. Installation of sediment traps and basins adjacent to a surface water body or in a densely populated area; and

E. Installation of additional safety related devices in the proximity of an elementary school, playground or other areas where small children may congregate without adult supervision.

Section 4-1-N-15 MODIFICATIONS OF PLANS.

A. Modifications of the approved plan may be authorized by the Public Works Director; provided those modifications are consistent with the erosion and sediment control design criteria of this Article, where:

1. Field inspection or evaluation has revealed the inadequacy of the approved plan to accomplish its erosion and sediment control objectives; or

2. The person responsible for carrying out the approved plan finds that, because of changed circumstances or for other reasons, the approved plan cannot be effectively carried out.

B. Modifications and proof of approval of the approved plan must be noted on Erosion and Sediment Control Plan kept on the site.

Section 4-1-N-16 FEES.

Before issuance of a permit, the applicant shall pay a fee, which shall be in addition to the building permit fee if otherwise applicable, to cover the cost of administration, plan review, and inspection services associated with evaluation of submittals and permits required by this Article. The amount of the fee shall be established by the City Council by resolution or ordinance.

Section 4-1-N-17 PERMIT AND/OR APPROVED PLAN; EXPIRATION AND RENEWAL.

A. The permit shall be valid from the time that it is issued until a final certificate of occupancy or completion certificate pursuant to *Section 4-1-N-24* has been issued.

B. If the permittee sells the property before the expiration of the permit, the permit may be assigned to the new owner of the site if the assignment is approved in writing by the Planning Director, provided that the permittee shall remain responsible for compliance with the permit until a final certificate of occupancy is issued or a completion certificate is issued pursuant to *Section 4-1-N-24*. Approval of an assignment shall not be unreasonably withheld.

C. If the permittee sells any portion of the property before the expiration of the permit, the permittee will remain responsible for that portion of the property until one of the following events occur:

1. The new owners of the property, with respect to property covered by a permit, makes all submissions required by this Article, which are not waived, to the Planning Director and he or she approves the plan and issues the new owner a permit; or

2. The new owner of the property obtains a building permit for that portion of the property sold by the permittee. When a new owner has contiguous lots totaling less than one (1) acre, the new owner may design a plan for the contiguous lots as approved by the Planning Director.

Section 4-1-N-18 COORDINATION WITH OTHER PERMITS.

When a person is developing a site and a permit is required, in accordance with *Section 4-1-N-5* of this Article, no other construction permits shall be issued to make improvements on that site until the person has secured the permit required by this Article for the same site. This includes all permits issued by an other City

department. If a permit required by this Article is revoked or suspended, no other permits for the site will be issued until all pending permit violations have been resolved to the satisfaction of the Public Works Director.

Section 4-1-N-19 INSPECTIONS.

A. Authorized representatives of the City may enter properties upon which land disturbance activities are occurring for the purpose of inspection and enforcement of the provisions of the Article.

B. Land disturbance activity may not proceed until a permit has been issued by the City in accordance with this Article. All work must be performed in accordance with a sequence shown on the approved plan and/or work schedule or a revised sequence approved by the Planning Director.

C. The permittee shall notify the City forty-eight (48) hours before commencing any land disturbance activity and, if required by the Public Works Director, hold a pre-construction meeting between the permittee or the representative of the permittee and an authorized representative of the Public Works Director.

D. A copy of the permit must be available on the site for inspection by authorized representatives of the City. Field markings showing limits of disturbance must be on site during all installation of erosion and sediment control measures, construction, or other land disturbance activities.

E. Each site that has an approved plan may be inspected as necessary to ensure that erosion and sediment control measures are installed and effectively maintained in compliance with the approved plan and permit. At the discretion of the Public Works Director, inspections may occur at any or all of the following stages:

1. Upon completion of installation of perimeter erosion and sediment controls, prior to proceeding with any other land disturbance activity. Other building or grading inspection approvals may not be authorized until initial approval by the Public Works Director occurs;
2. During the construction of sediment basins or storm water management structures, at the inspection points required by the permit;
3. During rough grading, including hauling of imported or wasted materials;
4. Prior to the removal or substantial modification of any erosion and sediment control measure or practice; and
5. Upon completion of final grading, including establishment of ground covers and planting, installation of all vegetative measures, and all other work in accordance with the approved plan.

Requests for inspection shall be made at least twenty-four (24) hours in advance (exclusive of Saturdays, Sundays, and holidays) of the time the inspection is desired.

F. If an inspection reveals a failure to comply with the requirements of this Article, the Public Works Director may notify the permittee or the representative of the permittee in writing of the violation. The notice issued must, as a minimum, state the nature of the violation, any practice or approved plan deficiencies, required corrective action, and compliance time. Any portion of the work that does not comply must be corrected in the compliance time given to the permittee. The City may make additional inspections as it deems necessary, and has the right to waive inspections, excluding the final inspection as provided in *Section 4-1-N-24*. The Public Works Director shall maintain a record of each inspection. Included in the record must be the date, the location or project identification, whether or not the approved plan has been implemented and measures maintained, and, if a violation exists, the type of enforcement action taken. The record of each inspection shall be maintained for a minimum of four years.

G. When an approved plan shows the use of temporary basins or permanent storm water management structures, the Public Works Director may require the submission of supportive documents, such as test results, or material certifications. If necessary, in addition to its own inspections, the City may require that any portion of the construction of said basins or structures be

inspected and certified by a licensed Professional Engineer, or Landscape Architect, or Land Surveyor. At the Public Works Director's option, the permittee may secure the services of a Professional Engineer, Landscape Architect, or licensed Land Surveyor to inspect the construction of the facilities and to provide the City with a fully documented certification that all construction is done, to the best of his/her knowledge, in accordance with the provisions of the approved plan, applicable rules, regulations and criteria. If a certification is provided to the City, inspections required under Subsection 4-1-N-19-E-2 for the basin or structure may be waived. In these cases, the Public Works Director must be notified at the required inspection points and may make periodic erosion sediment inspections, or any further inspections as needed.

Section 4-1-N-20 ACTION UPON NONCOMPLIANCE.

A. In the event work does not conform to the permit or conditions of approval or to the approved plan or to any instructions of the City as authorized by this Article, notice to comply shall be given to the permittee in writing. After a notice to comply is given, the permittee or the permittee's contractor(s) shall be required to make the corrections within the time period determined by the City. If the Public Works Director determines that the nonconforming work has caused or created an imminent threat to public health and safety, the City may perform the work necessary to eliminate the threat without notice to the permittee.

B. If the permittee fails to make the required corrections within the time period allotted by the City, as required in subsection A above, the Public Works Director may post a stop work order at the site directing that all land disturbance activity cease immediately. For the purposes of this Section, a stop work order is effective upon posting a copy of the stop work order on the site of the land disturbance activity in reasonable proximity to a location where the land disturbance activity is taking place. A person must not continue or permit the continuance of work in an area covered by a stop work order, except work required to correct deficiencies with respect to an erosion or sediment control measure. No inspections shall be performed and no additional permits will be issued by the City for the site while a stop work order is in effect. Any person who shall continue to work after a stop work order has been posted, except such work as that person is directed by the City to perform to remove a violation or unsafe condition, is guilty of a public offense and may be subject to penalties as prescribed herein.

    1. Except as set forth in subsection 2 below, the City must provide written notice to the permittee or a representative of the permittee when a stop work order is issued. A copy of the order, in the case of work for which there is a permit, shall be mailed by first class mail, postage prepaid, to the address listed by the permittee on the permit. In the case of work for which there is no permit, a copy of the order shall be mailed to the person listed as owner of the property by Johnson County land records. That notice must specify the extent to which work is stopped and the conditions under which work may resume. The permittee is responsible for the actions of agents of the permittee and must notify those agents when a stop work order is issued that will affect an area within which the agents are to work. In this regard, "agent" is defined as any person who acts at the instruction, with the permission, or to the benefit of the permittee.

    2. A stop work order may be issued without prior written notice where the Public Works Director determines that:

        a. Land disturbance is taking place that requires a permit under this Article and one has not been approved;

        b. Required erosion and sediment control measures are not installed, inspected, and approved before the land disturbance;

        c. The limits of disturbance are being violated; or

        d. An inspection reveals the existence of any condition or any act that:

1. is creating or will create a nuisance or hazard; or
2. endangers human life or the property of others.

C. Failure of the permittee to make the necessary corrections within 10 days after a stop work order is posted shall constitute a public offense and is punishable as prescribed in this Article. Upon such failure, the City may:

1. issue a Notice to Appear, setting a date and time for appearance in Municipal Court. The Public Works Director shall have authority to issue a Notice to Appear under this Article. The City may seek all criminal and civil penalties allowed by this Chapter, as well as any injunctive relief that may be appropriate; and/or
2. correct or abate the violation.

D. If the City performs work to correct a violation of this Article, the costs incurred by the City to perform this work shall be paid by the owner or permittee out of the performance guaranty required by *Section 4-1-N-22* to the extent that the amount is covered thereby, with any remainder being directly due and owing by the owner or permittee, as set forth in *Section 4-1-N-22*-D hereof. In the event no permit was issued or no performance guaranty was posted, the cost, plus interest at the rate authorized by the City, plus a reasonable administrative fee shall be billed to the owner. If in any event the amount due is not paid, the City Clerk shall certify the amount due to the Clerk of Johnson County, Kansas, and it shall, in accordance with law, become a lien upon all property and all rights to property, real or personal, of any person liable to pay the amount due. This amount shall be listed on the tax bill and be collected in the manner of ordinary taxes as authorized by law.

E. The Public Works Director shall have authority, but not the obligation, to issue additional notices and extend the time given to a permittee to perform any action required under this Article.

F. Any person who violates a provision of this Article, fails to comply with any of the requirements thereof, or fails to comply with a directive of the City as authorized by this Article is guilty of a public offense and shall be subject to penalties as provided in *Section 1-1-C-3* of this Code. In addition, the City may seek such additional remedies and have such additional enforcement powers as set forth in Section 4-1-L-2 of this Code.

Section 4-1-N-21 PERMIT SUSPENSION AND REVOCATION; STOP WORK ORDER. (Rep. Ord. 4986, eff. 9/25/2007)

Section 4-1-N-22 PERFORMANCE GUARANTY.

A. Prior to issuance of a permit the applicant must submit a performance guaranty that meets the requirements specified in this Section and in a satisfactory form approved by the City Attorney. That instrument shall be conditioned upon the faithful performance of the terms of the permit, and the soil erosion and sediment control measures specified in the permit and approved plan, within the time specified by the Public Works Director or within any extension granted by the Public Works Director. The amount of the performance guaranty required by this Section shall be as determined by the Public Works Director to secure the costs of improvements required in an approved plan, and this amount shall be in addition to any other amounts necessary to secure the faithful performance of other acts required of permittee by the City that the performance guaranty is intended to cover. The Public Works Director may grant a partial or complete waiver of the performance guaranty, upon application, for governmental or quasi-governmental entities or state regulated utilities or where the Public Works Director finds minimal impairment of existing surface drainage, minimal erosion hazard, minimal sedimentation hazard upon any adjacent land or watercourse, and no hazard to human life or property.

B. Whenever the City finds that a default has occurred in the performance of any term or condition of the permit, approved plan, or performance guaranty, or a violation of *Section 4-1-N-26* has occurred, written notice of default must be given to the permittee and to the surety or issuing organization or entity. The notice must state the work to be done, the estimated cost, and the specified period of time deemed by the Public Works Director to be reasonably necessary for completion of the work.

C. If a cash bond has been posted, notice of default as provided by the preceding paragraphs must be given to the permittee; and if compliance is not obtained within the time specified, the City may proceed, without delay and without further notice or proceedings, to use the cash deposited or any portion of the deposit to cause the required work to be done by contract or otherwise in the discretion of the Public Works Director.

D. In the event of any alleged default in the performance of any term or condition of the performance guaranty, the City, the surety, the issuing organization or entity, or any person employed or engaged on its behalf has a right to go upon the site to complete the required work necessary to control erosion and sedimentation or to protect properties, watercourses, and persons. In the event the City undertakes this work with the funds from a forfeited performance guaranty, the funds must be used to pay the cost of contracting, including engineering and administration, for necessary restoration of the site to control erosion and sediment within the requirements of the approved plan, permit, or performance guaranty or this Article. If the cost of the work necessary to control erosion and sediment or to protect properties, watercourses, and persons exceeds the amount of the performance guaranty, the permittee shall continue to be firmly bound under a continuing obligation for payment of all excess costs and expenses incurred by the City. The cost of necessary work in excess of the performance guaranty shall be certified by the City Clerk to the Clerk of Johnson County, Kansas, and shall, to the extent authorized by law, become a lien upon all property and all rights to property, real or personal, of any person liable to pay that cost. The cost of removal shall be listed on the tax bill and be collected in the manner of ordinary taxes to the extent authorized by law.

E. A person must not interfere with or obstruct the ingress or egress to or from a site or premises by an authorized representative or agent of any surety, issuing organization or entity, or the City engaged in completing the work required to be performed under the permit or in complying with the terms or conditions of the approved plan or the permit.

F. A performance guaranty remains in full force and effect until a completion certificate is issued, pursuant to *Section 4-1-N-24* of this Article, and all other permittee's acts covered by the performance guaranty have been determined to be complete in accordance with the applicable City Code provisions. A cash bond must be returned to the depositor or to the successors or assigns of the depositor upon issuance of a completion certificate for the work in accordance with *Section 4-1-N-24* of this Article, except any portion that may have been used. Failure to renew the performance guaranty 14 calendar days prior to expiration shall be deemed default.

G. The Public Works Director shall immediately direct the Building Official to revoke the permit upon failure of any permittee to maintain the performance guaranty.

Section 4-1-N-23 MAINTENANCE OF STRUCTURES, MEASURES AND DEVICES.

A. The permittee or the owner of any property on which work has been done pursuant to a permit, or any other person or agent in control of that property, must inspect and maintain in good and effective condition and promptly repair or restore all grade surfaces, walls, drains, dams and structures, plantings, vegetation, and other erosion and sediment control measures and devices. The permittee or owner, their agent, contractor, and employees shall, each day, maintain and repair all graded surfaces and erosion control facilities, drainage structures, and other protective devices, plantings, and ground cover installed while construction is active. After construction is complete, the owner or their agent shall continue to regularly inspect the vegetation until adequate turf or other suitable vegetative cover is established. Repair or restoration, and maintenance, must be in accordance with the approved plan, and permit as required by this Article until permanent measures are accepted by the City.

B. Any person who performs utility related work under a permit is responsible for the repair or maintenance of all erosion and sediment control measures affected by the utility construction. Repair or maintenance must be in accordance with subsection A of this Section.

Section 4-1-N-24 COMPLETION.

Upon completion of the project and after the site is stabilized, the permittee must notify the Public Works Director and schedule a final inspection. Upon final inspection of the project, the Public Works Director has sole discretion to determine whether all work subject to inspection has been satisfactorily completed in accordance with the requirements of this Article, the permit, and the approved plan, rules and regulations, and that any supporting documents required under *Section 4-1-N-19*-G are accepted.

Section 4-1-N-25 PROTECTION OF ADJACENT PROPERTY DURING LAND DISTURBANCE ACTIVITIES.

A person must not initiate land disturbance activities sufficiently close to the property line so as to endanger any adjoining property, including a public street, sidewalk, or alley. The adjoining property should be supported and protected from damage that may result from land disturbance activities including, but not limited to, settling, cracking, vegetative damage, erosion, soil deposition, and excessive construction dust. If, in the opinion of the Public Works Director, the land disturbance activity creates a hazard to life or property that is not adequately safeguarded, the permittee must construct walls, fences, guard rails, or other structures to safeguard the adjoining private property or public street, sidewalk, alley, or other public property and persons, as the Public Works Director may require.

Section 4-1-N-26 DEPOSITS OF SOIL OR OTHER MATERIAL PROHIBITED.

A. A person must not engage in any land disturbance activity or by any action cause or permit any soil, earth, sand, gravel, rock, stone, or other material, to be deposited upon or to roll, flow, or wash upon or over the premises of another without the express written consent of the owner of the premises affected. A person must not engage in any land disturbance activity or by any action cause or permit any soil, earth, sand, gravel, rock, stone, or other material to be deposited to roll, flow, or wash upon or over any public street, street improvement, road, sewer, storm drain, watercourse, rights-of-way, or any public property.

B. A person must not, when hauling soil, earth, sand, gravel, rock, stone, or other material over any public street, road, alley, or public property, allow those materials to blow or spill over and upon any street, road, alley, or public property or adjacent private property.

C. If any soil, earth, sand, gravel, rock, stone or other material is caused to be deposited upon or to roll, flow, or wash upon any public or private property in violation of subsections A and B above, the Public Works Director shall notify the person responsible within 10 days after becoming aware of the condition. The notice issued must, as a minimum, state the nature of the violation, required corrective action, and compliance time. The person responsible for the violation must cause the material to be removed from that property the compliance time set forth in the notice. In the event of an immediate danger to the public health or safety, as determined by the Public Works Director, notice must be given by the most expeditious means in the discretion of the Public Works Director and the material must be removed immediately. In the event it is not so removed, the City may cause the removal. The cost of the removal by the City must be paid to the City by the person who failed to remove the material. The cost of removal may be certified by the City Clerk to the Clerk of Johnson County, Kansas, and shall, to the extent authorized by law, become a lien upon all property and all rights to property, real or personal, of any person liable to pay that cost. The cost of removal shall be listed on the tax bill and be collected in the manner of ordinary taxes to the extent authorized by law. In addition, the City may treat the failure to remove as a default on the performance guaranty and remedy the default as authorized by *Section 4-1-N-22*-B and 4-1-N-22-D. If costs are not fully paid by the performance guaranty, the amount unpaid may be collected as taxes as provided above.

Section 4-1-N-27 LIABILITY.

The permittee is responsible for safely and legally completing the project. Neither the issuance of a permit under the provisions of this Article, nor the compliance with the provisions hereto or with any condition imposed by the City, shall relieve any person from responsibility for damage to persons or property resulting therefrom, or as otherwise imposed by law, nor impose any liability upon the City for damages to persons or property.

Section 4-1-N-28 FINES AND PENALTIES.
The City shall have the enforcement and remedial actions set forth in *Section 4-1-L-2* of the City Code if any person allows or performs a land disturbance activity without obtaining a permit, as required by this Article, allows or performs a land disturbance activity in a manner that does not comply with an approved plan or a permit or works with a revoked or suspended permit.

Section 4-1-N-29 REGULATIONS. (Rep. Ord. 4986, eff. 9/25/2007)

Appendix B
APWA 5100 Erosion and Sediment Control Design Criteria

DIVISION V
DESIGN CRITERIA

DIVISION 5100 EROSION AND SEDIMENT CONTROL

Approved and Adopted this 13th day of August 2003

Kansas City Metropolitan Chapter
American Public Works Association

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SECTION 5100 DESIGN PRINCIPLES AND PRACTICES

5100.1 PLANNING

Planning is the critical process in which land disturbing activities are formulated and presents the opportune time to plan to minimize impacts. To be successful, the construction plan must include control measures for efficient scheduling and coordination of construction activities and provisions for the construction and maintenance of erosion and sediment control practices. Stormwater management facilities should be utilized to reduce the impact of stormwater runoff, both during and after construction. Land disturbing activities normally will result in an increase in runoff from the site. Stormwater management structures will reduce the impact of increased runoff on downstream facilities. Permanent stormwater management controls are found in Section 5600 of the APWA Standard Specification and Design Criteria manual.

5100.2 SUITABILITY OF DEVELOPMENT TO EXISTING SITE CONDITIONS

Review and evaluate all existing conditions in the initial site selection for the project. Choose a site that is suitable rather than force the terrain to conform to development's needs. Ensure that the development's features follow natural contours. Steep slopes, areas subject to flooding, and highly erodible soils severely limit a site's use, while level, well-drained areas offer few restrictions. Any modification of a site's drainage features or topography requires protection from erosion and sedimentation.

5100.3 FINAL DESIGN

Final designs should be based on detailed engineering surveys, field investigations, sound conservation, professional erosion and sediment control assessment, and engineering principles. Stormwater flow from above the site should be directed away from the site to decrease the additional potential for soil movement and limit the quantity of stormwater to be controlled and treated.

5100.4 MINIMIZATION OF AREA AND TIME OF EXPOSURE

When natural vegetation is removed and soil disturbances occur, the extent and duration of exposure should be minimized. Plan the phases or stages of development so that only the areas that are actively being developed are exposed. All other areas should have a good cover of temporary or permanent vegetation or mulch. Grading should be completed as soon as possible after it is initiated. As slopes are cut and as fill slopes are brought to grade, the areas should be revegetated as the work progresses.

5100.5 DIVERSION OF CLEAN WATER

Runoff from the area upland of the development should be diverted around the construction site. This can be accomplished by using perimeter controls or diversions. This will limit the quantity of stormwater to be controlled and treated on the disturbed construction site.

5100.6 STABILIZATION OF CONCENTRATED FLOWS BEFORE DISTURBANCE OCCURS

Runoff from the development should be safely conveyed to a stable outlet using storm drains, diversions, stable waterways, or similar sediment control measures. Temporary facilities for conveyance of stormwater should be designed to withstand the velocities of projected peak discharges. These facilities should be operational as soon as possible after the start of construction and, if possible, before the disturbance of the surrounding areas. For permanent stormwater management controls refer to Section 5600 of the APWA Standard Specifications and Design Criteria manual.

5100.7 APPLICATION OF EROSION CONTROL AS A FIRST LINE OF DEFENSE AGAINST ON-SITE DAMAGE

Implementing practices that prevent or minimize erosion on a construction site is called erosion control. Erosion control strategies attempt to prevent or minimize the problem of erosion on development sites. The following guidelines apply to erosion control strategies.

A. Clear only what is required for construction. Where possible, large projects should be cleared and graded as construction progresses, and mass clearing and grading should be avoided.

B. Reestablish with vegetation as soon as possible after construction is completed. Certain sections of large construction projects may be completed before others and be ready for stabilization before the total project is completed. Waiting until the end of the project to commence all site stabilization may leave areas exposed for an unnecessarily long duration.

C. Areas that have been cleared and graded, but will not be constructed on for more that 14 days (7 days for steep slopes), must be stabilized with mulch or temporary vegetation.

D. Extraneous runoff should be diverted from critical areas, such as highly erodible soils and steep slopes, and conveyed to stable areas.

E. The formation of a large drainage area and the concentrating of surface runoff flow patterns should be avoided where possible.

5100.8 SEDIMENT RETENTION ON CONSTRUCTION SITES

Even with careful planning, some erosion is unavoidable. Minimize the amount of sediment leaving the site by using proper Best Management Practices (BMPs). Plan the location where sediment deposition will occur, and maintain access for clean out. Protect low points below disturbed areas by building barriers to reduce sediment loss. Whenever possible, plan and construct sediment traps and basins before other land-disturbing activities.

5100.9 ENCROACHMENT ON WATERCOURSES

Permanent buildings should not be subjected to flooding, sediment damages, or erosion hazards. Earth fills that adversely obstruct water flows or increase downstream velocity of water flows should not be constructed in flood-prone areas. When necessary to span a flood-prone area or watercourse, bridge and culvert openings should be sized to permit passage of peak discharges without causing undue restrictions in water flows and without creating excessive damages from flooding, scour, and sediment. Temporary bridges or culverts should be employed when it is necessary for construction equipment to cross natural or constructed channels.

5100.10 INSPECTION AND MAINTENANCE OF CONTROL MEASURES

Inspection and maintenance is vital to the performance of erosion and sediment control measures. If not properly maintained, some practices may cause more damage than they prevent. Always evaluate the consequences of a control measure failing when considering which control measure to use since failure of a practice may be hazardous to both people and property. For example, a large sediment basin failure can have disastrous results, and low points in dikes can cause major gullies to form on a fill slope. It is essential to inspect all practices to determine that they are working properly and to ensure that problems are corrected as soon as they develop.

5100.11 INSTALLATION OF CONSTRUCTION ENTRANCES

Before construction begins on a project, a construction entrance must be built for equipment and materials to enter and exit the site from a public road. A temporary entrance will help reduce the sediment that could potentially leave the site.

SECTION 5101 REFERENCE DOCUMENTS

The information contained in this APWA document is based in large part on the following documents:

Virginia Department of Conservation and Recreation, Erosion and Sediment Control Handbook, Division of Soil and Water Conservation. Richmond, VA. 1992. http://www.dcr.state.va.us/sw/index.htm

Georgia Soil and Water Conservation Commission, Manual for Erosion and Sediment Control in Georgia. Athens, GA. 2000. http://www.ganet.org/dnr/environ/techguide_files/wpb/esc_manual.pdf

Maryland Department of the Environment, Standards and Specifications for Soil Erosion and Sediment Control. Water Management Administration. Baltimore, MD. 1994. http://www.mde.state.md.us/

Missouri Department of Natural Resources, Protecting Water Quality: A Field Guide to Erosion, Sediment and Stormwater Best Management Practices for Development Sites in Missouri and Kansas. Rolla, MO. 1998.

North Carolina Sedimentation Control Commission, Erosion and Sediment Control Planning and Design Manual. North Carolina, 1993.

In addition, the following documents offer information on the subject of erosion and sediment control:

State Manuals:

Alabama Department of Environmental Management, Non-Point Source Management Program. Montgomery, AL. 1989.

California Regional Water Quality Control Board, Erosion and Sediment Control Field Manual. San Francisco Bay Region Oakland, CA. 1997.

California Regional Water Quality Control Board, Guidelines for Construction Projects. San Francisco Bay Region. Sacramento, CA. 1997.

Commonwealth of Pennsylvania, Erosion and Sediment Pollution Control Program Manual. Bureau of Water Quality Protection, PA. 2000.

Delaware Department of Natural Resources and Environmental Control, Erosion and Sediment Control Handbook for Development. Division of Soil and Water Conservation, DE. 1989. http://www.dnrec.state.de.us/dnrec2000/

Honolulu Department of Public Works, Soil Erosion Standards & Guidelines. City and County of Honolulu, HI. 1975.

Illinois Environmental Protection Agency, 1995 Illinois Urban Manual. Division of Water Pollution Control, Springfield, IL. 1995. www.il.nrcs.usda.gov/

Georgia Soil and Water Conservation Commission, Field Manual for Erosion and Sediment Control in Georgia: Vegetative and Structural Best Management Practices (BMP's) for Land-Disturbing Activities. Athens, GA. 1997.

Indiana Department of Natural Resources, Handbook for Erosion Control in Developing Areas: Guidelines for Protecting Water Quality Through the Control of Soil Erosion and Sedimentation on Construction Sites. Division of Soil Conservation, Indianapolis, IN. 1992.

Kentucky Division of Conservation, Best Management Practices for Construction Activities. Division of Water, KY. 1994.
http://www.nr.state.ky.us/nrepc/dnr/dnrhome2.htm

Massachusetts Department of Environmental Protection, Stormwater Management Volume One: Stormwater Policy Handbook. Massachusetts Office of Coastal Zone Management, 1997.

Massachusetts Department of Environmental Protection, Stormwater Management Volume Two: Stormwater Technical Handbook. Massachusetts Office of Coastal Zone Management, 1997.

Minnesota Pollution Control Agency, Protecting Water Quality in Urban Areas: Best Management Practices for Minnesota. Division of Water Quality, 1989.
http://www.pca.state.mn.us/water/pubs/sw-bmpmanual.html

Mississippi Department of Environmental Quality, Planning & Design Manual for the Control of Erosion, Sediment & Stormwater. Office of Pollution Control, Jackson, MS. 1994.

New Jersey State Soil Conservation Committee, Standards for Soil Erosion & Sediment Control. Division of Rural Resources, New Jersey Department of Agriculture, Trenton, NJ. 1987.
http://www.state.nj.us/dep/watershedmgt/bmpmanual.htm

North Carolina Department of Environment, Health, and Natural Resources, Erosion and Sediment Control: Field Manual. Division of Land Resources, 1991.

North Central Texas Council of Governments, Storm Water Quality Best Management Practices for Construction Activities. Arlington, TX. 1993.

Ohio Department of Natural Resources, Rainwater and Land Development: Ohio's Standards for Stormwater Management Land Development and Urban Stream Protection. Division of Soil and Water Conservation, Columbus, OH. 1996.

State of Florida, Stormwater and Erosion and Sediment Control Best Management Practices for Developing Areas. Department of Environmental Protection, FL.

Virginia Department of Conservation and Recreation, Virginia Erosion & Sediment Control Field Manual. Division of Soil and Water Conservation, VA. 1995.

Washington State Department of Ecology, Stormwater Management Manual for Western Washington Volume I: Minimum Technical Requirements and Site Planning. Water Quality Program, 2001. www.ecy.wa.gov/biblio/wq.html

Washington State Department of Ecology, Stormwater Management Manual for Western Washington Volume II: Construction Stormwater Pollution Prevention. Water Quality Program, 2001. www.ecy.wa.gov/biblio/wq.html

Washington State Department of Ecology, Stormwater Management Manual for Western Washington Volume III: Hydrologic Analysis and Flow Control Design/ BMPs. Water Quality Program, 2001. www.ecy.wa.gov/biblio/wq.html

Washington State Department of Ecology, Stormwater Management Manual for Western Washington Volume IV: Source Control BMPs. Water Quality Program, 2001. www.ecy.wa.gov/biblio/wq.html

Washington State Department of Ecology, Stormwater Management Manual for Western Washington Volume V: Runoff Treatment BMPs. Water Quality Program, 2001. www.ecy.wa.gov/biblio/wq.html

West Virginia Soil Conservation Service, Erosion & Sediment Control Handbook for Developing Areas. Soil Conservation Service, Morgantown, WV. 1993.

Wisconsin Department of Natural Resources, Construction Site Best Management Practice Handbook. Bureau of Water Resources Management, WI. 1994. http://www.dnr.state.wi.us/org/water/wm/nps/publications.htm

Wyoming Department of Environmental Quality, Urban Best Management Practices for Non-point Source Pollution. Water Quality Division, WY. 1999. http://deq.state.wy.us/wqd/wtrshedpg.htm

Books:

Coppin, N.J., I. G. Richards, Use of Vegetation in Civil Engineering. Butterworths, London, 1990.

Environmental Law Institute Research Report, Almanac of Enforceable State Laws to Control Non-point Source Water Pollution. Environmental Law Institute, 1998.

Goldman, Steven J., Katharine Jackson, Taras A. Bursztynsky, Erosion & Sediment Control Handbook, McGraw-Hill Inc., New York, NY. 1986.

Haan, C.T., B.J. Barfield, and J.C. Hayes, Applied Hydrology and Sedimentology for Small Catchments. Academic Press, Inc., San Diego, CA. 1994.

International Erosion Control Association, "Sustaining Environmental Quality: The Erosion Control Challenge." Proceedings of Conference XXV, Reno, NV. 1994.

International Erosion Control Association, Erosion Control Technology Brining It Home. Proceedings of Conference XXVII, Seattle, WA. 1996.

International Erosion Control Association, Proceedings of Conference 28. Nashville, TN. 1997.

International Erosion Control Association, Proceedings of Conference 32. Las Vegas, NV. 2001.

Munshower, Frank F., Practical Handbook of Disturbed Land Revegetation. CRC Press, Inc., Boca Raton, FL. 1994.

Texas Department of Transportation, The Performance of Flexible Erosion Control Materials and Hydraulic Mulches. Texas Transportation Institute, College Station, TX. 1994.

Texas Department of Transportation, The Use of Compost and Shredded Brush on Rights-of-Way for Erosion Control: Final Report. Texas Transportation Institute, College Station, TX. 1995.

Texas Nonpoint Source Book. www.txnpsbook.org

Trow Consulting Engineers Ltd., Instream Sediment Control Techniques Field Implementation Manual. Queen's Printer for Ontario, Ontario, 1997.

United States Environmental Protection Agency, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices. Office of Water, Smoley, Boca Raton, FL. 1993.

Articles:

Chirbas, Urroz. "Performance Evaluation of Rolled Erosion Control Products." Land and Water. September/October 1999.

Dissart, Baker, Thomassin. "The Economics of Erosion and Sustainable Practices: The Case of the Saint-Esprit Watershed." Canadian Journal of Agricultural Economics 48 (2000).

Lutyens, Donald E. "Comparison of Sediment Control Devices." Land and Water. May/June 2001.

Showler, John E. "New Approaches to Implementing Soil Erosion and Water Quality Controls on Construction Sites." Water Resources IMPACT. March 1999.

Urban Water Resources Research Council of ASCE, "Determining Urban Stormwater BMP Removal Efficiencies-Final Data Exploration & Evaluation Report." June 2000.

Websites:

BMP-Soil & Water Conservation. www.wvu.edu/~agexten/forestry/bestprac.htm

Further Help in Evaluatation of BMPs on Construction Sites. http://science/kennesaw/edu/~jdirnber/scienceI/Erosion/BMP.html

Glossary of Industry Terms, Erosion Control Magazine. www.forester.net

Stormwater Industry Association Inc., Publications Available. www.stormwater.asn.au/sia4.htm

Texas Transportation Instituite. "Field Performance Testing of Selected Erosion Control Products Final Analysis." www.dot.state.tx.us/insdtdot/orgchart/cmd/erosion/contents.htm

United States Environmental Protection Agency, National Menu of Best Management Practices for NPDES Storm Water Phase II Downloadable Files. http://www.epa.gov/npdes/menuofbmps/BMP files.htm

Other Resources:

Geotechnical Fabrics Report, Specifier's Guide 2001. Vol. 18 No. 9, December 2000.

Geotechnical Fabrics Report, www.ifai.com

Stormwater Magazine, www.stormh2o.com.

Erosion Control Magazine, www.erosioncontrol.com.

SECTION 5102 EDUCATION, TRAINING, AND CERTIFICATION

5102.1 BACKGROUND

The goal of this APWA document is to serve as a manual that is easy to understand and provide a depth of technical detail that adequately presents the recommended standards and performance levels. Users of the document need the required level of competency and education to properly practice in the field of erosion and sediment control. The people who use this document could include the designer, the reviewer, and the inspector of the design installations and the Contractor implementing the design. Table 5102-1 includes the recommended educational criteria for users of this manual.

5102.2 RESOURCES

An extensive literature list which provides a basis for a basic level of understanding of the principles of erosion and sediment control is located in Section 5101, Reference Documents, of this document.

5102.3 PROFESSIONAL CERTIFICATION

The standard for competency by license, certification, or recognized equivalent appropriate for the desired level is included in the Table 5102-1.

Table 5102-1: Professional Standard

Role	Professional License or Certification[1]	Equivalent Private Certification[1]
Designer	LA or PE License	CPESC[4] or CPESC in training
Installer	N/A[2]	NICET[3], CPESC or CPESC in training
Capital Construction Inspector or Developer Inspector	PE License	NICET[3] or CPESC
Erosion and Sediment Control Inspector	LA or PE License	NICET[3], CPESC or CPESC in training

[1] Unless Jurisdiction has adopted more stringent requirements.
[2] The installer shall have 1 person or foreman of adequate competency at his disposal to make decisions as may be necessary in the field. Designer's Plans shall not be modified without proper consent as so noted by initialed changes on the records.
[3] NICET is the National Institute for Certified Engineering Technicians (www.nicet.org).
[4] CPESC is a Certified Professional in Erosion and Sediment Control (www.cpesc.net).

5102.4 SKILL RATING AND TRAINING PERFORMANCE

This section covers the minimum areas of training, recommended rating of importance, and required training needed for practice and application of the erosion and sediment

control standards. APWA will track the attendance of the training events for State verification only. The jurisdictional authorities who adopt the APWA standards are responsible for making spot checks when and where appropriate. This may include, but is not limited to, problems in design, construction, and implementation. Table 5102-2 includes the skill rating for each of the training sessions for those involved in erosion and sediment control practices. Table 5102-3 includes a list of Professional Development Hours (PDHs) required for annual training and updating of knowledge in the field of erosion and sediment control. There will be a mandatory, 20-hour introductory training session explaining the new manual and its use prior to practice and application of the APWA standards.

Table 5102-2: Skills Rating

Skills:	Designer	Installer	Inspector
Mechanics of Erosion	3	3	3
NPDES Permit Process(KS, MO)	3	1	3
BMP Applicability	3	3	3
Advanced BMP	2	1	2
BMP Design	3	1	1
BMP Periodic Inspection & Maintenance	1	3	3
Communication/Teamwork	2	2	3
Phasing Sequencing of Erosion Control Plan	3	2	2
Total*	20*	16*	20*

* Totals represent 1 hour of Professional Development Hours (PDH) of training per rating point, as applied to specific skill areas

Rating Scale:
3 = high importance
2 = moderate importance
1 = low importance

Table 5102-3: Required Training Prior to Practice and Application of APWA Standards

Role:	Required PDHs[1]
Designer	20 Hours/Year
Installer	16 Hours/Year
Capital Construction Inspector (Gen. Insp.)	20 Hours/Year
Erosion and Sediment Control Inspector (Specialized Insp.)	20 Hours/Year

[1] Unless Jurisdiction has adopted more stringent requirements.

5102.5 TRAINING SUMMARY

An initial 8-hour training session with the new manual will be required. An additional 20 hours per year will be required for designers and inspectors and 16 hours per year for installers.

SECTION 5103 PLAN REQUIREMENTS

5103.1 CHECKLIST

The checklist includes the required contents of an erosion and sediment control plan. The checklist is divided into a narrative section, a site plan section, design guidance, and verification of design performance.

Narrative:

_____ Project Description – Briefly describe the nature and purpose of the land-disturbing activity and the number of acres to be disturbed.

_____ Phased Development – Briefly describe the location, nature, and size of each phase of development. Include a list of contractors for each aspect or phase of construction.

_____ Project Dates – List starting dates of initial land disturbing activities and the expected date of completion of final stabilization for each phase.

_____ Existing Site Conditions – Describe the existing topography, vegetation, and drainage.

_____ Soils – Briefly describe the soils on the site giving such information as soil name, mapping unit, erodibility, permeability, depth, texture, and soil structure.

_____ Critical Areas – Describe the areas on the development site that have potentially serious erosion problems such as steep slopes, channels, underground spring, wetlands, and environmentally sensitive areas.

_____ Erosion and Sediment Control Measures – Describe the methods that will be used to control erosion and sedimentation on the site.

_____ Permanent Stabilization – Briefly describe and include specifications of how the development site will be stabilized after construction is completed.

_____ Stormwater Runoff Considerations – Describe the strategy to control stormwater runoff. Will the development site cause an increase in peak runoff rates? Will the increase in runoff cause flooding or channel degradation downstream? How will the design prevent this?

_____ Calculations – Show detailed calculations for the design of temporary sediment basins, diversions, channels, etc. Include calculations for pre- and post-development runoff.

_____ Inspection and Maintenance – Include a schedule of regular inspections and repairs of erosion and sediment control structures.

_____ Spill Prevention and Material Management Practices – Provide a plan of methods to manage materials and spills during construction.

Site Plan:

General Information:

_____ General Information – Include information such as title block, scale, and legend on the site plan.

_____ Vicinity Map – Include a small map locating the site and adjacent watersheds in the surrounding area. Include any landmarks which might assist in locating the site.

_____ Indicate North – Include north arrows on all plan sheets.

_____ Limits of Clearing and Grading – Show areas that are to be cleared and graded.

Existing Conditions Plan:

_____ Existing Contours – Show existing contours of the site.

_____ Existing Vegetation – Show existing tree lines, grassed areas, or unique vegetation.

_____ Soils – Show the boundaries of different soil types.

_____ Existing Drainage Patterns – Show the dividing lines and the direction of flow for different drainage areas. Include the acreage of each drainage area.

_____ Critical Areas – Indicated all steep slopes, channels, wetlands, underground springs, and environmentally sensitive areas.

Proposed Construction Plan:

_____ Proposed Contours – Show the proposed contours of the site.

_____ Site Development – Show all improvements such as buildings, parking lots, access roads, and utility construction.

_____ Location of Practices – Show the locations and types of erosion and sediment controls and stormwater management practices used on the site.

_____ Location of Topsoil Stockpile – Indicate the location of all soil stockpiles on the site.

_____ Detail Drawings – Explain and Illustrate with detail drawings any structural practices used which are not referenced in this manual.

_____ Construction Access – Show the access on which construction traffic will be entering and exiting the construction site.

_____ Staging Area – Indicate the area on which the construction equipment and materials will be stored.

_____ Inspection and Maintenance – Provide a schedule of regular inspections and maintenance of erosion and sediment control structures.

_____ Template Standards – Provide all standard templates applicable to this construction project.

Controls Checklist:

See Design Guidance

Other Permits Required:

_____ Construction Activity (NPDES)

_____ Section 401

_____ Section 404

_____ Other State applicable permits

_____ Other Local applicable permits

5103.2 DESIGN GUIDANCE

Design guidance aids the designer with choosing the BMPs to use for erosion and sediment control. A series of questions lead the designer to specific erosion and sediment control practices.

A. **General Criteria 1:** Diversion of Upland Water

Is there any upland area?

If YES – Use diversions as much as practicable to divert stormwater runoff from above the construction site around the disturbed area to decrease volume of runoff treated.

B. **General Criteria 2:** Concentrated Flow Paths

Are dikes, swales, and diversions planned for the site?

If YES – Those areas must be seeded and mulched or sodded within 24 hours of construction.

C. **General Criteria 3:** Phasing Disturbance

Note: If utility construction or the grading operation can be phased, the plan should indicate the anticipated schedule. Detailed construction schedules must be submitted as part of the erosion and sediment control plan.

D. **General Criteria 4:** Surface Stabilization for Slopes

Are there slopes of 0-6% that are longer than 200 feet?
Are there slopes 6-12% and longer than 100 feet?
Are there slopes >12% and longer than 50 feet?

If YES – Use surface stabilization BMPs such as mulch with tackifier, RECP, and sodding along with measures to reduce slope length to reduce the potential for surface runoff that produces rills and gullies.

Note: All slopes that are 3H:1V or steeper must be fully and permanently stabilized within 2 weeks of final grading.

Are concentrated stormwater flows expected over cut and fill slopes?
If YES – Divert stormwater around cut and fill slopes as much as practicable until the slopes are fully stabilized with vegetation.

E. **General Criteria 5:** Perimeter Control

Is the drainage area less than 2 acres, sheet flow anticipated, or the slope length less than 150 feet?

If YES – Use perimeter controls such as sediment fence and triangular silt dike, along those perimeter areas where surface runoff leaves the site.

Is the drainage area less than 5 acres?
If YES – Use a temporary sediment trap or similar sediment control.

Note: If the drainage area is greater than 10 acres, use a temporary sediment basin. Construction sites draining between 5 & 10 acres must have a temporary storm detention structure designed for the appropriate runoff from the site.

F. **General Criteria 6:** Runoff Control and Conveyance

Does runoff concentrate in a swale or channel?

If YES – The channel must be fully stabilized with sod or seed and erosion control blankets within 48 hours after channel is constructed.

Does the channel velocity range from 10-20 feet per second or the shear stress range from 6-10 pounds per square foot?
If YES – Use Turf Reinforcement Mats (TRMs).

Is the channel velocity more than 20 feet per second or shear stress greater than 10 pounds per square foot?
If YES – Use riprap, bioengineering, or concrete.

Note: To reduce velocity in channel and provide sediment control, install check dams as in Section 5108.6.

G. **General Criteria 7:** Sediment Controls

Does the design include concentrated stormwater flow through pipes?
If YES – Use inlet and outlet protection for the pipes. See Sections 5108.7, Inlet Protection, and Section 5108.15, Outlet Stabilization Structures.

H. **General 8:** Other Related Practices

Note: Whenever a construction entrance intersects a paved public road, provisions must be made to minimize the transport of sediment by runoff or vehicle tracking onto the paved surface. Where sediment is transported onto a public road surface, the road should be cleaned thoroughly at the end of each day. Sediment should be removed from roads by shoveling or sweeping and be transported to a controlled sediment disposal area. Street washing should be allowed only after sediment is removed in this manner.

The plan must show on a detailed drawing where the construction entrance(s) will be located.

5103.3 VERIFICATION OF DESIGN PERFORMANCE

Verification of design performance measures, as depicted on erosion and sediment control plans or SWPPPs, to accurately predict potential damage to the environment by erosion and sedimentation is inherently difficult due to the number of external factors associated with accurate field information, field implementation, and field conditions during land disturbance activity and the inability to reliably predict industry BMP products or process performance under all potential conditions. Converting design principles to formulas that predict performance, while not exact, necessarily reliable, or technically justified in all respects, can potentially develop a basic understanding of relative performance and further stimulate analysis and development of reliable models. While APWA includes the following formula for such purposes, it does so recognizing these limitations and benefits. Therefore, APWA considers the following formula to be a simplification of a complicated design procedure. However, the formula also promotes a focus by professionals on the further analysis of BMP performance and plan design by industries that supply products and establish installation practices to protect the environment. It should in no way be used as a guarantee or considered an implied warranty to the success of any given plan. The factors in the formula include: size of drainage area, length and slope, soil erodibility, distance from a waterway, duration of the project, erosive factor from rainfall, and associated controls and practices. The final value (H) should be less than 50 times the drainage area (50 x A) and the controls/practice (CP) value should be less than or equal to 0.2. Several of the factors in the equation can be adjusted to reduce the final number, which is the measurement of the potential for erosion and sediment damage.

Rating of Potential Damage by Erosion and Sedimentation:

H = FTAE

H = Measurement of potential for erosion and sediment damage for each drainage area. The value of H must be less than 25 times the drainage area acreage.

F = Rating factor determined by the distance from the disturbed site to the receiving waterway. Depending on the type and size of the construction site, the receiving waterway could be a storm sewer inlet, roadway ditch, drainage swale, or a more defined channel such as an intermittent creek, perennial creek, or river. (See Table 5103-1 for values of F.)

Table 5103-1: Values for F

F	Distance from Waterway (ft)
1.0	2500 or greater
1.5	1200 – 2500
2.0	500 – 1200
2.5	250 – 500
3.0	100 – 250
4.0	Less than 100

T = Time duration of the project, in years, from the first disturbance to final stabilization.

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Note: T can be a fraction if completed in less than 1 year.
For example: 1 year: T = 1.0 and 6 months: T = 0.5

A = Disturbed area, in acres, in each drainage area

E = Annual soil loss, in tons/acre/year

E = RK(LS)(CP)

R = Erosive factor from rainfall during 1 year. For the Kansas City Metropolitan area, the value of R should be 200. This value is a fixed number and cannot be changed.

K = Soil erodibility factor (See Table 5103-2)

K is an erodibility factor which quantifies the susceptibility of soil particles to detach and be moved by water. The values in Table 5103-2 are an estimate; refer to the County Soil Surveys for a better approximation of soil erodibility.

Note: If two or more soils are present in the same drainage area, a weighted value for K will be calculated according to the area. If the disturbance includes stripping the topsoil, the K value for the subsoil will be used.

LS = Factor for length and steepness of slope combine L, length of slope, and S, percent of slope. See Table 5103-3 for values of LS.

Note: Length of slope can be reduced by the use of diversion. If more than one slope is present, a weighted average of all the LS factors for the entire area should be calculated.

CP = A combined factor for the protective effect of ground cover and erosion control measures. (See Table 5103-4, Controls and Practices Values, for each erosion and sediment control)

Note: If no controls are applied, then CP = 1.0

Each value for each measure shall be multiplied to calculate the final CP value for each drainage area. CP must be less than or equal to 0.2 for each drainage area.

Table 5103-2: Estimated Soil Erodibility Factor (K)

Soil Mapping Unit	K Factor
Aholt clay	0.28
Armster clay loam	0.37
Barco loam	0.32
Basehor	0.32
Blackoar silt loam	0.28
Booker silty clay	0.28
Bremer silt loam	0.43
Colo silt loam	0.28
Cotter silt loam	0.43
Coweta loam	0.37
Deepwater silt loam	0.32
Dockery silt loam	0.43
Elmont silt loam	0.43
Eram silty clay loam	0.37
Eudora Complex	0.2
Freeburg silt loam	0.37
Gilliam silt loam	0.28
Gosport Complex	0.43
Greenton silty clay	0.37
Grundy silt loam	0.37
Haig silt loam	0.37
Haynie silt loam	0.37
Higginsville silt loam	0.37
Kamie fine sandy loam	0.32
Kennebec silt loam	0.43
Kenoma silt loam	0.43
Knox Complex	0.36
Knox silt loam	0.43
Knox silty clay loam	0.43
Knox-Gosport Complex	0.43
Knox-Urban Land complex	0.43
Ladoga silt loam	0.43
Lagonda silt loam	0.37
Lagonda silty clay loam	0.37
Landes fine sandy loam	0.2
Leta silty clay	0.28
Levasy silty clay	0.28
Macksburg silt loam	0.32
Macksburg-Urban Land Complex	0.43

Soil Mapping Unit	K Factor
Mandeville silt loam	0.37
Marshall silt loam, 1 to 4 percent slopes	0.43
Martin silty clay loam	0.37
Martin soils	0.28
McGirk silt loam	0.32
Menfro silt loam	0.37
Menfro silty clay loam	0.37
Modale silt loam	0.28
Moniteau silt loam	0.43
Morrill clay loam	0.37
Myrick silty clay loam	0.28
Napier silt loam	0.43
Nodaway silt loam	0.43
Norborne very fine sandy loam	0.43
Norris silty clay loam	0.37
Nowata variant silt loam	0.32
Onawa soils	0.32
Onawet silty clay loam	0.17
Oska silty clay loam	0.37
Palermo silty clay loam	0.43
Parkville silty clay loam	0.28
Pawnee clay loam	0.37
Polo silt loam	0.32
Reading silt loam	0.43
Sampsel silty clay loam	0.37
Sarpy fine sand	0.15
Sarpy fine sandy loam	0.15
Sarpy loamy fine sand	0.17
Sarpy-Eudora Complex	0.17
Sarpy-Haynie Complex	0.17
Sharpsburg silt loam	0.43
Sharpsburg silty clay loam	0.43
Sharpsburg-Urban Land complex	0.43
Shelby clay loam	0.28
Shelby loam	0.37
Shelby-Pawnee Complex	0.37
Sibley silt loam	0.28
Sibley-Urban Land complex	0.28
Sibleyville Complex	0.32
Sibleyville loam	0.32

Soil Mapping Unit	K Factor
Snead silty clay loam	0.37
Snead-Rock Outcrop Complex	0.37
Snead-Urban Land complex	0.37
Sogn-Vinland Complex	0.32
Summit silty clay loam	0.37
Urban Land-Harvester complex	0.32
Verdigris silt loam	0.32
Vinland Complex	0.32
Vinland-Martin Complex	0.37
Vinland-Rock Outcrop Complex	0.32
Vinland-Sibleyville Complex	0.32
Wabash silty clay loam	0.28
Wabash silty clay	0.28
Waldron silty clay loam	0.32
Wathena-Haynie Complex	0.17
Welda silt loam	0.32
Wiota silt loam	0.43
Zook silty clay loam, occasionally flooded	0.28

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Table 5103-3: Slope-Effect (LS) Values

Slope (%)	Slope Length (feet)											
	10	20	30	40	50	60	70	80	90	100	150	200
0.5	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.10	0.11
1	0.08	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.12	0.14	0.14
2	0.10	0.12	0.14	0.15	0.16	0.17	0.18	0.19	0.19	0.20	0.23	0.25
3	0.14	0.18	0.20	0.22	0.23	0.25	0.26	0.27	0.28	0.29	0.32	0.35
4	0.16	0.21	0.25	0.28	0.30	0.33	0.35	0.37	0.38	0.40	0.47	0.53
5	0.17	0.24	0.29	0.34	0.38	0.41	0.45	0.48	0.51	0.53	0.66	0.76
6	0.21	0.30	0.37	0.43	0.48	0.52	0.56	0.60	0.64	0.67	0.82	0.95
7	0.26	0.37	0.45	0.52	0.58	0.64	0.69	0.74	0.78	0.82	1.01	1.17
8	0.31	0.44	0.54	0.63	0.70	0.77	0.83	0.89	0.94	0.99	1.21	1.40
9	0.37	0.52	0.64	0.74	0.83	0.91	0.98	1.05	1.11	1.17	1.44	1.66
10	0.43	0.61	0.75	0.87	0.97	1.06	1.15	1.22	1.30	1.37	1.68	1.94
11	0.50	0.71	0.86	1.00	1.12	1.22	1.32	1.41	1.50	1.58	1.93	2.23
12.5	0.61	0.86	1.05	1.22	1.36	1.49	1.61	1.72	1.82	1.92	2.35	2.72
15	0.81	1.14	1.40	1.62	1.81	1.98	2.14	2.29	2.43	2.56	3.13	3.62
16.7	0.96	1.36	1.67	1.92	2.15	2.36	2.54	2.72	2.88	3.04	3.72	4.30
20	1.29	1.82	2.23	2.58	2.88	3.16	3.41	3.65	3.87	4.08	5.00	5.77
22	1.51	2.13	2.61	3.02	3.37	3.69	3.99	4.27	4.53	4.77	5.84	6.75
25	1.86	2.63	3.23	3.73	4.16	4.56	4.93	5.27	5.59	5.89	7.21	8.33
30	2.51	3.56	4.36	5.03	5.62	6.16	6.65	7.11	7.54	7.95	9.74	11.25
33.3	2.98	4.22	5.17	5.96	6.67	7.30	7.89	8.43	8.95	9.43	11.55	13.34
35	3.23	4.57	5.60	6.46	7.23	7.92	8.55	9.14	9.70	10.22	12.52	14.46
40	4.00	5.66	6.93	8.00	8.95	9.80	10.59	11.32	12.00	12.65	15.50	17.89
45	4.81	6.80	8.33	9.61	10.75	11.77	12.72	13.60	14.42	15.20	18.62	21.50
50	5.64	7.97	9.76	11.27	12.60	13.81	14.91	15.94	16.91	17.82	21.83	25.21
55	6.48	9.16	11.22	12.96	14.48	15.87	17.14	18.32	19.43	20.48	25.09	28.97
57	6.82	9.64	11.80	13.63	15.24	16.69	18.03	19.28	20.45	21.55	26.40	30.48
60	7.32	10.35	12.68	14.64	16.37	17.93	19.37	20.71	21.96	23.15	28.35	32.74
66.7	8.44	11.93	14.61	16.88	18.87	20.67	22.32	23.87	25.31	26.68	32.68	37.74
70	8.98	12.70	15.55	17.96	20.08	21.99	23.75	25.39	26.93	28.39	34.77	40.15
75	9.78	13.83	16.94	19.56	21.87	23.95	25.87	27.66	29.34	30.92	37.87	43.73
80	10.55	14.93	18.28	21.11	23.60	25.85	27.93	29.85	31.66	33.38	40.88	47.20
85	11.30	15.98	19.58	22.61	25.27	27.69	29.90	31.97	33.91	35.74	43.78	50.55

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90	12.02	17.00	20.82	24.04	26.88	29.44	31.80	34.00	36.06	38.01	46.55	53.76
95	12.71	17.97	22.01	25.41	28.41	31.12	33.62	35.94	38.12	40.18	49.21	56.82
100	13.36	18.89	23.14	26.72	29.87	32.72	35.34	37.78	40.08	42.24	51.74	59.74
Slope (%)	Slope Length (feet)											
	250	300	350	400	450	500	600	700	800	900	1000	
0.5	0.11	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15	
1	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20	
2	0.26	0.28	0.29	0.30	0.32	0.33	0.34	0.36	0.37	0.39	0.40	
3	0.38	0.40	0.42	0.43	0.45	0.46	0.49	0.51	0.54	0.55	0.57	
4	0.58	0.62	0.66	0.70	0.73	0.76	0.82	0.87	0.92	0.96	1.00	
5	0.85	0.93	1.00	1.07	1.13	1.20	1.31	1.42	1.51	1.60	1.69	
6	1.06	1.16	1.26	1.34	1.43	1.50	1.65	1.78	1.90	2.02	2.13	
7	1.30	1.43	1.54	1.65	1.75	1.84	2.02	2.18	2.33	2.47	2.61	
8	1.57	1.72	1.85	1.98	2.10	2.22	2.43	2.62	2.80	2.97	3.13	
9	1.85	2.03	2.19	2.35	2.49	2.62	2.87	3.10	3.32	3.52	3.71	
10	2.16	2.37	2.56	2.74	2.90	3.06	3.35	3.62	3.87	4.11	4.33	
11	2.50	2.74	2.95	3.16	3.35	3.53	3.87	4.18	4.47	4.74	4.99	
12.5	3.04	3.33	3.59	3.84	4.08	4.30	4.71	5.08	5.43	5.76	6.08	
15	4.05	4.43	4.79	5.12	5.43	5.72	6.27	6.77	7.24	7.68	8.09	
16.7	4.81	5.27	5.69	6.08	6.45	6.80	7.45	8.04	8.60	9.12	9.62	
20	6.45	7.06	7.63	8.16	8.65	9.12	9.99	10.79	11.54	12.24	12.90	
22	7.54	8.26	8.92	9.54	10.12	10.67	11.68	12.62	13.49	14.31	15.08	
25	9.31	10.20	11.02	11.78	12.49	13.17	14.43	15.58	16.66	17.67	18.63	
30	12.57	13.77	14.88	15.91	16.87	17.78	19.48	21.04	22.49	23.86	25.15	
33.3	14.91	16.33	17.64	18.86	20.00	21.09	23.10	24.95	26.67	28.29	29.82	
35	16.16	17.70	19.12	20.44	21.68	22.86	25.04	27.04	28.91	30.67	32.32	
40	20.01	21.91	23.67	25.30	26.84	28.29	30.99	33.48	35.79	37.96	40.01	
45	24.03	26.33	28.44	30.40	32.24	33.99	37.23	40.22	42.99	45.60	48.07	
50	28.18	30.87	33.34	35.65	37.81	39.85	43.66	47.16	50.41	53.47	56.36	
55	32.39	35.48	38.32	40.97	43.45	45.80	50.18	54.20	57.94	61.45	64.78	
57	34.08	37.33	40.32	43.10	45.72	48.19	52.79	57.02	60.96	64.66	68.15	
60	36.60	40.10	43.31	46.30	49.11	51.77	56.71	61.25	65.48	69.45	73.21	
66.7	42.19	46.22	49.92	53.37	56.60	59.66	65.36	70.60	75.47	80.05	84.38	
70	44.89	49.17	53.11	56.78	60.23	63.48	69.54	75.12	80.30	85.17	89.78	

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75	48.89	53.56	57.85	61.85	65.60	69.15	75.75	81.82	87.46	92.77	97.79
80	52.77	57.81	62.44	66.75	70.80	74.63	81.76	88.31	94.41	100.13	105.55
85	56.51	61.91	66.87	71.48	75.82	79.92	87.55	94.57	101.09	107.23	113.03
90	60.10	65.84	71.11	76.02	80.63	84.99	93.11	100.57	107.51	114.03	120.20
95	63.53	69.59	75.17	80.36	85.23	89.84	98.42	106.30	113.64	120.54	127.06
100	66.79	73.17	79.03	84.49	89.61	94.46	103.48	111.77	119.48	126.73	133.59

Table 5103-4: Controls and Practices Values

Practice	CP Value
SITE PREPARATION	
Construction Sequence Schedule	n/a
Land Grading	n/a
Surface Roughening	0.8
Topsoiling	n/a
Vegetative Buffers (Filter Strips)	0.7
Vegetated Stream Buffers	0.7
Tree Protection	n/a
PERIMETER CONTROLS	
Sediment Fence	0.6
Straw Bale Barrier	0.9
Temporary Sediment Basin	0.3
Temporary Gravel Construction Entrance	n/a
Filter Strip	n/a
Vegetative Buffer	n/a
SURFACE STABILIZATION	
Temporary Seeding	0.6
Permanent Seeding	0.3
Sodding	0.3
Trees, Shrubs, Vines, and Ground Covers	n/a
Mulching (2 ton/acre)-Hydro Mulch	0.5
Mulching (3 ton/acre)-Hydro Mulch	0.4
Tackifiers, Soil Binders and Bonded Fiber Matrix	0.5
Rolled Erosion Control Products	0.3
RUNOFF CONTROL AND CONVEYANCE	
Temporary Fill Diversion	0.5
Temporary Diversion Dike	0.5
Right-of-Way Diversion	0.5
Grass-Lined Channels (using sod)	0.3
Grass-Lined Channels (using seeding and TRM*)	0.4
Riprap and Paved Channels	0.5
Temporary Slope Drains	0.8
Paved Flume	0.7
Level Spreader	0.5
Outlet Stabilization Structure	n/a
Subsurface Drain	0.8
Infiltration Basin	0.4
Infiltration Trench	0.5
Porous Pavement (Temporary)	0.9

Practice	Rating Value
RUNOFF CONTROL AND CONVEYANCE (CONT.)	
Constructed Wetlands	0.5
SEDIMENT CONTROL	
Straw Bale Barrier	0.9
Sediment Fence	0.6
Sediment Fence Installed with Slicing Machine	0.5
Brush Barrier	0.5
Rock Check Dams	0.5
Filter Strip	0.7
Block and Gravel Inlet Protection	0.5
Storm Inlet Protection	0.5
Curb Inlet Protection	0.5
Culvert Inlet Protection	0.5
Temporary Diversion Dike	0.5
Temporary Fill Diversion	0.5
Right-of-Way Diversion	0.5
Diversion	0.5
Temporary Sediment Trap	0.6
Temporary Sediment Basin	0.3
Temporary Slope Drain	0.8
Level Spreader	0.5
Subsurface Drain	0.8
Super Silt Fence	0.5
Triangular Silt Dike	0.5
STEEP SLOPE	
Straw Bale Barrier	0.9
Sediment Fence	0.6
Triangular Silt Dike	0.7
Mulching (2 ton/acre)-Hydro Mulch	0.5
Mulching (3 ton/acre)-Hydro Mulch	0.4
Tackifiers, Soil Binders and Bonded Fiber Matrix	0.5
Rolled Erosion Control Products	0.3
OTHER RELATED PRACTICES	
Dust Control	n/a
Solid Waste Disposal	n/a
Sanitary Waste Disposal	n/a
Hazardous Waste Control	n/a

*TRM = Turf Reinforcement Mat

EXAMPLE 1: SINGLE FAMILY RESIDENTIAL

Less than 100 ft from a Waterway (F) = 4.0 (See Table 5103-1)

Time of Construction (T) = 6 months = 0.5

Area of Disturbance (A) = 1/3 Acre = 0.33

Erosive Factor for Rainfall for one year (R) = 200 x 0.5 = 100

Soil Type (K): Assume Clay Loam = 0.17 (See Tables 5103-2)

Grade Characteristics (LS) = 0.201
Assume: Slope = 2%, Length = 100' (See Table 5103-3)

BMPs Used (CP): (See Table 5103-4)
Stream Buffer = 0.7
Grass Lined Channel with Sod = 0.3
Block and Gravel Inlet Protection = 0.5
Sediment Fence =0.6

CP = 0.7 x 0.3 x 0.5 x 0.6 = 0.063

E = RK(LS)(CP)
E = 100 x 0.17 x 0.201 x 0.063
E = 0.215

H = 2FTAE
H = 2 x 4 x 0.5 x 0.33 x 0.215
H = 0.284

Requirements:
H must be less than 50 x Area

H = 50 x A
H = 50 x 0.33
H = 16.5 0.284 < 16.5...OK

CP must be less than 0.2
CP = 0.063 < 0.2...OK

EXAMPLE 2A: LARGE DEVELOPMENT

Less than 100 ft from a Waterway (F) = 4 (See Table 5103-1)

Time of Construction (T) = 2 years = 2

Area of Disturbance (A) = 100 Acres = 100

Erosive Factor for Rainfall for one year (R) = 200 x 2 = 400

Soil Type (K): Assume Clay Loam = 0.17 (See Tables 5103-2)

Grade Characteristics (LS) = 3.53
Assume: Slope = 20%, Length = 100' (See Table 5103-3)

BMPs Used (CP): (See Table 5103-4)
- Stream Buffer = 0.7
- Block and Gravel Inlet Protection = 0.5
- Sediment Fence =0.6
- Sediment Trap = 0.6
- Sediment Basin = 0.3
- Mulch = 0.5

CP = 0.7 x 0.5 x 0.6 x 0.6 x 0.3 x 0.5 = 0.0189

E = RK(LS)(CP)
E = 400 x 0.17 x 3.53 x 0.0189
E = 4.54

H = 2FTAE
H = 2 x 4 x 2 x 100 x 4.54
H = 7,264

Requirements:
H must be less than 50 x Area

H = 50 x A
H = 50 x 100
H = 5,000 7,264 < 5,000…NO

CP must be less than 0.2
CP = 0.0189 < 0.2…OK

EXAMPLE 2B: LARGE DEVELOPMENT (PHASED CONSTRUCTION)

Less than 100 ft from a Waterway (F) = 4 (See Table 5103-1)

Time of Construction (T) = 1 year = 1

Area of Disturbance (A) = 50 Acres = 50

Erosive Factor for Rainfall for one year (R) = 200 x 1 = 200

Soil Type (K): Assume Clay Loam = 0.17 (See Tables 5103-2)

Grade Characteristics (LS) = 3.53
Assume: Slope = 20%, Length = 100' (See Table 5103-3)

BMPs Used (CP): (See Table 5103-4)
- Stream Buffer = 0.7
- Block and Gravel Inlet Protection = 0.5
- Sediment Fence =0.6
- Sediment Trap = 0.6
- Sediment Basin = 0.3
- Mulch = 0.5

CP = 0.7 x 0.5 x 0.6 x 0.6 x 0.3 x 0.5 = 0.0189

E = RK(LS)(CP)
E = 200 x 0.17 x 3.53 x 0.0189
E = 2.27

H = 2FTAE
H = 2 x 4 x 1 x 50 x 2.27
H = 908

Requirements:
H must be less than 50 x Area

H = 50 x A
H = 50 x 50
H = 2,500 908 < 2,500...OK

CP must be less than 0.2
CP = 0.0189 < 0.2...OK

SECTION 5104 TEMPLATES

5104.1 SINGLE FAMILY RESIDENTIAL LOT

Template 5104-1 should be followed as a model for single family residential lots that are ½ acre in size or greater. If the lot is smaller than ½ acre, refer to the Single Family Residential Standard Design Booklet.

5104.2 CONSTRUCTION IN A WATERWAY

These templates should be used for the different types of construction projects that cross or are within waterways. Choose the template that best fits the project and waterway you are working in. They include:

- Template 5104-2, Flow Diversion (also see Detail ESC-36, Diversion Channel Crossing)
- Template 5104-3, Intermittent or Low Flow
- Template 5104-4, Turbidity Curtain
- Template 5104-5, Rock Weirs

Sections 2152.17 and 5108.18 cover waterway crossings for both construction within the waterway and vehicle crossing through or over the waterway. There are a number of details in Division III that cover waterway crossing as well. These include:

- Detail ESC-36, Diversion Channel Crossing
- Detail ESC-37, Flume Pipe Crossing
- Detail ESC-38, Cofferdam Crossing
- Detail ESC-39, Temporary Culvert Crossing
- Detail ESC-40, Temporary Bridge Crossing

5104.3 LINEAR CONSTRUCTION

These templates should be used for the different types of linear construction projects that occur. Choose the template that best fits your project. They include:

- Template 5104-6, Pipeline Construction Across Open Land
- Template 5104-7, Utility Line Across Open Ground
- Template 5104-8, Roadway Construction
- Template 5104-9, Linear Construction in Existing Right-of-Way

These templates should only be used as models. A specific plan must be developed using professional judgement to determine Best Management Practices necessary for erosion and sediment control during construction on the site.

Template 5104-1 Single Family Large Residential Lot

SINGLE FAMILY LARGE RESIDENTIAL LOT
(1/2 ACRE SIZE OR GREATER)

SEQUENCE OF WORK:

1. STABILIZED LOT ENTRANCE 20' MINIMUM WIDTH.
2. IF LOT IS ADJACENT TO A WATERWAY, MAINTAIN A 50' VEGETATIVE BUFFER STRIP.
3. STABILIZE DRAINAGE SWALE W/ SOD OR EROSION BLANKET IMMEDIATELY AFTER GRADING.
4. TREAT RUNOFF BEFORE IT LEAVES THE SITE.
5. DIVERT THE WATER RUNOFF FROM ADJACENT PROPERTIES W/ COMPOST BERM OR SEDIMENT FENCE.
6. STORM INLET PROTECTION.
7. OBTAIN ALL FEDERAL, STATE, AND LOCAL REQUIRED PERMITS PRIOR TO CONSTRUCTION.
8. EXCAVATED MATERIAL MUST BE KEPT A MINIMUM OF 5 FEET FROM ALL PROPERTY BOUNDARIES AND ITS AREA DELINEATED ON THE PLAN.
9. ALL EXPOSED SOIL MUST BE STABLIZIED BY SEEDING OR SODDING PRIOR TO COMPLETION OF CONSTRUCTION.

LEGEND:

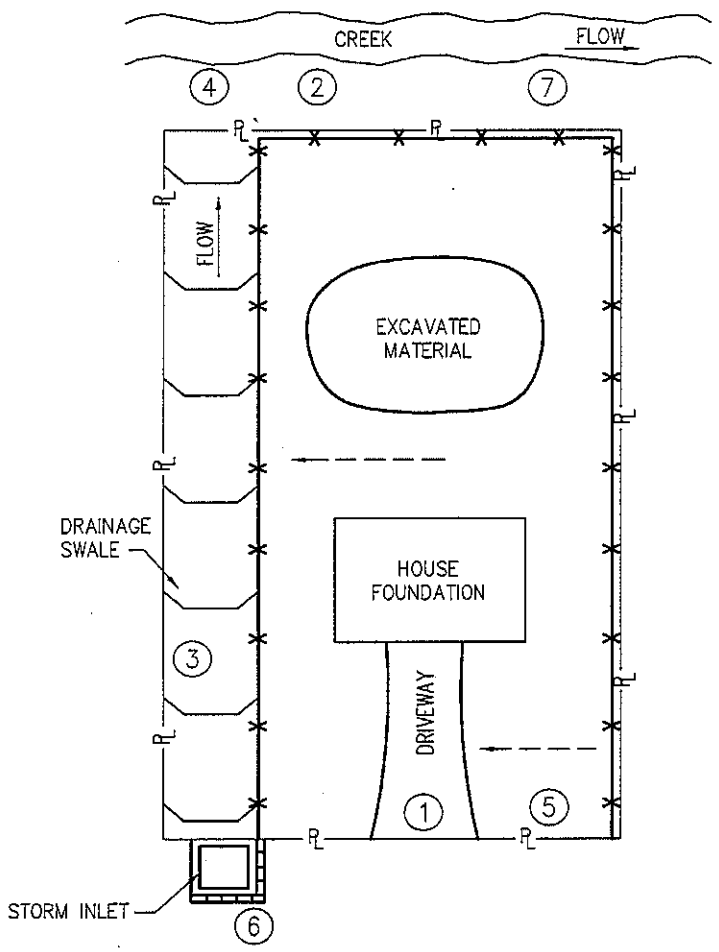
HAY BALES

SEDIMENT BARRIER

DIRECTION OF SURFACE WATER RUNOFF

DISCLAIMER:

THIS TEMPLATE SHOULD ONLY BE USED AS A MODEL. A SPECIFIC PLAN SHOULD BE DEVELOPED, USING PROFESSIONAL JUDGEMENT, TO DETERMINE BEST MANAGEMENT PRATICES NECESSARY FOR EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION ON THE SITE.



5104.3

Template 5104-2 Flow Diversion

WORK WITHIN A WATERWAY USING FLOW DIVERSION PERENNIAL STREAMS

SEQUENCE OF WORK:

1. DIG A TEMPORARY CHANNEL OR INSTALL PIPE TO DIVERT FLOW. STABILIZE CHANNEL W/ SOD, BLANKET, OR RIPRAP DEPENDING ON THE FLOW VELOCITY.
2. CONNECT CHANNEL OR PIPE ON DOWNSTREAM SIDE.
3. ONCE TEMPORARY CHANNEL IS STABILIZED OR PIPE IS IN PLACE, DAM UP WATERWAY AND DIVERT FLOW.
4. CONSTRUCT RCB.
5. STABILIZE WATERWAY BANKS AND RETURN TO PRECONSTRUCTION CONDITIONS.
6. TAKE OUT DAM IN EXISTING CHANNEL.
7. INSTALL DAM AT THE UPSTREAM END OF CHANNEL OR AT INLET OF PIPE.

SEQUENCE OF WORK:

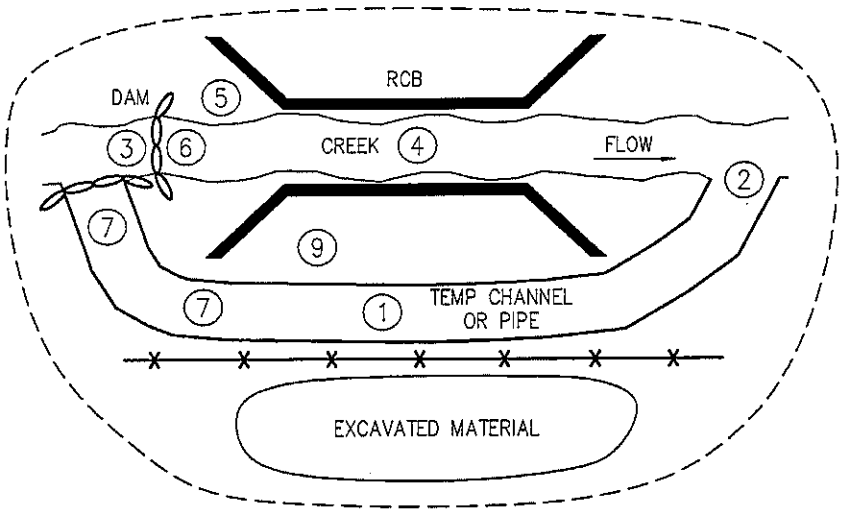
8. FILL DIVERSION AND STABILIZE OR REMOVE PIPE AND RETURN AREA TO PRECONSTRUCTION CONDITIONS.
9. STABILIZE DISTURBED SOIL WITH VEGETATION.
10. OBTAIN ALL FEDERAL, STATE, AND LOCAL REQUIRED PERMITS PRIOR TO CONSTRUCTION.

LEGEND:

- SEDIMENT BARRIER
- LIMITS OF DISTURBANCE
- DAM

DISCLAIMER:

THIS TEMPLATE SHOULD ONLY BE USED AS A MODEL. A SPECIFIC PLAN SHOULD BE DEVELOPED, USING PROFESSIONAL JUDGEMENT, TO DETERMINE BEST MANAGEMENT PRATICES NECESSARY FOR EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION ON THE SITE.



5104.3

Template 5104-3 Intermittent or Low Flow

WORK WITHIN A WATERWAY WITH INTERMITTENT OR LOW FLOW

SEQUENCE OF WORK:

1. SET PUMP UP.
2. DAM FLOW UPSTREAM AND DOWNSTREAM OF CONSTRUCTION AREA.
3. AFTER CONSTRUCTION STABILIZE BANKS AND BED OF WATERWAY DISTURBED DURING CONSTRUCTION.
4. REMOVE DAMS.
5. OBTAIN ALL FEDERAL, STATE, AND LOCAL REQUIRED PERMITS PRIOR TO CONSTRUCTION.

LEGEND:

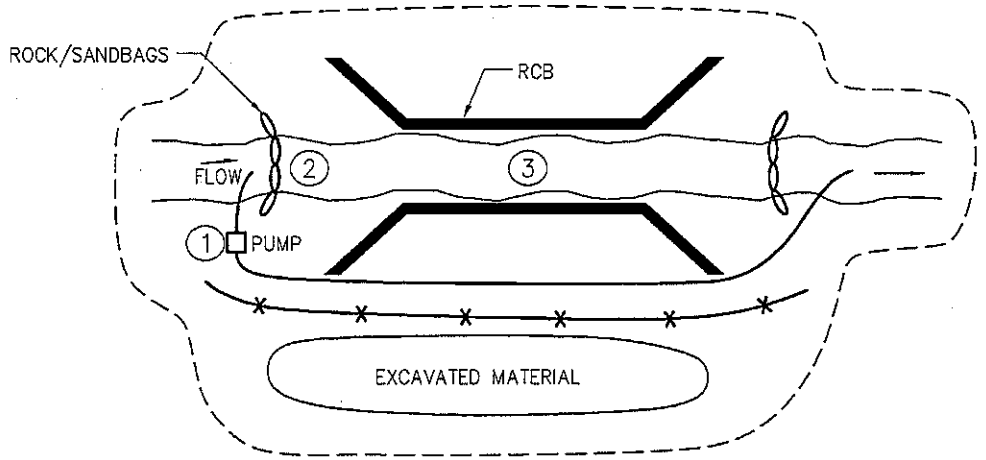
—X—X— SEDIMENT BARRIER

— — — — LIMITS OF DISTURBANCE

DAM

DISCLAIMER:

THIS TEMPLATE SHOULD ONLY BE USED AS A MODEL. A SPECIFIC PLAN SHOULD BE DEVELOPED, USING PROFESSIONAL JUDGEMENT, TO DETERMINE BEST MANAGEMENT PRACTICES NECESSARY FOR EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION ON THE SITE.



5104.3

Template 5104-4 Turbidity Curtain

WORK WITHIN A WATERWAY WITH FLOWS LESS THAN 5 cfs.

SEQUENCE OF WORK:

1. INSTALL TURBIDITY CURTAIN DOWNSTREAM OF WORK AREA.
2. PERFORM WORK IN CHANNEL.
3. REMOVE CURTAIN.
4. ANY CHANGES MADE TO BANK FOR RESTABILIZATION AFTER CONSTRUCTION USING ENGINEERING OR BIOENGINEERING TECHNIQUES MUST BE SHOWN ON AN APPROVED PLAN WITH ENGINEER'S SEAL.
5. REMOVE SEDIMENT FROM CHANNEL AND PROPERLY DISPOSE OF BEFORE TURBIDITY CURTAIN IS REMOVED FROM CHANNEL.
6. OBTAIN ALL FEDERAL, STATE, AND LOCAL REQUIRED PERMITS PRIOR TO CONSTRUCTION.

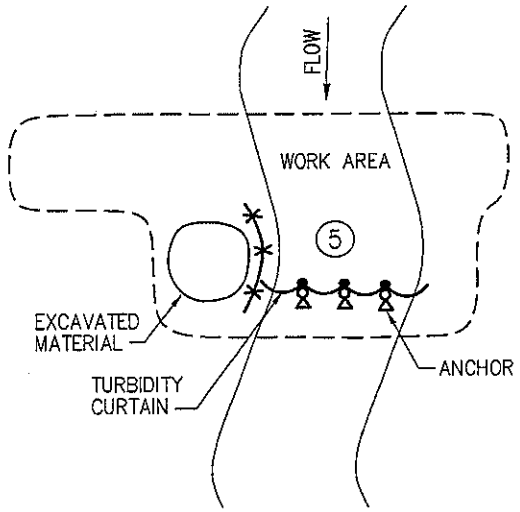
LEGEND:

—X—X— SEDIMENT BARRIER

– – – – LIMITS OF DISTURBANCE

DISCLAIMER:

THIS TEMPLATE SHOULD ONLY BE USED AS A MODEL. A SPECIFIC PLAN SHOULD BE DEVELOPED, USING PROFESSIONAL JUDGMENT, TO DETERMINE BEST MANAGEMENT PRACTICES NECESSARY FOR EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION ON THE SITE.



5104.3

Template 5104-5 Rock Weirs

WORK WITHIN A WATERWAY WITH FLOWS GREATER THAN 5 cfs.

SEQUENCE OF WORK:

1. CONSTRUCT ROCK OR SANDBAG WEIRS DOWNSTREAM OF WORK AREA.
2. CONDUCT WORK IN THE STREAM CHANNEL.
3. CLEAN OUT SEDIMENT AND OTHER DEBRIS BEHIND WEIRS AFTER CONSTRUCTION IS COMPLETE, AS NECESSARY.
4. REMOVE WEIRS WITH AS LITTLE DISTURBANCE TO THE WATERWAY BANK AND BED AS POSSIBLE. INSTALL A TURBIDITY CURTAIN ACROSS WATERWAY DURING REMOVAL PROCESS TO KEEP DISTURBED BED AND BANK SOILS FROM MOVING TOO FAR DOWN STREAM. (SEE TURBIDITY CURTAIN TEMPLATE).
5. OBTAIN ALL FEDERAL, STATE, AND LOCAL REQUIRED PERMITS PRIOR TO CONSTRUCTION

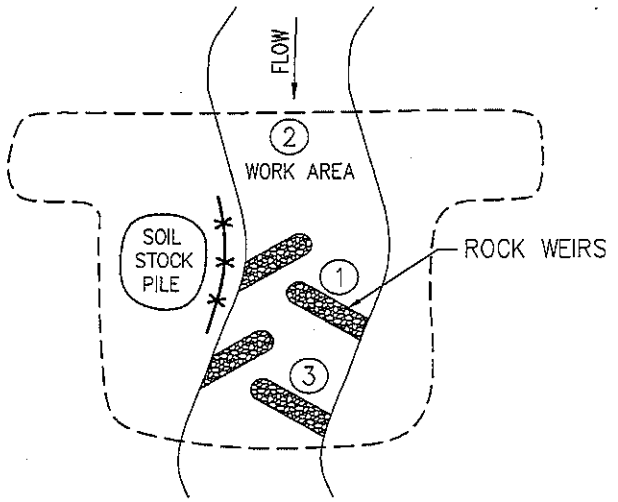
LEGEND:

—X—X— SEDIMENT BARRIER

— — — — LIMITS OF DISTURBANCE

DISCLAIMER:

THIS TEMPLATE SHOULD ONLY BE USED AS A MODEL. A SPECIFIC PLAN SHOULD BE DEVELOPED, USING PROFESSIONAL JUDGEMENT, TO DETERMINE BEST MANAGEMENT PRATICES NECESSARY FOR EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION ON THE SITE.



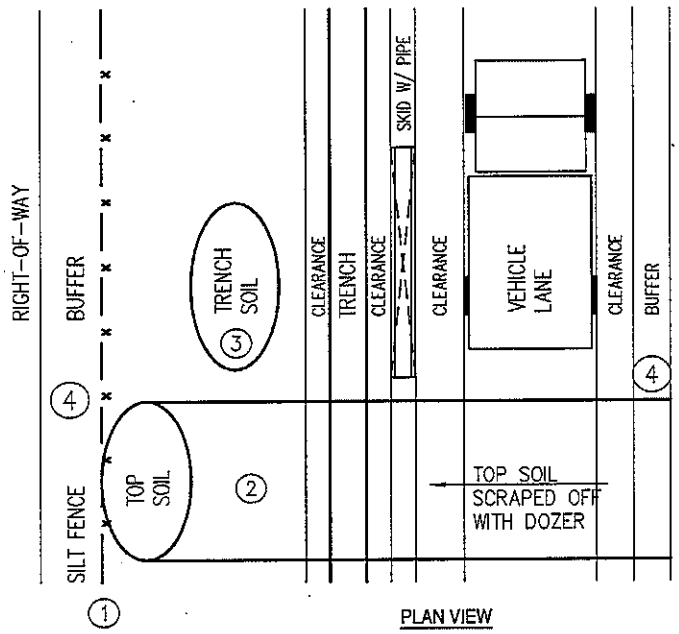
5104.3

Template 5104-6 Pipeline Construction Across Open Ground

LINEAR UTILITY CONSTRUCTION

NOTES:

1. INSTALL FENCE ON DOWNHILL SIDE OF STOCK PILE.
2. BLADE TOPSOIL INTO A PILE.
3. STOCKPILE TRENCH SOIL.
4. MAINTAIN VEGETATIVE BUFFERS ON BOTH EDGES OF UTILITY R-O-W.



Template 5104-7 Utility Line Across Open Ground

NOTES:

① CONSTRUCTION ENTRY @ HAUL ROAD ACCESS TO STREET.

② BEDDING STOCKPILE. AVOID CONCENTRATED FLOW AREAS.

③ MINIMIZE DISTURBED AREA. CONSIDER FENCING TO CONTROL TRAFFIC. DEFINE SEQUENCE OF CLEARING.

④ TOPSOIL. STOCKPILE FOR REUSE. DIVERT WATER. TRAP & TREAT RUNOFF. TARP OR SEED IF STOCKPILE TO LAST FOR MORE THAN 21 DAYS.

⑤ PLAN SHOULD INDICATE REQUIRED MAINTENENCE & WHEN TO REMOVE ESC DEVICE.

⑥ ESTABLISH VEGETATIVE COVER. BREAK OVERALL PROJECT INTO PHASES FOR REVEGETATION. MINIMIZE LAPSED TIME FOR REVEGETATION. SEED AS YOU GO. SEPERATE TIME LINES FOR TRENCH AND HAUL ROAD.

⑦ SLOPE ALONG MAIN. DIVERT SHEET FLOW TO UNDISTURBED AREAS. REFER TO STD. DRAWING

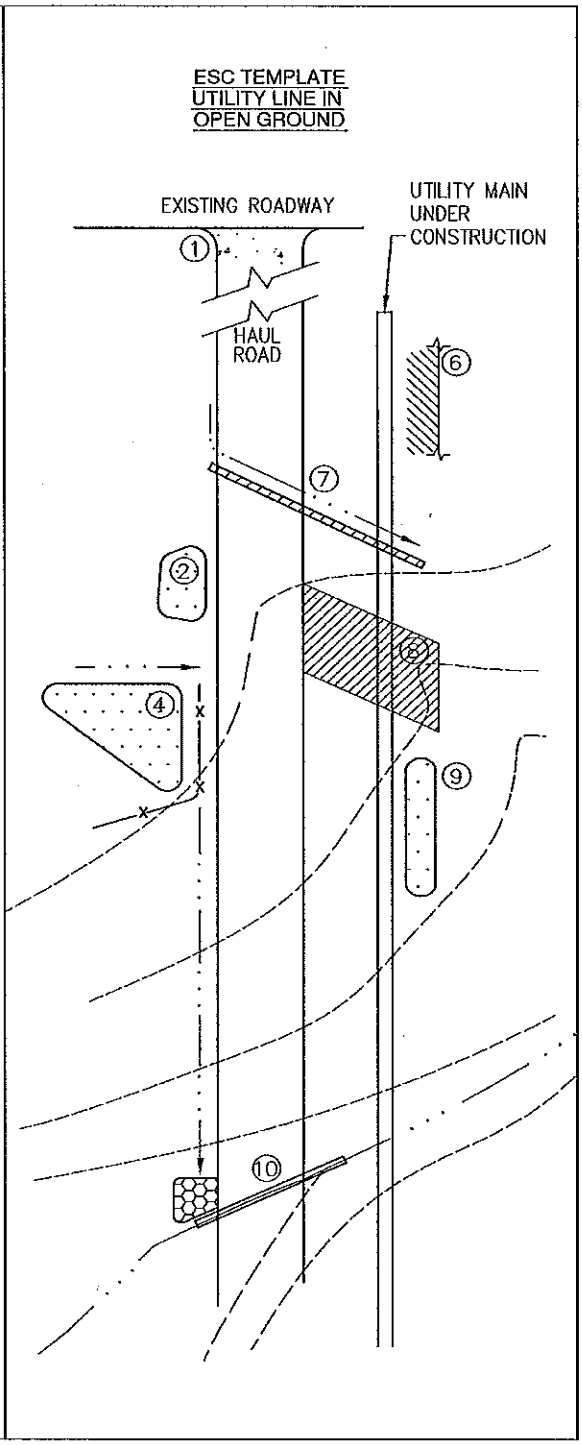
⑧ CONCENTRATED FLOW CROSSING. IMMEDIATE STABILIZATION. SELECT SOD OR BLANKETS. RESTRICT TIMING TO PERIOD OF NO RAIN FORCAST.

⑨ SLOPE ACROSS MAIN. DOWNHILL LOCATION OF TRENCH SPOIL STOCKPILE. CONSIDER DIVERSION OF CLEAN WATER PAST CONSTRUCTION AREA OUTLET PROTECTION. CONSIDER LIMITS OF DURATION & LINEAR EXTENT OF EXPOSED TRENCH & STOCKPILE.

⑩ TEMPORARY STREAM CROSSING. SELECT LOW WATER OR CULVERT CROSSING. BANK RESTORATION. REFER TO STREAM CROSSING STD. DRAWING.

LEGEND

- CONSTRUCTION ENTRY
- FLOW BARRIER
- —x—x— SILT FENCE
- CONCENTRATED FLOW PATH
- STOCKPILED MATERIAL
- STABILIZED SOIL
- EROSION PROTECTION

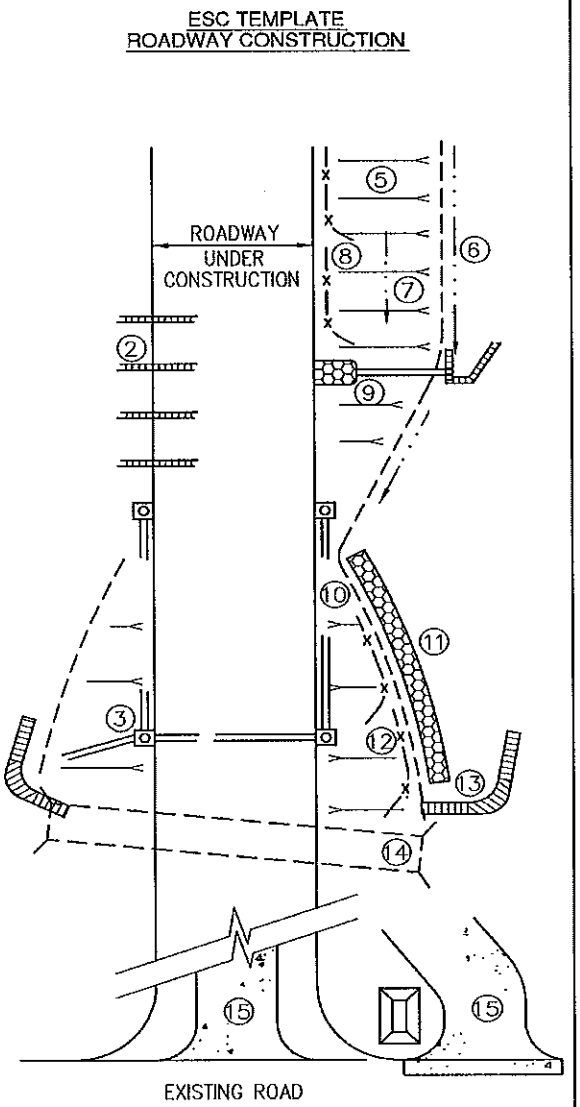


5104.3

Template 5104-8 Roadway Construction

NOTES:

1. CONSIDER SEPARATE PLANS FOR EACH STAGE OF CONSTRUCTION –STREAM CROSSING. –GRADING. –STORM SEWER & UTILITIES. –BASE PREP. AND PAVING.
2. PROTECT DISTURBED FLOW PATHS DURING GRADING & UTILITY PHASES.
3. ALTERNATES FOR STORM SEWER –SEDIMENT TRAP @ EACH INLET. –BYPASS ON GRADE INLETS. –NO INLET PROTECTION & TREAT @ OUTLET SOLUTION MAY VARY BY PHASE.
4. PLAN SHOULD INDICATE REQUIRED MAINTENENCE & WHEN TO REMOVE ESC DEVICE.
5. CUT SLOPE
   SLOPE PROTECTION. –DEFINE PHASING OF VEGETATIVE ESTABLISHMENT. –DEFINE MULCH OR BLANKETS.
6. DIVERT CLEAN WATER –DIVERSION STABILIZATION METHOD.
7. LONG SLOPES MAY NEED MID–SLOPE DIVERSION
8. SILT FENCE –DEFINE FREQUENCY OF TURNOUTS. –DEFINE PROXIMITY TO TOE OF SLOPE.
9. PROTECTED DOWNDRAIN –UPSTREAM & DOWNSTREAM EROSION PROTECTION.
10. FILL SLOPE
    SLOPE PROTECTION. –DEFINE PHASING OF VEGETATIVE ESTABLISHMENT. –DEFINE MULCH OR BLANKETS.
11. PROTECT FLOW PATH AT TOE OF FILL SLOPE. CONSIDER COMBINING WITH POST CONSTRUCTION WQ MEASURES
12. SILT FENCE & VEGETAIVE ESTABLISHMENT. SAME ISSUES AS CUT SLOPE
13. TREATMENT PRIOR TO RELEASE
14. REFER TO STREAM CROSSING TEMPLATE
15. CONSIDER ALT. LOCATIONS FOR CONST. ENTRY & WASHOUT BASIN



LEGEND

- CUT OR FILL SLOPE
- STORM SEWER INLET
- CONSTRUCTION ENTRY
- EROSION PROTECTION
- CONCENTRATED FLOW PATH
- FLOW BARRIER
- SEDIMENT BARRIER
- LIMITS OF DISTURBANCE

Template 5104-9 Linear Construction in Existing Right-of-Way

NOTES:

① INLET PROTECTION ALTERNATES
–DIVERT OFFSITE WATER.
–SEDIMENT TRAP.

② RESTORE VEGETATION
–DEFINE PHASES.
–DEFINE LAPSED TIME
–PLANT AS YOU GO.

③ STOCKPILE ON PAVEMENT
–AVOID IF POSSIBLE.
–LIMIT ON DURATION.
–CONSIDER CLIMATE CONDITIONS DURING CONSTRUCTION PERIOD.
–CONSIDER TARPS OR TREATMENT.
–CONSIDER DIVERSION.

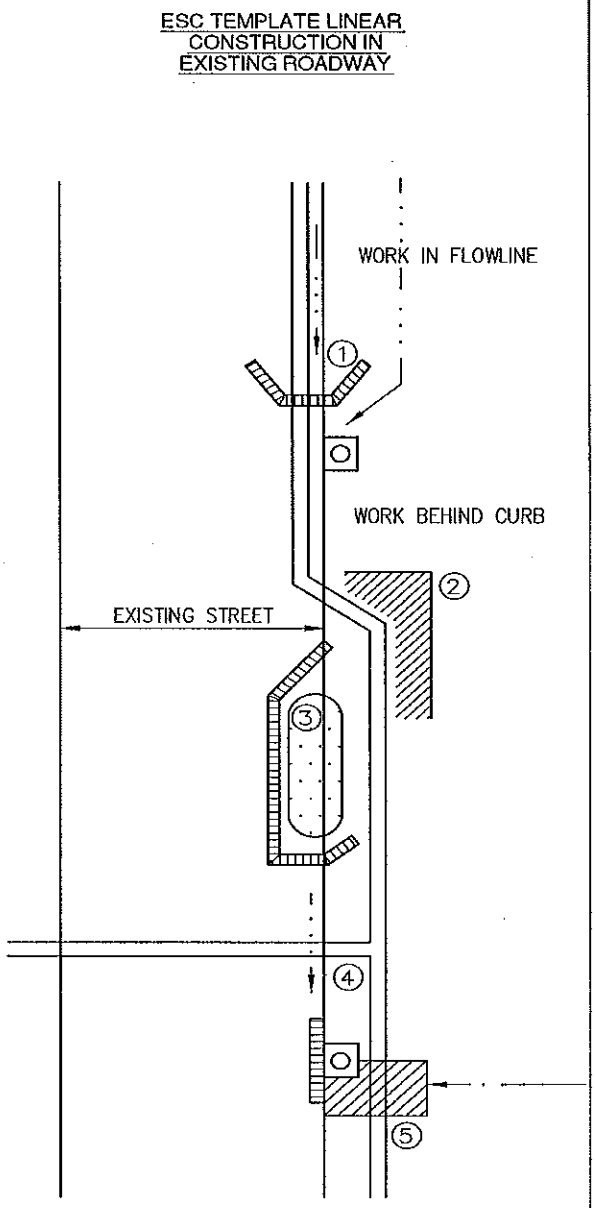
④ WORK CROSSES FLOWLINE
–TIMING OF PAVEMENT PATCH.
–RESTRICT TIMING TO PERIOD OF NO RAIN FORECAST.
–CONTAIN FLOW IN FLOWLINES.

⑤ CONCENTRATED FLOW CROSSING
–IMMEDIATE STABILIZATION.
–SELECT SOD OR BLANKETS.

⑥ PLAN SHOULD INDICATE REQUIRED MAINTENANCE & WHEN TO REMOVE ESC DEVICE.

LEGEND

FLOW BARRIER
STORM SEWER INLET
STOCKPILED MATERIAL
CONCENTRATED FLOW PATH
STABILIZED SOIL



SECTION 5105 MATRIX OF BEST MANAGEMENT PRACTICES

5105.1 MATRIX

The matrix includes a complete listing of all the Best Management Practices (BMPs) included in Division 5, Design Criteria. Within each of the BMPs there is a quick reference to all the information about that particular practice. Such information includes the section in which more detailed information about the practice can be found within Division 5, a brief description about the practice, and a break down of different ways in which the practice can be used. The matrix is included in a table in this section.

5105.1

KANSAS CITY AMERICAN PUBLIC WORKS ASSOCIATION BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL			SITE PREPARATION	PERIMETER CONTROLS	SURFACE STABILZATION	RUNOFF CONTROL AND CONVEYANCE	SEDIMENT CONTROL	STEEP SLOPE	OTHER RELATED PRACTICES
TITLE	DESIGN STANDARD SECTION	DESCRIPTION	A	B	C	D	E	F	G
Construction Sequence Schedule	5106.1	A specified work schedule that coordinates the timing of land-disturbing activities and the installation of erosion and sediment control measures.	*						
Temporary Construction Entrance	5106.2	A stabilized stone pad with a filter fabric underliner located at points of vehicular ingress and egress on a construction site.	*	*			*		
Slope Breaks	5106.3	Reshaping the ground surface or installing devices to provide suitable topography for buildings, facilities, and other land uses.				*	*	*	
Surface Roughening	5106.4	Grading practices such as stair-stepping or grooving slopes or leaving slopes in a roughened condition by not fine-grading them. Reduces runoff velocity, provides sediment trapping and increases infiltration, all of which facilitate establishment of vegetation on exposed slopes.	*				*		
Topsoiling	5106.5	Stockpiling and reusing topsoil or providing topsoil to promote good vegetative cover to control erosion.	*						
Vegetated Buffers (Filter Strips)	5106.6	Strips of undisturbed, original land surrounding the disturbed site. They can slow runoff and increase infiltration. They can also act as a screen for visual pollution and reduce construction noise.	*	*			*		
Vegetated Stream Buffers	5106.7	Strips of vegetation along the perimeter of the construction site or a waterway. As the surface stormwater runoff flows through the strip, the velocity of the flow should decrease allowing sediment to settle out		*	*	*	*		
Tree Protection	5106.8	Protection of desirable trees from mechanical and other injury during land disturbing and construction activity.	*						
Temporary Seeding	5107.1	Establishment of a temporary vegetative cover on disturbed areas by seeding with appropriate rapidly growing annual plants.			*				

5105.1

KANSAS CITY AMERICAN PUBLIC WORKS ASSOCIATION BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL			SITE PREPARATION	PERIMETER CONTROLS	SURFACE STABILZATION	RUNOFF CONTROL AND CONVEYANCE	SEDIMENT CONTROL	STEEP SLOPE	OTHER RELATED PRACTICES
TITLE	DESIGN STANDARD SECTION	DESCRIPTION	A	B	C	D	E	F	G
Permanent Seeding	5107.2	Establishment of perennial vegetative cover on disturbed areas by planting seed.			*				
Sodding	5107.3	Stabilizing fine-graded disturbed areas by establishing permanent grass stands with sod.		*	*				
Mulching and Hydro Mulch	5107.4	Application of plant residues or other suitable materials to the soil surface.			*			*	
Tackifiers, Soil Binders, and Bonded Fiber Matrix	5107.5	Substances used to hold soil and mulches in place.			*			*	
Rolled Erosion Control Products	5107.6	Nets, blankets, and mats used to cover and protect the soil from raindrop impact.			*			*	
Straw Bale Barrier	5108.1	Temporary sediment barrier composed of straw bales placed across or at the toe of a slope to intercept and detain sediment and decrease flow velocities from drainage areas of limited size; applicable where sheet and rill erosion may be a problem. Maximum effective life is 3 months.		*			*	*	
Compost Berm or Tubes	5108.2	Organic mulch or composted material blown in place and used as an erosion and sediment control device.		*	*		*	*	
Sediment Fence	5108.3	Temporary sediment barrier constructed of posts and filter fabric placed across or at the toe of a slope or in a minor drainageway to intercept and detain sediment and decrease flow velocities from drainage areas of limited size; applicable where sheet and rill erosion or small concentrated flows may be a problem. Maximum effective life-6 months.		*			*	*	

5105.1

KANSAS CITY AMERICAN PUBLIC WORKS ASSOCIATION BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL			SITE PREPARATION	PERIMETER CONTROLS	SURFACE STABILZATION	RUNOFF CONTROL AND CONVEYANCE	SEDIMENT CONTROL	STEEP SLOPE	OTHER RELATED PRACTICES
TITLE	DESIGN STANDARD SECTION	DESCRIPTION	A	B	C	D	E	F	G
Super Sediment Fence	5108.5	Temporary barrier of Geotextile Class F over wire fence used to intercept sediment laden runoff from small drainage areas.		*			*	*	
Log or Wattle Products	5108.6	Tubes that can be used as perimeter control for disturbed areas of a quarter-acres or less, along contours as slope breaks, for inlet protection, for ditch checks, and for streambank protection.		*		*	*	*	
Check Dams	5108.7	Small, temporary dams constructed across a drainage ditch to reduce the velocity of concentrated flows, reducing erosion of the swale or ditch.				*	*		
Drop or Curb Inlet Protection	5108.8	Installation of various kinds of sediment trapping measures around drop inlet or curb inlet structures prior to permanent stabilization of the disturbed area; limited to drainage areas not exceeding one acre and not intended to control large, concentrated stormwater flows.				*	*		
Culvert Inlet Protection	5108.9	Sediment filter located at the inlet to storm sewer culverts which prevents sediment from entering, accumulating in, and being transferred by the culvert. Also provides erosion control at culverts during the phase or a project where elevations and drainage patterns are changing, causing original control measures to be ineffective.				*	*		
Temporary Fill Diversion	5108.10.1	Channel with a supporting ridge on the lower side constructed along the top of an active earth fill constructed in order to divert runoff away from the unprotected fill slope to a stabilized outlet or sediment trapping structure; applicable where the area at the top of the fill drains toward the exposed slope and continuous fill operations make the use of a temporary diversion dike infeasible; maximum effective life is one week.				*	*		

5105.1

KANSAS CITY AMERICAN PUBLIC WORKS ASSOCIATION BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL			SITE PREPARATION	PERIMETER CONTROLS	SURFACE STABILZATION	RUNOFF CONTROL AND CONVEYANCE	SEDIMENT CONTROL	STEEP SLOPE	OTHER RELATED PRACTICES
TITLE	DESIGN STANDARD SECTION	DESCRIPTION	A	B	C	D	E	F	G
Temporary Diversion Dike	5108.10.2	Ridge of compacted soil constructed at the top or base of a sloping disturbed area which diverts off-site runoff away from unprotected slopes and to a stabilized outlet or diverts sediment-laden runoff to a sediment trapping structure. Maximum effective life is 18 months.		*		*	*		
Right-of-Way Diversion	5108.10.3	Ridge of compacted soil or loose gravel constructed across a disturbed right-of-way to shorten the flow length within the disturbed strip and divert the runoff to a stabilized outlet. Earthen diversions are applicable where there will be little or no construction traffic within the right-of-way, and gravel structures are applicable where vehicular traffic must be accommodated.				*	*		
Temporary Sediment Trap	5108.11	Small ponding area formed by constructing an earthen embankment with a stone outlet across a drainage swale to detain sediment-laden runoff from small disturbed areas for enough time to allow most of the suspended solids to settle out. Maximum effective life is 18 months.					*		
Temporary Sediment Basin	5108.12	Temporary barrier or dam with controlled stormwater release structure which is formed by constructing an embankment of compacted soil across a drainageway. It is used to detain sediment-laden runoff from drainage areas three acres or greater for enough time to allow most of the suspended solids to settle out.		*			*		
Temporary Slope Drain	5108.13	Flexible tubing or conduit used before permanent drainage structures are installed intended to conduct concentrated runoff safely from the top to the bottom of a disturbed slope without causing erosion on or below the slope.				*	*		
Triangular Silt Dike™	5108.14	Dikes used as continuous linear barriers at the toe of slope to contain sediment or as a ditch check barriers placed perpendicular to the flow of water in a defined drainage ditch to minimize erosion and contain sediment.		*		*	*	*	

5105.1

KANSAS CITY AMERICAN PUBLIC WORKS ASSOCIATION BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL			SITE PREPARATION	PERIMETER CONTROLS	SURFACE STABILZATION	RUNOFF CONTROL AND CONVEYANCE	SEDIMENT CONTROL	STEEP SLOPE	OTHER RELATED PRACTICES
TITLE	DESIGN STANDARD SECTION	DESCRIPTION	A	B	C	D	E	F	G
Grass-Lined Channels (using sod)	5108.15	Channel with a vegetative lining of sod constructed for conveyance of stormwater runoff.				*			
Grass-Lined Channels (using seed and TRM)	5108.15	Channel with a vegetative lining of seed and a Turf Reinforcement Mat, constructed for conveyance of stormwater runoff.				*			
Outlet Stabilization Structure	5108.16	Structure designed to stabilize the soil and control erosion at the outlet of a channel or conduit.				*			
Infiltration Basin	5108.17	Grassed depression to collect stormwater flows allowing infiltration and reducing stormwater runoff.				*			
Infiltration Trench	5108.18	Grassed linear depression to collect stormwater flows allowing infiltration and reducing stormwater runoff.				*			
Temporary Waterway Crossing	5108.19	Strategy for crossing small waterways when in-stream utility construction is involved or when construction vehicles need to cross.							*
Dewatering	5108.20	Temporary settling and filtering devise for water which is discharged from dewatering activities.				*	*		
Turbidity Curtain	5108.21	Floating geotextile material that minimizes sediment transport from a disturbed site adjacent to or within a body of water.				*	*		
Dust Control	2153.1	Reducing surface and air movement of dust during land disturbing, demolition, and construction activities.							*
Solid Waste Disposal	2153.2	Disposal of all solid waste in the proper manner.							*

5105.1

KANSAS CITY AMERICAN PUBLIC WORKS ASSOCIATION BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL			SITE PREPARATION	PERIMETER CONTROLS	SURFACE STABILZATION	RUNOFF CONTROL AND CONVEYANCE	SEDIMENT CONTROL	STEEP SLOPE	OTHER RELATED PRACTICES
TITLE	DESIGN STANDARD SECTION	DESCRIPTION	A	B	C	D	E	F	G
Sanitary Waste Disposal	2153.3	Disposal of all sanitary waste in the proper manner.							*
Spill Prevention and Material Management	2153.4	Disposal of hazardous waste and petroleum products, fueling and servicing, concrete truck usage, and spill controls in the proper manner.							*

SECTION 5106 SITE PREPARATION

5106.1 CONSTRUCTION SEQUENCE SCHEDULE

A. **Description:** A construction sequence schedule is a specified work schedule that coordinates the timing of land-disturbing activities and the installation of erosion and sediment control measures. This practice reduces on-site and off-site sedimentation caused by land-disturbing activities by installing erosion and sediment control practices in accordance with a planned schedule.

B. **Application:** A construction sequence schedule is applicable to all land development projects that disturb more than one contiguous acre.

C. **Planning Considerations:** The removal of existing surface ground cover leaves a site vulnerable to accelerated erosion. Good planning will reduce the amount of land clearance, provide necessary controls, and restore protective cover in an efficient and effective manner. Appropriate sequencing of construction activities can be a cost-effective way to help accomplish this goal.

D. **Design Criteria:** The proposed construction sequence should be indicated clearly in the erosion and sediment control plan. Installation of construction access is the first land-disturbing activity. Install principal sediment basins and traps before any major site grading takes place to keep sediment contained on-site at appropriate locations. Locate key runoff-control measures in conjunction with sediment traps to divert stormwater from planned undisturbed areas away from the disturbed site and sediment-laden water from the disturbed site into traps. Install any additional perimeter controls necessary for areas where sheet flow may leave the site. Install the main runoff conveyance system with inlet and outlet protection devices early, and use this system to convey storm runoff through the development site without creating gullies and washes. Begin land clearing and grading as soon as key erosion and sediment control devices are in place. Immediately after land clearing and grading, apply surface stabilization on graded areas, channels, dikes, and all other disturbed areas where construction activity will not take place for 30 days. Coordinate building construction with other development activities so that all work can take place in an orderly manner and on schedule. Landscaping and final stabilization is the last major construction phase. All disturbed areas should have permanent stabilization practices applied.

The construction sequence schedule should show, at a minimum, the following:

1. The erosion and sediment control practices to be installed;
2. Principal development activities;
3. What measures should be in place before other activities begin; and
4. Compatibility with the general construction schedule of the contract.

5106.2 TEMPORARY CONSTRUCTION ENTRANCE

A. **Description:** A temporary construction entrance is a stabilized layer of large aggregate that is located at any point where traffic leaves a construction site and move directly onto a public road or other paved area.

B. **Application:** A temporary construction entrance is a stone base pad designed to provide a buffer area where construction vehicles can drop their mud to avoid transporting it onto public roads.

C. **Planning Considerations:** Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. During wet weather, they often become muddy quagmires that generate significant quantities of sediment which may pollute nearby streams or be transported off site on the wheels of construction vehicles. Dirt on roads can become so unstable during wet weather that they are virtually unusable and unsafe.

D. **Design Criteria:**

1. **Length** – Minimum of 50 feet or 30 feet for single residence lot.

2. **Width** – Minimum of 20 feet and should be flared at the existing road to provide a turning radius.

3. **Geotextile** shall be placed over the existing ground prior to placing stone.

4. **Stone** – 2 to 3-inch crushed aggregate or recycled concrete equivalent shall be placed at least 6 inches deep over the length and width of the entrance.

5. Surface water – All surface water flowing to or diverted toward construction entrances shall be piped under the entrance to maintain positive drainage. Pipe installed under the construction entrance shall be protected with a mountable berm. The pipe shall be sized according to the drainage with the minimum diameter being 6 inches. A pipe will not be necessary when the entrance is located at a high spot.

6. **Location** – A stabilized construction entrance shall be located at every point where construction traffic enters or leaves a construction site. Vehicles leaving the site must travel over the entire length of the stabilized construction entrance.

A detail for this device is located in Division III as Detail ESC-01, Temporary Construction Entrance.

5106.3 SLOPE BREAKS

A. **Description:** Slope breaks consist of reshaping the ground surface to provide suitable topography for buildings, facilities, and other land uses. Measures such as slope breaks can be installed during land grading to control surface runoff and to minimize soil erosion and sedimentation both during and after construction.

B. **Application:** Slope breaks can be applied to sites where the existing topography must be modified to prepare for another land use or where adapting proposed development to the existing landscape can reduce the erosion potential of the site and the cost of installing erosion and sediment control measures.

C. **Planning Considerations:** Prior to start of construction, the site grading plan should be designed by a qualified design professional. The grading plan should show disturbed areas, cuts, fills, and finished elevations for all graded areas. Plans and specifications should be referred to by field personnel throughout the construction process.

D. **Design Criteria:**

1. **Scheduling Construction Activities:** Schedule construction activities in such a way that the least area is disturbed at one time.

2. **Slope Breaks:** Use slope breaks, such as diversions, sediment fence, compost berms, or other devices as appropriate to reduce the length of cut-and-fill slope to limit sheet and rill erosion and prevent gullying. Refer to Table 5106-1, which provides suggested guidelines for spacing of slope breaks.

Table 5106-1: Guidelines for Spacing Slope Breaks

Slope	Spacing (ft)
33-50%	20
25-33%	40
15-25%	60
10-15%	80
6-10%	120
3-6%	200
<3%	300

3. **Surface Runoff:** Avoid disturbing natural drainageways, if possible. At each slope break, intercept runoff and channel to storm drains or stabilized watercourses. If runoff is laden with sediment, protect drain inlets with a filter or divert water to a sediment trap or basin according to the site grading plan.

4. **Erosion Control:** Graded areas should be stabilized with mulch, vegetation, crushed stone, riprap, or other measures, as soon as work is completed or if work is interrupted for 30 or more working days.

5. **Slopes to be Vegetated:** Vegetation shall be placed on slopes of 2H:1V or flatter or 3H:1V or flatter where maintained by tractor or other equipment. Slopes should be roughened during grading operations to retain water, increase infiltration, and promote vegetative growth. Slopes should be protected from surface runoff while vegetation is being established.

6. **Borrow and Disposal Areas:** Borrow and disposal areas shall be shown on the grading plan and no closer than 50 feet to a streambank. Sediment control devices must be used on the down slope side of these areas.

7. **Outlet:** Stable channels and waterways should be provided for runoff from the disturbed area to retain sediment on site.

5106.4 SURFACE ROUGHENING

A. **Description:** This practice provides a rough soil surface with horizontal depressions to aid in the establishment of vegetation, reduce runoff, increase infiltration, reduce erosion, and provide for sediment trapping.

B. **Application:** Slopes steeper than 3H:1V may need surface roughening if not covered by a rolled erosion control product. Stair-step grading, grooving, harrowing, or tracking accomplishes this if the slopes are to be stabilized with vegetation. If the slope is designed for a rolled erosion control product, it should be fine graded.

Areas with grades of 3H:1V or flatter should have the soil surface lightly roughened and loosened to a depth of 2 to 4 inches prior to seeding.

Areas that have been graded and will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place. Slopes with a stable rock face do not require roughening or stabilization.

C. **Planning Considerations:** There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, and tracking. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.

Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Areas flatter than 3H:1V that will be mowed may have small furrows left by discing, harrowing, raking, or seed-planting machinery operated on the contour.

It is important to avoid excessive compacting of the soil surface when scarifying. Tracking with bulldozer treads is preferable to not roughening at all but is not as effective as other forms of roughening because the soil surface is severely compacted and runoff is increased.

D. **Design Criteria:** Areas where surface roughening is to be applied must be shown on the plans.

5106.5 TOPSOILING

A. **Description:** This is a method of preserving and using the surface layer of undisturbed soil, often enriched in organic matter, to obtain a more desirable planting and growth medium.

B. **Application:** Conditions where topsoiling is applicable:

1. Where the preservation or importation of topsoil is determined to be the most effective method of providing a suitable growth medium;

2. Where the subsoil or existing soil presents the following problems:

    a. Texture, pH, or nutrient balance of available soil cannot be modified by reasonable means to provide adequate growth medium.

    b. The soil is too shallow to provide an adequate root zone and to supply necessary moisture and nutrients for plant growth.

    c. The soil contains substances potentially toxic to plant growth.

3. Where high quality turf is desirable to withstand intense use or meet aesthetic requirements;

4. Where ornamental plants will be established; and

5. Only on slopes that are 2H:1V or flatter, unless other measures are taken to prevent erosion and sloughing.

C. **Planning Considerations:** Measure whether an adequate volume of topsoil exists on the site. Topsoil will be spread at a compacted depth of 4 to 6 inches. Locate the topsoil stockpile so that it does not interfere with work on the site and stabilize it as per Section 2102.4. Allow sufficient time in scheduling for topsoil to be spread and bonded prior to seeding, sodding, or planting.

Care must be taken not to apply topsoil to subsoil if the two have contrasting textures. Clayey topsoil over sandy subsoil or vice versa is a particularly poor combination. Water may creep along the junction between the soil layers, causing the topsoil to slough. If topsoil and subsoil are not properly bonded, water will not

infiltrate the soil profile evenly and it will be difficult to establish vegetation. Topsoiling of steep slopes should be discouraged unless good bonding of soils can be achieved.

D. **Design Criteria:** No formal design is required.

5106.6 VEGETATIVE BUFFERS (FILTER STRIPS)

A. **Description:** These are wide strips of undisturbed existing vegetation or constructed vegetation areas consisting of grass, woody vegetation, or other erosion resistant plants surrounding the disturbed site. They provide infiltration, intercept sediment and other pollutants, and reduce stormwater flow and velocity. They can also act as a screen for visual pollution and reduce construction noise.

B. **Application:** They can be used as perimeter control for sites less than 5 acres on ground with slopes less than 15 percent. They can also be used in conjunction with infiltration basins or infiltration trenches.

C. **Planning Considerations:** Natural wooded strips or grass strips should be fenced off prior to construction. Avoid storing debris from clearing and grubbing and other construction waste material on these strips during construction. Wooded or grass strips should be constructed along the perimeter of a site immediately after the area for the filter strip is graded. This area should be fenced off and protected from traffic. The constructed vegetative buffer should be planted with trees, shrubs, or grasses with a more fibrous or seed-forming root system. Avoid using trees or shrubs with top roots or clump forming grasses.

D. **Design Criteria:** The minimum length of strip must be at least as long as the contributing runoff area but no less than 50 feet plus 4 feet for each one percent increase in slope. The minimum width should conform to Table 5106-2 below.

Table 5106-2: Minimum Width of Filter Strips

Slope of Land %	Width of Filter Strip for Grassed Areas (ft)	Width of Filter Strip for Forested Areas (ft)
0	20	50
2	20	50
4	20	50
5	20	50
8	25	60
10	30	60
15	60	75

5106.7 VEGETATED STREAM BUFFERS

A. **Description:** Buffers bordering streams are critical due to the invaluable protection of streams from sediment. Stream buffers are also useful in cooling rivers and streams and providing food and cover for wildlife.

B. **Application:** This practice is intended to protect the banks of a natural stream from damage due to development, lessen the risk of flooding in developed areas, and provide a buffer between the developed area and the stream. A properly maintained streambank buffer will help maintain channel capacity and stability, reduce sediment load in the channel, and reduce movement of pollutants into the stream.

C. **Planning Considerations:** A vegetated stream buffer of 50 feet or greater can protect water from excess sedimentation. The buffer should be increased to 2 feet in width for every one percent slope. Ensure the channel is stable before determining the width of streambank setback.

D. **Design Criteria:** The buffer shall either extend beyond the 100-year built-out floodplain or a minimum of 50 feet from the top of the streambank. Larger buffers will be needed where channels are downcutting, where hydrology is shifting, and in large drainage areas.

5106.8 TREE PROTECTION

A. **Description:** Tree protection is the protection of desirable trees from mechanical and other injury during land disturbing and construction activity. See Section 2101.2.

B. **Application:** Tree protection ensures the survival of trees to be left on the construction site where they will be effective for erosion and sediment control, watershed protection, landscape beautification, dust and pollution control, noise reduction, shade and other environmental benefits while the land is being developed.

The practice applies to tree-inhabited areas subject to land-disturbing activities.

C. **Planning Considerations:** Care should be taken to preserve existing trees. Trees perform the following functions on a site:

1. Assist in stabilizing the soil and preventing erosion.
2. Help to decrease stormwater runoff through canopy interception and root zone absorption.
3. Moderate temperature changes and provide shade.
4. Moderate the effects of sun and wind.
5. Provide buffers and screens against noise.

6. Filter pollutants from the air.

7. Help to remove carbon dioxide from the air and release oxygen.

8. Provide a haven for animals and birds which help to control insect populations.

9. Conserve and increase property values.

D. **Design Criteria:** No formal design is required. However, in planning for the development of a wooded site where some trees will be preserved, a number of criteria must be considered.

1. **Stresses of Construction:** Trees may appear to be inanimate objects, but they are living organisms that are constantly involved in the process of respiration, food processing, and growth. Construction activities expose trees to a variety of stresses resulting in injury ranging from superficial wounds to death. An understanding of these stresses is helpful in planning for tree protection.

a. **Surface Impacts:** Natural and man-related forces exerted on the tree above the ground can cause significant damage to trees.

1) Wind damage: Removal of some trees from groups will expose those remaining to greater wind velocities. Trees tend to develop anchorage where it is most needed. Isolated trees develop anchorage rather equally all around, with stronger root development on the side of the prevailing winds. The more a tree is protected from the wind, the less secure is its anchorage. The result of improper thinning is often wind-thrown trees. Selective removal in favor of a single tall tree may also create a lightning hazard.

2) Excessive pruning: Unprotected trees are often topped or carelessly pruned to prevent interference with utility wires or buildings. If too many branches are cut, the tree may not be able to sustain itself. If the pruning is done without considering the growth habit, the tree may lose all visual appeal. If the branches are not pruned correctly, decay may set in.

3) Trunk damage: Tree trunks are often nicked or scarred by trucks and construction equipment. These superficial wounds provide access to insects and disease.

b. **Root Zone Impacts:** Disturbing the delicate relationship between soil, roots, and the rest of the tree can damage or kill a tree. The roots of an existing tree are established in an area where essential water, oxygen, and nutrients are present. The mass of the root system is the correct size to balance the intake of water from the soil with the transpiration of water from the leaves.

1) Raising the grade as little as 6 inches can retard the normal exchange of air and gases. Roots may suffocate due to lack of oxygen or be damaged by toxic gases and chemicals released by soil bacteria.

2) Raising the grade may also elevate the water table. This can cause drowning of the deeper roots.

3) Lowering the grade is not usually as damaging as raising it. However, even shallow cuts of 6 to 8 inches will remove most of the topsoil, remove some feeder roots, and expose the rest to drying and freezing.

4) Deep cuts may sever a large portion of the root system depriving the tree of water and increasing the chance of wind-throw.

5) Lowering the grade may lower the water table inducing drought. This is a problem in large roadway cuts or underdrain installations.

6) Trenching or excavating through a tree's root zone can eliminate as much as 40 percent of the root system. Trees suffering such damage usually die within 2 to 5 years.

7) Compaction of the soil within the drip line or even a few feet beyond the drip line of a tree by equipment operation, materials storage, or paving can block off air and water from roots.

8) Construction chemicals or refuse disposed of in the soil can change soil chemistry and be toxic to trees. Most damage to trees from construction activities is due to the invisible root zone stresses.

2. **Selecting Trees to Remain:** The proper development of a wooded site requires completion of a plan for tree preservation before clearing and construction begin. Trees should be identified by species and located on a topographical map either as stands or as individuals, depending on the density and value of the trees. Base decisions on which trees to save on the following considerations:

5106.8

a. **Life Expectancy and Present age:** Preference should be given to trees with a long life span such as white oak, beech, and maple. Long-lived specimens that are past their prime may succumb to the stresses of construction; smaller, younger trees of desirable species are preferred because they are more resilient and will last longer. However, if the cost of preservation is greater than the cost of replacement for a specimen of the same age and size, replacement may be preferred.

b. **Health and Disease Susceptibility:** Check for scarring caused by fire or lightning, insect or disease damage, and rotted or broken trunks or limbs. Pest and pollution-resistant trees are preferred.

c. **Structure:** Check for structural defects that indicate weakness or reduce the aesthetic value of a tree such as trees growing from old stumps, large trees with overhanging limbs that endanger property, trees with brittle wood, misshapen trunks or crowns, and small crowns at the top of tall trunks. Open grown trees often have better form than those grown in the woods. Trees with strong tap or fibrous root systems are preferred to trees with weak rooting habits.

d. **Cleanliness:** Some trees such as elm and black locust are notoriously dirty, dropping twigs, bark, fruit, or plant exudates. A clean tree is worth more than a dirty one. Trees which seed prolifically or sucker profusely are generally less desirable in urban areas. Thornless varieties are preferred.

e. **Aesthetic Values:** Handsome bark and leaves, neat growth habit, fine fall color, and attractive flowers and fruit are desirable characteristics. Trees that provide interest during several seasons of the year enhance the value of the site.

f. **Comfort:** Trees help relieve the heat of summer and buffer strong winds throughout the year. Summer temperatures may be 10 degrees cooler under hardwoods than under conifers. Deciduous trees drop their leaves in winter, allowing the sun to warm buildings and soil. Evergreens are more effective wind buffers.

g. **Wildlife:** Preference should be given to trees that provide food, cover, and nesting sites for birds and game.

h. **Adaptability to the Proposed Development:**

    a. Consider the mature height and spread of trees; they may interfere with proposed structures and overhead utilities. Roots may interfere with walls, walks, driveways, patios,

and other paved surfaces or with water lines, septic tanks, and underground drainage.

b. Trees must be appropriate to the proposed use of the development; select trees that are pollution-tolerant for high-traffic and industrial areas, screen and buffer trees for noise or objectionable views, salt-tolerant species for areas exposed to deicing salts or ocean spray.

c. Consider location of landfills. Gases generated can travel long distances underground to injure distant trees. Choose species tolerant of anaerobic soil conditions.

d. Determine the effect of proposed grading on the water table. Grading should not take place within the drip line of any tree to remain.

i. **Survival Needs of the Tree:** Trees to remain on site must have enough room to develop naturally. They will be subject to injury from increased exposure to sunlight, heat radiated from buildings and pavement, and wind. It is best to retain groups of trees rather than individuals. As trees mature they can be thinned gradually.

j. **Relationship to Other Trees:** Individual species should be evaluated in relation to other species on the site. A species with low value growing among hardwoods will increase in value if it is the only species present. Trees standing alone generally have higher landscape value than those in a wooded situation. However, tree groups are much more effective in preventing erosion and excess stormwater runoff.

3. **Site Planning for Tree Protection:**

a. If lot size allows, select trees to remain before siting the building. No tree should be destroyed or altered until the design of buildings and utility systems is final.

b. Critical areas such as floodplains, steep slopes, and wetlands should be left in their natural condition or only partially developed as open space.

c. Locate roadways to cause the least damage to valuable stands. Follow original contours where feasible to minimize cuts and fills.

d. Minimize trenching by locating several utilities in the same trench. Excavations for basements and utilities should be kept away from the drip line of trees.

5106.8

e. Construction material storage areas and worker parking should be noted on the site plan and located where they will not cause compaction over roots.

f. When retaining existing trees in parking areas, leave enough ground ungraded beyond the drip line of the tree to allow for its survival.

g. Locate erosion and sediment control measures at the limits of clearing and not in wooded areas to prevent deposition of sediment within the drip line of trees being preserved. Sediment basins should be constructed in the natural terrain if possible, rather than in locations where extensive grading and tree removal will be required.

SECTION 5107 SURFACE STABILIZATION (EROSION CONTROLS)

5107.1 TEMPORARY SEEDING

A. **Description:** Temporary seeding is the establishment of fast-growing annual vegetation to provide economical erosion control for up to 12 months and reduce the amount of sediment moving off the site. Annual plants which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover.

B. **Application:** This practice applies where short-lived vegetation can be established before final grading or in a season not suitable for permanent seeding. It helps prevent costly maintenance operations on other erosion control systems such as sediment basin clean-out. Temporary or permanent seeding is necessary to protect earthen structures such as dikes, diversions, and the banks and dams of sediment basins.

C. **Planning Considerations:** Prior to the start of construction, plant materials, seeding rates, and times should be specified by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. To ensure emergence, vigorous growth of seedlings, and continued plant growth, prepare seedbed, add lime and fertilizer according to soil tests, mulch all but the most ideal sites, and follow seeding dates.

D. **Design Criteria:** See Section 2151.1 for seeding rates and mixes.

5107.2 PERMANENT SEEDING

A. **Description:** Permanent seeding is the establishment of perennial vegetation on disturbed areas for periods longer than 12 months. Permanent vegetation provides economical, long-term erosion control and helps prevent sediment from leaving the site.

B. **Application:** This practice is used when vegetation is designed to permanently stabilize the soil. It is necessary to protect earthen structures such as dikes, channels, and embankments. Particular care is required to establish a thick cover of permanent grass.

C. **Planning Considerations:** Prior to the start of construction, plant materials, seeding rates, and times should be specified by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. To ensure germination and growth, prepare seedbed, add lime, and fertilizer according to soil tests, mulch all but the most ideal sites, and follow seeding dates.

D. **Design Criteria:** See Section 2151.1 for seeding rates and mixes.

5107.3 SODDING

A. **Description:** Sodding is the use of a vegetative cover to provide immediate erosion control in disturbed areas.

B. **Application:** Sodding is well suited for stabilizing erodible areas such as grass-lined channels, stormwater detention basins, diversions, swales, slopes, and filter strips because it provides an instant vegetative cover with an established root system.

C. **Planning Considerations:** Prior to installation, plant materials and amendments should be specified by a qualified professional. Plans and specifications should be referred to by field personnel throughout the installation process.

D. **Design Criteria:** See Detail ESC-02, Sodding in Division III of this manual.

5107.4 MULCHING AND HYDRO MULCH

A. **Description:** Mulching and hydro mulch are the application of plant residues such as straw or other suitable materials to the soil surface. Mulch protects the soil surface from the erosive force of raindrop impact and reduces the velocity of overland flow. It helps seedlings germinate and grow by conserving moisture, protecting against temperature extremes, and controlling weeds. Mulch also maintains the infiltration capacity of the soil.

B. **Application:** Mulch can be applied to seeded areas to help establish plant cover. It can also be used as temporary cover in unseeded areas to protect against erosion over the winter or until final grading and shaping can be accomplished. Application rates are found in Table 2151-8 in Section 2151.2 in Division II.

C. **Planning Considerations:** Prior to the construction, mulch requirements should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process.

5107.5 TACKIFIERS, SOIL BINDERS, AND BONDED FIBER MATRIX

A. **Description:** Tackifiers, binders, and bonded filber matrix (BFM) can increase the performance of mulch material. Approved tackifiers and binders are listed below with their recommended application rates.

1. **Polyacrylamide (PAM)** – The land application of a product containing anionic polyacrylamide as a temporary soil binding agent to reduce soil erosion.

2. **Tackifiers and Binders** – Substances used to anchor straw, hay, paper, or wood mulch by causing the organic material to bind together.

3. **Bonded Fiber Matrix (BFM)** – A classification of erosion control products that are designed to stay in place on steep slopes. A bonded fiber matrix is a continuous layer of elongated fiber strands held together by a binding agent that is water-resistant. Once dry, the BFM forms a water absorbent protective cover that is porous and breathable and secures soil and seed while enhancing establishment of vegetation.

B. **Application:** Due to many different types of products available on the market, it is best to consult with the manufacturer for proper application rates and procedures.

C. **Planning Considerations:** Tackifiers and binders must be applied to organic mulch to reduce the potential of mulch movement by water or wind and increase the performance of the material. Binders and BFM can be directly applied to the bare soil to provide binding of the soil particles and reduce the erosion potential of the bare soil.

5107.6 ROLLED EROSION CONTROL PRODUCTS

A. **Description:** Rolled erosion control products are protective covering netting, blankets or turf reinforcement mats (TRMs) installed on a prepared planting area of a steep slope, channel, or shoreline. They aid in controlling erosion on critical areas by absorbing the energy from raindrop impacts and providing a microclimate which protects young vegetation and promotes its establishment. TRMs are also used to raise the maximum permissible velocity and shear stress of turf grass stands in channelized areas by enabling the turf to resist the forces of erosion during storm events.

B. **Application:** Netting, blankets, and TRMs will aid in controlling erosion on slopes steeper than 8 percent and of highly erodible soils by providing a protective cover made of straw, jute, wood, or other organic plant fiber with cotton string or polypropylene netting to hold the product in a flat form. Netting can be used alone over blown straw as an alternative to crimping or use of a tackifier.

These products can be used on short, steep slopes where erosion hazard is high and planting is likely to be too slow in providing adequate protective cover; in vegetated channels where the design velocity and shear stress of design flow exceed allowable on streambanks where moving water is likely to wash out new plantings; or in areas where the forces of wind prevent standard mulching practices from remaining in place until vegetation becomes established.

Rolled erosion control products provide protection from raindrop impact and offer additional soil stabilization on prepared planting areas. TRMs also raise the maximum permissible velocity and shear stress of turfgrass stands in channelized areas by reinforcing the vegetation to resist the forces of erosion during storm events.

Before installation of these products, the area should be final graded to a smooth and uniform surface, free of debris. Topsoil should be incorporated if needed. Seed and fertilize as shown on the plan. The erosion control netting, blankets, and mats should be installed in accordance with the manufacturer's recommendations and specifications. All products should be anchored firmly with continuous contact to the soil surface. Product should be anchored following the manufacturer's recommended stapling pattern for each specific application. Details for blanket and mat installation can be found in Division III, Details ESC-04 through ESC-09.

Some important factors in the choice of netting, blanket, or TRM are soil conditions, steepness of slope, length of slope, type and duration of protection required to establish desired vegetation, and probable sheer stress. Consult the manufacturer's product specifications to determine the correct product for each specific application required.

C. **Planning Considerations:** Rolled erosion control blankets and mats can be applied to problem areas to supplement vegetation in its initial establishment and to provide a safe and more natural conveyance for high velocity stormwater runoff. They are used in many applications where a structural lining would previously have been required. Care must be taken to choose the blanket or matting which is most appropriate for the specific needs of a project. Two general types of blankets and mats are discussed within this section. However, with the abundance of soil stabilization products available today, it is impossible to cover all the advantages, disadvantages, and specifications of all manufactured blankets and mats. Therefore, there is no substitute for a thorough understanding of the manufacturer's recommendations and a site visit by a designer or plan reviewer to verify a product's appropriateness.

Blankets should be used to help establish vegetation on previously disturbed slopes of 3H:1V or steeper. Since the materials which compose the soil stabilization blankets will deteriorate over time, they should be used in permanent conveyance channels with the realization that resistance to erosion will ultimately be based on the type of vegetation planted and the existing soil characteristics. During the establishment of vegetation, blankets should not be subjected to velocities greater than 4 feet per second.

Blankets provide the following benefits in vegetative stabilization when properly applied:

1. Protection of the seed and soil from raindrop impact and subsequent displacement.

2. Thermal consistency and moisture retention for seedbed area.

3. Stronger and faster germination of grasses and legumes.

4. Planing off excess stormwater runoff.

5. Prevention of sloughing of topsoil added to steeper slopes.

TRMs consist of a non-degradable, three-dimensional polypropylene structure which may also have coconut or other organic fiber layers within it so long as the non-degradable portion of the blanket will withstand design velocities and shear stresses after the organic fibers degrade. The matting becomes entangled and penetrated by roots forming continuous anchorage for surface growth and promoting enhanced energy dissipation. They should be used on slopes 2H:1V or steeper, and in stormwater conveyance channels.

In addition to those benefits noted for blankets, TRMs provide the following benefits for vegetative stabilization and when replacing concrete and riprap channel linings:

1. Cause sediment to drop out of stormwater and fill matrix with fine soils which become the growth medium for the development of roots.

2. Act with the vegetative root system to form an erosion resistant cover, which resists hydraulic lift and shear forces when embedded in the soil within stormwater channels.

Since TRMs are non-degradable, they can be used in permanent conveyance channels to withstand higher velocities and shear stresses than would normally be allowable with only soil and vegetation. Permissible velocities and shear stresses of TRM for reinforced grass-lined channels range from 10-20 fps and 6-10 psf respectively.

SECTION 5108 SEDIMENT CONTROL

5108.1 STRAW BALE BARRIER

A. **Description:** A straw bale barrier is a temporary sediment barrier consisting of a row of entrenched and anchored straw bales.

B. **Application:**

1. To intercept and detain small amounts of sediment from disturbed areas of less than one acre in order to prevent sediment from leaving the construction site.

2. To decrease the velocity of sheet flows.

C. **Planning Considerations:** Prior to the start of construction, straw bale sediment barriers should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process. The straw bale sediment barriers should be built according to planned grades and dimensions.

D. **Design Criteria:** Straw bale barriers shall be used for sheet flow only with less than ¼ acre drainage area per 100 linear feet of barrier. An effort should be made to locate the straw bale barrier as well as other perimeter controls at least 5 to 7 feet from the base of disturbed slopes with grades steeper than 7 percent. This will help prevent the measure from being rendered useless following the initial movement of soil. Straw bale barriers should be installed on the contour to be most effective. See Detail ESC-13, Straw Bale Barrier, in Division III in this manual.

5108.2 COMPOST BERM OR TUBES

A. **Description:** Compost berms and tubes consist of organic mulch or composted material blown in place and used as erosion and sediment control devices.

B. **Application:** These berms can be designed as perimeter controls for surface runoff from areas less than 0.5 acres. They can also be designed as diversions above the disturbed area to bypass stormwater around the site that does not need to be treated with Best Management Practices.

C. **Planning Considerations:** Berms should be placed on the contour prior to the start of construction and are very effective if used in combination with vegetation buffers or filter strips.

D. **Design Criteria:** When no seeding or planting is planned, use material for filter berm mulch that conforms to the following:

1. pH – 5.0 to 8.0

2. Particle Size: 99 percent passing 1-inch sieve, 90 percent passing ¾-inch sieve and not more than 30 percent passing the 3/8-inch sieve. 98 percent of the material shall not exceed 3-inches in length.

3. Moisture content less than 60 percent.

4. No less than 70 percent organic matter.

5. Material shall have <1 percent by dry weight of man-made foreign matter.

6. A sample shall be submitted to the Engineer or Landscape Architect for approval prior to being used and must comply with local, county and state regulations.

Where seeding or planting is planned or where biological filtration may be desired, use material derived from well-composted organic matter or in combination with filter berm mulch. The compost material shall be produced by the aerobic decomposition of organic matter. Organic matter may include, but is not limited to, well-decomposed vegetative matter, leaves and yard trimmings, Class A Biosolids (as defined by Federal Regulation 40 CFR, Part 503), food scraps, composted manures, paper fiber, wood, bark, or combinations of these products. The compost shall be free of any refuse, contaminants, and any material toxic to plant growth. All compost material supplied shall be processed to meet the U.S. Composting Council's Seal of Testing Assurance Program, or equivalent, for control of noxious weeds and pathogen and vector attraction and disclosure of heavy metals, nutrient levels, and maturity level of compost. All lab analysis to follow testing procedures of the U.S. Composting Council's TMECC material. Information is available on-line at www.compostingcouncil.org.

Filter berm material shall conform to the following:

1. pH – 5.5 to 8.0.

2. Particle Size – 99 percent passing 1-inch sieve, 90 percent passing ¾-inch sieve and not more than 60 percent passing the 3/8-inch sieve. 98 percent of the material shall not exceed 3-inches in length.

3. Moisture content less than 60 percent.
4. No less than 70 percent organic matter.

5. The compost portion shall be <1 percent by dry weight of man-made foreign matter.

6. A sample shall be submitted to the Engineer or Landscape Architect for approval prior to being used and must comply with local city, county and state regulations.

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5108.3 SEDIMENT FENCE

A. **Description:** Sediment fence is a temporary sediment barrier consisting of a synthetic fabric stretched across and attached to supporting posts and entrenched or sliced in place. See Detail ESC-10, Sediment Fence, in Division III of this manual.

B. **Application:**

1. To intercept and detain small amounts of sediment from disturbed areas of limited extent in order to prevent sediment from leaving the construction site.

2. To decrease the velocity of sheet flows.

C. **Planning Considerations:** Prior to start of construction, sediment fence placement should be designed by a qualified professional. Plans and specifications should be referred to by field personnel throughout the construction process.

D. **Design Criteria:**

1. **Drainage Area:** Limited to ¼ acre per 100 feet of fence. Area is further restricted by slope steepness as shown in Table 5108-1.

2. **Location:** Fence should be built on a nearly level grade and at least 10 feet from the toe of the slope to provide a broad shallow sediment pool. Install on the contour where fence can intercept runoff as a sheet flow, not in channels, waterways, or other concentrated flow paths and not attached to existing trees.

3. **Length:** Maximum of 600 feet. Flare ends of fence uphill to temporarily impound water.

Table 5108-1: Typical Land Slope and Distance for Sediment Fence

Land Slope (%)	Maximum Slope Distance* above Fence (feet)
Less than 2	150
2 to 5	100

* Follow manufacturer's recommendations for proper placing.

4. **Spacing of Support Posts:** 10 feet maximum for fence supported by wire; 6 feet maximum for high strength fabric without supportive wire backing.

5. **Trench:** Bottom 1 foot of fence must be buried minimum of 6 inches deep as per Detail ESC-10 or slice into place as per Detail ESC-11.

6. **Impounded Water Depth:** Not to exceed 1.5 feet at any point along the fence.

7. **Support Posts:** 4-inch diameter wood or 1.33 lb./linear foot steel, buried or driven to a depth of 24 inches with support wire; 2-inch square wood or 1.0 lb./linear foot steel without support wire. Steel posts should have projections for fastening fabric.

8. **Synthetic Geotextile Fabric:** Conforming to specifications in the table below and containing ultraviolet light inhibitors and stabilizers. Minimum design life of 6 months.

Table 5108-2: Example Specifications for Sediment Fence Fabric

Physical Property	Minimum Requirement	Test
Filtering Efficiency	75%	ASTM 5141
Tensile Strength at 20% (maximum) elongation*: Standard strength	30 lb./ linear inch	ASTM 4632
High strength	50 lb./linear inch	ASTM 4632
Flow Rate	0.2 gal./sq.ft./minute	ASTM 5141
Ultraviolet Radiation Stability	90 %	ASTM-G-26

* Properties are reduced by 50% after 6 months of installation.

A detail is located on Detail ESC-10, Sediment Fence, in Division III of this manual.

5108.4 SEDIMENT FENCE INSTALLATION MACHINES

A. **Description:** Installation machines insert a narrow custom-shaped blade at least 10 inches into the ground and simultaneously pull sediment fence fabric into the opening created as the blade is pulled through the ground.

B. **Application:** Installation of sediment fence is accomplished by inserting sediment fence fabric while slicing the ground.

C. **Planning Considerations:** When sediment fence is used in an erosion and sediment control plan, a sediment fence installation machine should be used to place the sediment fence. By slicing the fence into the ground and compacting soil over the embedded fence, a sturdy structure is created that can trap sediment efficiently.

D. **Design Criteria:** See Detail ESC-11, Sediment Fence Installation Slicing Method, in Division III of this manual.

5108.5 SUPER SEDIMENT FENCE

A. **Description:** A temporary barrier of Geotextile Class F over wire fence is used to intercept sediment-laden runoff from small drainage areas.

B. **Application:** Super sediment fence reduces runoff velocity and allows for the deposition of transported sediment. Limits imposed by ultraviolet light stability of the fabric will dictate the maximum period that the sediment fence may be used.

1. Super sediment fence provides a barrier that collects and holds debris and soil, protecting sensitive areas, woods, and wetlands.

2. Super sediment fence can be used where the installation of a dike would destroy sensitive areas, woods, and wetlands.

3. Super sediment fence should be placed as close to the contour as possible. No section of sediment fence should exceed a longitudinal grade of 5% for a distance of more than 50 feet.

C. **Planning Considerations:** See Detail ESC-12, Super Sediment Fence, in Division III of this manual.

D. **Design Criteria:** Length of the flow above a super sediment fence shall conform to the limitations in Table 5108-3:

Table 5108-3: Length of Super Sediment Fence

Slope	Slope Steepness	Slope Length (maximum)	Sediment Fence Length (maximum)
0 – 10%	0 – 10:1	Unlimited	Unlimited
10 – 20%	10:1 – 5:1	200 feet	1,500 feet
20 – 33%	5:1 – 3:1	100 feet	1,000 feet
33 – 50%	3:1 – 2:1	100 feet	500 feet
50% +	2:1 +	50 feet	250 feet

Ends of geotextile fabric shall be overlapped, folded, and stapled to prevent sediment bypass.

5108.6 LOG OR WATTLE PRODUCTS

A. **Description:** Log or wattle products are tubes of open weave containment material filled with straw, rice or wheat straw, excelsior, coir, or coconut. They come in a variety of diameters and lengths.

B. **Application:** Logs or wattles can be used as perimeter control for disturbed areas of one quarter acre or less, along contours as slope breaks, for inlet protection, for ditch checks, and for streambank protection.

C. **Planning Considerations:** This type of sediment barrier is designed for surface flows not exceeding 1 cfs, slopes 1H:1V or flatter, and areas where sediment fence in not practicable.

D. **Design Criteria:** Logs or wattles should be designed and used as per manufacturer's recommendations for each specific products.

5108.7 CHECK DAMS

A. **Description:** Check dams are small temporary dams constructed across a swale or drainage ditch. These can be constructed of rock, Triangular Silt Dike™, Geo-Ridge®, or super sediment fence under low flow conditions.

B. **Application:** Check dams reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. They also trap sediment generated from adjacent areas or the ditch itself, mainly by ponding the stormwater runoff.

C. **Planning Considerations:** Check dams are effective in reducing flow velocity and thereby the potential for channel erosion. It is usually better to establish a protective vegetative lining before flow is confined or to install channel lining in addition to installing check dams.

Check dams installed in grass-lined channels may kill the vegetative lining if submergence after rains is too long or sedimentation is excessive.

If check dams are used in grass-lined channels which will be mowed, care should be taken to remove all the stone when the dam is removed, including any stone which has washed downstream. A geotextile fabric may be used under the rock for easier removal.

D. **Design Criteria:** Details for these devices are located in Details ESC-15 through ESC-17 in Division III of this manual.

5108.8 DROP OR CURB INLET PROTECTION

A. **Description:** Inlet protection consists of a sediment barrier or an excavated impounding area with free-draining material such as gravel around a storm drain drop inlet or curb inlet.

B. **Application:** Inlet protection prevents sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

C. **Planning Considerations:** Prior to the start of construction, inlet protection structures should be designed by a registered design professional. Plans and specifications should be referred to be field personnel throughout the construction process.

1. Storm sewers which are made operational prior to stabilization of the associated drainage areas can convey large amounts of sediment to natural drainageways. In case of extreme sediment loading, the storm sewer itself may clog and lose its capacity. To avoid these problems it is necessary to prevent sediment from entering the system at the inlets.

2. There are several types of inlet protection and traps which have different

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applications depending on site conditions and type of inlet. Other innovative techniques for accomplishing the same purpose are encouraged, but only after specific plans and details are submitted to and approved by the appropriate authority.

3. Care should be taken when choosing a specific type of inlet protection. Inlet protection which causes excessive ponding in an area of high construction activity may become so inconvenient that it is removed or bypassed, thus transmitting sediment-laden flows unchecked. In such situations, a structure with an adequate overflow mechanism should be utilized.

4. The following inlet protection devices are for drainage areas of one acre or less. Runoff from larger disturbed areas should be routed to a temporary sediment trap or a temporary sediment basin. The following are types of drop and curb inlet protection devices within this manual and the detail sheet they are located on in Division III:

    a. Silt Saver® – Detail ESC-18
    b. Sediment Fence Drop Inlet Protection – Detail ESC-19
    c. Gravel and Wire Mesh Drop Inlet Sediment Trap – Detail ESC-20
    d. Block and Gravel Drop Inlet Sediment Trap– Detail ESC-21
    e. Excavated Drop Inlet Sediment Trap – Detail ESC-22
    f. Sod Drop Inlet Sediment Trap – Detail ESC-23
    g. Gutterbuddy®Curb Inlet
    h. Gravel Curb Inlet Sediment Trap – Detail ESC-24
    i. Wooden Weir Curb Inlet Protection – Detail ESC-25
    j. Block and Gravel Curb Inlet Protection – Detail ESC-26
    k. Beaver Dam® or True Dam®

D. **Design Criteria:**

1. Drainage Area: Less than 1 acre.

2. Capacity: 10-year or design storm should enter inlet without bypass flow.

3. The inlet protection device shall be constructed in a manner that will facilitate clean out and disposal of trapped sediment and minimize interference with construction activities.

4. The inlet protection devices shall be constructed in such a manner that any resultant ponding of stormwater will not cause excessive inconvenience or damage to adjacent areas or structures.

5. Design criteria more specific to each particular inlet protection device will be found in standard drawings.

6. For the inlet protection devices which utilize stone as the chief ponding medium, a range of stone sizes should be used. The designer or plan

7. reviewer should maximize treatment action and minimize stone size while not creating significant ponding problems.

8. In all designs which utilize stone with a wire-mesh support as a ponding mechanism, the stone can be completely wrapped with the wire mesh to improve stability and provide easier cleaning.

8. High porosity geotextile fabric may be added to any of the devices which utilize coarse aggregate to significantly enhance sediment removal. The fabric, which must meet the physical requirements noted for extra strength, should be secured between the stone and the inlet on wire-mesh if it is present. As a result of the significant increase in treatment efficiency provided by the fabric, a larger range of stone sizes may be utilized with such a configuration. The larger stone will help keep larger sediment masses from clogging the cloth. Notably, significant ponding may occur at the inlet if geotextile cloth is utilized in this manner.

5108.9 CULVERT INLET PROTECTION

A. **Description:** A sediment settling device located at the inlet to storm sewer culverts.

B. **Application:**

1. To prevent sediment from entering, accumulating in, and being transferred by a culvert and associated drainage system prior to permanent stabilization of a disturbed project area.

2. To provide sediment control at culvert inlets during the phase of a project where elevation and drainage patterns change, causing original control measures to be ineffective or in need of removal.

C. **Planning Considerations:**

1. When construction on a project reaches a stage where culverts and other storm sewer appurtenances are installed and many areas are brought to a desired grade, the erosion control measures used in the early stages normally need to be modified or may need to be removed altogether. At that time, there is a need to provide protection at points where runoff will leave the area via culverts and drop or curb inlets.

2. Similar to drop and curb inlets, culverts which are made operational prior to stabilization of the associated drainage areas can convey large amounts of sediment to natural drainageways. In case of extreme sediment loading, the pipe or pipe system itself may clog and lose its capacity. To avoid these problems, it is necessary to prevent sediment from entering the culvert by using one of the methods noted in this section.

D. **Design Criteria:**

1. **Sediment Fence Culvert Inlet Protection** – Detail ESC-28 in Division III

   a. Sediment fence culvert inlet protection has an expected maximum usable life of three months.

   b. The maximum drainage shall not exceed acre.

   c. Use high porosity geotextile fabric.

2. **Culvert Inlet Sediment Trap** – Detail ESC-27 in Division III

   a. Runoff storage requirements shall be in accordance with information outlined under Section 5108.11, Temporary Sediment Trap

   b. Culvert inlet sediment traps have a maximum expected useful life of 18 months.

   c. The maximum drainage area shall not exceed 3 acres.

5108.10 DIVERSIONS

A. **Description:** Diversions consist of channels constructed across slopes with a supporting earthen ridge on the lower side.

B. **Application:**Diversions reduce slope length and to intercept and divert stormwater runoff to stabilized outlets at non-erosive velocities.

C. **Planning Considerations:**

1. Diversions can be useful tools for managing surface water flows and preventing soil erosion. On moderately sloping areas they may be placed at intervals to trap and divert sheet flow before it concentrates and causes rill and gully erosion. They may be placed at the top of cut or fill slopes to keep runoff from upland drainage areas off the slope. They can also be used to protect structures, parking lots, adjacent properties, and other special areas from flooding.

2. Diversions are preferable to other types of man-made stormwater conveyance systems because they more closely simulate natural flow patterns and characteristics. Flow velocities are generally kept to a minimum. When properly coordinated into the landscape design of a site, diversions can be visually pleasing as well as functional.

3. As with any earthen structure, it is very important to establish adequate vegetation as soon as possible after installation. It is equally important to

4. stabilize the drainage area above the diversion so that sediment will not enter and accumulate in the diversion channel.

D. **Design Criteria:** Diversion location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, seepage planes, and development layout. The details are located on Detail ESC-29, Diversions, in Division III of this manual.

1. **TEMPORARY FILL DIVERSION**

a. **Description:** A temporary fill diversion is a channel with a supporting ridge of soil on the lower side, constructed along the top of an active earth fill.

b. **Application:** To divert storm runoff away from the unprotected slope of the fill to a stabilized outlet or sediment-trapping facility.

c. **Planning Considerations:**

1) One important principle of erosion and sediment control is to keep stormwater runoff away from exposed slopes. This is often accomplished by installing a dike, diversion, temporary slope drain, or paved ditch at the top of a slope to carry the runoff away from the slope to a stabilized outlet. In general, these measures are installed after the final grade has been reached. On cuts, the measures may be installed before work begins since work proceeds from the top to the bottom of the slope and the measures have little chance of being covered or damaged. On fills, the work proceeds from the bottom to the top and the elevation changes daily. It is therefore not feasible to construct a compacted dike or permanent diversion which may be covered by the next day's activity.

2) The temporary fill diversion is intended to provide some slope protection on a daily basis until final elevations are reached and a more permanent measure can be constructed. They can be constructed by use of a motor grader or a small dozer. To shape the diversion, the piece of machinery used may run near the top edge of the fill with its blade tilted to form the channel. This work should be done at the end of the working day and provide a channel with a berm to protect the slope. Wherever possible, the temporary diversion should be sloped to direct water to a stabilized outlet. If the runoff is diverted over the fill itself, it may cause erosion by concentrating water at a single point.

3) Good timing is essential to fill construction. The filling operation should be completed as quickly as possible and the

4) permanent slope protection measures and slope stabilization measures installed as soon after completion as possible. With prompt and proper construction, the landowner or Contractor will save both time and money in building, repairing, and stabilizing the fill area. The longer the time period for construction and stabilization extends, the more prone the fill operation is to be damaged by erosion. Repairing the damages adds additional time and expense to the project.

d. **Design Criteria:** The following criteria must be met:

1) **Drainage Area:** The maximum allowable drainage area is 5 acres.

2) **Height:** The minimum height of the supporting ridge shall be 9 inches.

3) **Grade:** The channel shall have a positive grade to a stabilized outlet.

4) **Outlet:** The diverted runoff should be released through a stabilized outlet, slope drain, or sediment trapping measure.

2. **TEMPORARY DIVERSION DIKE**

a. **Description:** A temporary diversion dike is a temporary ridge of compacted soil constructed at the top or base of a sloping disturbed area.

b. **Application:**

1) To divert storm runoff from upslope drainage areas away from unprotected disturbed areas and slopes to a stabilized outlet.

2) To divert sediment-laden runoff from a disturbed area to a sediment-trapping facility such as a sediment trap or sediment basin.

c. **Planning Considerations:**

1) A temporary diversion dike is intended to divert overland sheet flow to a stabilized outlet or a sediment-trapping facility during establishment of permanent stabilization on sloping disturbed areas. When used at the top of a slope it protects exposed slopes by keeping upland runoff away. When used at the base of a slope, it protects adjacent and

2) downstream areas by diverting sediment-laden runoff to a sediment trapping facility.

3) It is very important that a temporary diversion dike be stabilized immediately following installation with temporary or permanent vegetation to prevent erosion of the dike itself. The gradient of the channel behind the dike is also an important consideration. The dike must have a positive grade to assure drainage, but if the gradient is too great, precautions must be taken to prevent erosion due to high-velocity channel flow behind the dike. The cross section of the channel which runs behind the dike should be of a parabolic or trapezoidal shape to help inhibit a high velocity of flow which could arise in a vee ditch.

3) This practice is considered an economical one because it uses material available on the site and can usually be constructed with equipment needed for site grading. The useful life of the dike can be extended by stabilizing it with vegetation. Diversion dikes are preferable to silt fence because they are more durable, less expensive, and require much less maintenance when constructed properly. Along with a temporary sediment trap, they become a logical choice for a control measure once the control limits of the silt fence or straw bale barrier have been exceeded.

4) Temporary diversion dikes are often used as a perimeter control in association with a sediment trap, a sediment basin, or a series of sediment-trapping facilities on moderate to large construction sites. If installed properly and in the first phase of grading, maintenance costs are very low. Often, cleaning of sediment-trapping facilities is the only associated maintenance requirement.

5) This practice is intended to be temporary. However, with more stringent design criteria, it can be made permanent with diversions.

d. **Design Criteria:** The following criteria must be met:

1) **Drainage Area:** The recommended drainage area is 5 acres and should be designed by a professional.

2) **Height:** The minimum allowable height measured from the upslope side of the dike is 18 inches.

3) **Side Slopes:** 1.5H:1V or flatter, along with a minimum base width of 4.5 feet.

4) **Grade:** The channel behind the dike shall have a positive grade to a stabilized outlet. If the channel slope is less than or equal to 2%, no stabilization is required. If the slope is greater than 2%, the channel shall be stabilized with the stormwater conveyance channel.

5) **Outlet:**

a) The diverted runoff, if free of sediment, must be released through a stabilized outlet or channel.

b) Sediment-laden runoff must be diverted and released through a sediment-trapping facility such as a temporary sediment trap or temporary sediment basin.

3. **RIGHT-OF-WAY DIVERSION**

a. **Description:** A right-of-way diversion is a ridge of compacted soil, loose rock, or gravel constructed across disturbed rights-of-way and similar sloping areas.

b. **Application:** To shorten the flow length within a sloping right-of-way, thereby reducing the erosion potential by diverting storm runoff to a stabilized outlet.

c. **Planning Considerations:** Construction of utility lines and roads often requires clearing of long strips of right-of-way over sloping terrain. The volume and velocity of stormwater runoff tend to increase in these cleared strips and the potential for erosion is much greater since the vegetative cover is diminished or removed. To compensate for the loss of vegetation, it is good practice to break up the flow length within the cleared strip so that runoff does not have a chance to concentrate and cause erosion. At proper intervals, temporary right-of-way diversions can significantly reduce the amount of erosion which will occur until the area is permanently stabilized. Since many rights-of-way are constructed through heavily-vegetated areas, runoff can often be diverted into a vegetative buffer strip provided it has a minimum flow length of 75 feet.

d. **Design Criteria:** The following criteria must be met:

1) **Height:** The minimum allowable height of the diversion is 18 inches.

2) **Side Slopes:** Side slopes should be 2H:1V or flatter to allow the passage of construction traffic.

3) **Length:** The diversion should be constructed completely across the disturbed portion of the right-of-way; the minimum base width is 6 feet.

4) **Spacing:** See Table 5108-4.

Table 5108-4: Spacing of Right-of-Way Diversions

% Slope	Spacing (ft.)
Less than 7%	100
Between 7% and 25%	75
Between 25% and 40%	50
Greater than 40%	25

5) **Grade:** Positive drainage with flatter than 2% slope should be provided to a stabilized outlet, sediment-trapping facility, or a vegetative buffer strip of adequate size.

6) **Outlet:** Interceptor dikes must have an outlet which is not subject to erosion.

The location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet. Concentrated flows should spread over the widest possible area after release. Flows with high sediment concentrations should pass through an appropriate sediment-trapping measure.

5108.11 TEMPORARY SEDIMENT TRAP

A. **Description:** A temporary sediment trap is a temporary ponding area formed by constructing an earthen embankment with a stone outlet. It serves to detain sediment-laden runoff from small-disturbed areas long enough to allow the majority of the sediment to settle out.

B. **Application:**

1. Locate the trap below disturbed areas where the total contributing drainage area is less than 3 acres.

2. The trap will be used no longer than 18 months.

3. The sediment trap may be constructed either independently or in conjunction with a temporary diversion dike.

C. **Planning Considerations:** Sediment traps should be used only for small drainage areas. If the contributing drainage area is 3 acres or greater, refer to Section 5108.12, Temporary Sediment Basin.
Sediment traps, along with other perimeter controls intended to trap sediment, shall be constructed as a first step in any land-disturbing activity and shall be made functional before upslope land disturbance takes place.

In most cases excavation will be required to attain the necessary storage volume. Also, sediment must be periodically removed from the trap to maintain the required volume. Plans should detail how excavated sediment is to be disposed of.

D. **Design Criteria:**

1. **Trap Capacity:** The sediment trap must have an initial storage volume of 134 cubic yards per acre of drainage area, half of which shall be in the form of a permanent pool or wet storage to provide a stable settling medium. The remaining half shall be in the form of a drawdown or dry storage which will provide extended settling time during less frequent, larger storm events. The volume of the wet storage shall be measured from the low point of the excavated area to the base of the stone outlet to the crest of the stone outlet overflow mechanism. Sediment should be removed from the basin when the volume of the wet storage is reduced by one-half.

   For a sediment trap the wet storage volume may be approximated as follows:

$$V_1 = 0.85 \times A_1 \times D_1$$

where,

V_1 = the wet storage volume in cubic feet
A_1 = the surface area of the flooded area at the base of the stone outlet in square feet.
D_1 = the maximum depth in feet, measured from the low point in the trap to the base of the stone outlet

The dry storage volume may be approximated as follows:

$$V_2 = \frac{A_1 + A_2}{2} \times D_2$$

where,

V_2 = the dry storage volume in cubic feet
A_1 = the surface area of the flooded area at the base of the stone outlet in square feet
A_2 = the surface area of the flooded area at the crest of the stone outlet overflow mechanism, in square feet
D_2 = the depth in feet, measured from the base of the stone outlet to the crest of the stone outlet

The designer should seek to provide a storage area which has a minimum 2:1 length to width ratio measured from the point of maximum runoff introduction to outlet.

2. **Excavation:** Side slopes of excavated areas should be no steeper than 1H:1V. The maximum depth of excavation within the wet storage area should be 4 feet to facilitate clean-out and for site safety considerations.

3. **Outlet:** The outlet for the sediment trap shall consist of a stone section of the embankment located at the low point in the basin. A combination of coarse aggregate and riprap shall be used to provide for filtering and detention as well as outlet stability. The smaller stone, which enhances filter efficiency, shall be 2-inch, and riprap shall be 10-inch d_{50}. Filter cloth shall be placed at the stone-soil interface to act as a separator. The minimum length of the outlet shall be 6 feet times the number of acres comprising the total area draining to the trap. The crest of the stone outlet must be at least 1.0 foot below the top of the embankment to ensure that the flow will travel over the stone and not the embankment. The outlet shall be configured as noted in Section 5600.

4. **Embankment Cross Section:** The maximum height of the sediment trap embankment shall be 5 feet as measured from the base of the stone outlet. Minimum top widths (W) and outlet heights (H_o) for various embankment heights (H) are shown in Section 5600. Side slopes of the embankment shall be 2H:1V or flatter.

5. **Removal:** Sediment traps must be removed after the contributing drainage area is stabilized. Plans should show how the site of the sediment trap is to be graded and stabilized after removal.

5108.12 TEMPORARY SEDIMENT BASIN

A. **Description:** A temporary sediment basin is a temporary barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted soil across a drainageway. It can detain sediment-laden runoff from disturbed areas in wet and dry storage long enough for the majority of the sediment to settle out.

B. **Application:** They are used below disturbed areas where the total contributing drainage area is greater than or equal to 3 acres. There must be significant space and appropriate topography for the construction of a temporary impoundment. These structures are limited to a useful life of 18 months unless they are designed as permanent impoundments. Due to their potential to impound large volumes of water, it is recommended they be designed by a qualified professional.

C. **Planning Considerations:**

1. **Effectiveness:** The effectiveness of the basin is based on primarily two factors: the system of erosion and sediment controls above the basin and the designed shape of the basin. The sediment basin is usually the final control

2. before stormwater discharges from the site, therefore, it should be used in conjunction with erosion control practices such as temporary seeding, mulching, diversion dikes, and other sediment control devices to reduce the amount of sediment flowing into the basin.

   The shape of the basin can increase its effectiveness by increasing the distance between where runoff enters the basin and where it is discharged; this will increase the settling time for the sediment.

   The sediment removal efficiency problems of the temporary sediment trap are also applicable to the sediment basin. In order to contain the majority of sediment which flows to the structure, the basin should have a permanent pool, or wet storage area, and a dry storage area which dewaters over time. The volume of wet storage required to prevent short-circuiting of the basin during larger storm events must be an additional 67 cubic yards per acre of drainage area. The total storage volume of the basin at the principal spillway riser crest should therefore be 134 cubic yards per acre of drainage area.

   Sediment basins, along with other perimeter controls intended to trap sediment, shall be constructed as a first step in any land disturbing action and shall be made functional before upslope land disturbance takes place.

3. **Location:** To improve the effectiveness of the basin, it should be located to intercept the largest possible amount of runoff from the disturbed area. The best locations are generally low areas and natural drainageways below disturbed areas. Drainage into the basin can be improved by the use of diversion dikes and ditches. The basin must not be located in a live stream but should be located to trap runoff before it enters a stream. The basin should not be located where its failure could result in the loss of life or interruption of public utility service or roads.

4. **Multiple Use:** Sediment basins may remain in place after construction and final site stabilization are completed to serve as permanent stormwater management structures. Because the most practical location for a sediment basin is often the most practical location for a stormwater management basin, it is often desirable to utilize these structures for permanent stormwater management purposes. It should be noted that in most cases, a typical structure's outfall system will be defined during construction and post-construction periods. Care must be taken to avoid constructing an outfall system which will achieve the desired post-construction control but will not provide the requirements for construction runoff. The design for permanent ponds is beyond the scope of these standards and specifications.

D. **Design Criteria:**

1. **Maximum Drainage Area:** The maximum allowable drainage area to a temporary sediment basin shall be 100 acres. It is recommended that when the drainage area to any one temporary basin exceeds 50 acres, an alternative

2. design procedure be used which more accurately defines the specific hydrology and hydraulics of the site and the control measure. The design procedures in this document does not generate hydrographs, utilize storage volumes, or provide a routing of the design storms; for a large drainage area, this may result in an excessively large diameter riser or an oversized basin. Design considerations which are more accurate and project-specific than those in this specification are acceptable and encouraged with any size basin.

3. **Basin Capacity:** The design storage capacity of the basin must be at least 134 cubic yards per acre of contributing drainage area. One half of the total design volume shall be in the form of a permanent pool and the remaining half as drawdown volume. The permanent pool shall be from the low point of the basin to the elevation corresponding to one half the total storage volume. The drawdown area shall be from the elevation of the permanent pool to the crest of the principal spillway or riser pipe. Sediment should be removed from the basin when the volume of the permanent pool has been reduced by one-half. In no case shall the sediment clean out level be higher than one foot below the bottom of the dewatering device. The elevation of the sediment clean out level should be calculated and clearly marked on the plans and riser. The location of this mark on the riser normally will be under water, therefore a mark should also appear above the permanent pool a measured distance above the clean out elevation.

   While attempting to attain the desired storage capacities, efforts should be made to keep embankment heights to a minimum. This precaution takes on added significance when the basin will only serve as a temporary structure or will need substantial retrofitting prior to functioning as a permanent structure. When site topography permits, the designer should give strong consideration to the use of excavation to obtain the required capacity and to possibly reduce the height of the embankment. This excavation can be performed in a manner which creates a wet storage area or which increases the storage capacity over the entire length of the basin.

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

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

      where,
      V_1 = the wet storage volume in cubic feet
      A_1 = the surface area of the flooded area at the invert of the dewatering outlet in square feet
      D_1 = the maximum depth, measured from the low point in the basin to the invert of the dewatering outlet in feet

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

$$V_2 = \frac{A_1 + A_2}{2} \times D_2$$

where,

V_2 = the dry storage volume in cubic feet

A_1 = the surface area of the flooded area at the invert of the dewatering outlet in square feet

A_2 = the surface area of the flooded area at the crest of the principal spillway in square feet

D_2 = the depth measured from the invert of the dewatering outlet to the crest of the principal spillway in feet

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

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

4. **Basin Shape:** To improve sediment trapping efficiency of the basin, the effective flow length should be twice the effective flow width. This basin shape may be attained by properly selecting the site of the basin or by using excavation or baffles.

   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:

   $$\text{Length-to-Width Ratio} = \frac{L}{We}$$

   where,

   We = 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 which carries more than 30 percent of the peak rate of inflow must meet these criteria.

   b. Baffles increase the flow length by deflecting the flow. The baffles should be placed halfway between the inflow point and the outflow. Figure 5108-1 shows the detail for baffle construction and three situations where baffles might be used.

5. **Embankment Cross Section:** For embankments of less than 10 feet, the embankment must have a minimum top width of 6 feet, and the side slopes must be 2H:1V or flatter. In the case of an embankment 10 to 14 feet in height, the minimum top width shall be 8 feet and the side slopes shall be 2.5H:1V or flatter.

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6. **Spillway Design:** The outlets for the basin shall consist of a principal and an emergency spillway. These outlets must pass the peak runoff expected for a 25-year storm. If a separate emergency spillway is not feasible due to site conditions or basin geometry, the principal spillway must pass the entire peak runoff expected from the 25-year storm. An attempt to provide a separate emergency spillway should always be made. Runoff computations shall be based upon bare soil conditions. The flow through the dewatering orifice cannot be utilized when calculating the 25-year storm elevation because of its potential to become clogged; therefore, available spillway storage must begin at the principal spillway riser crest.

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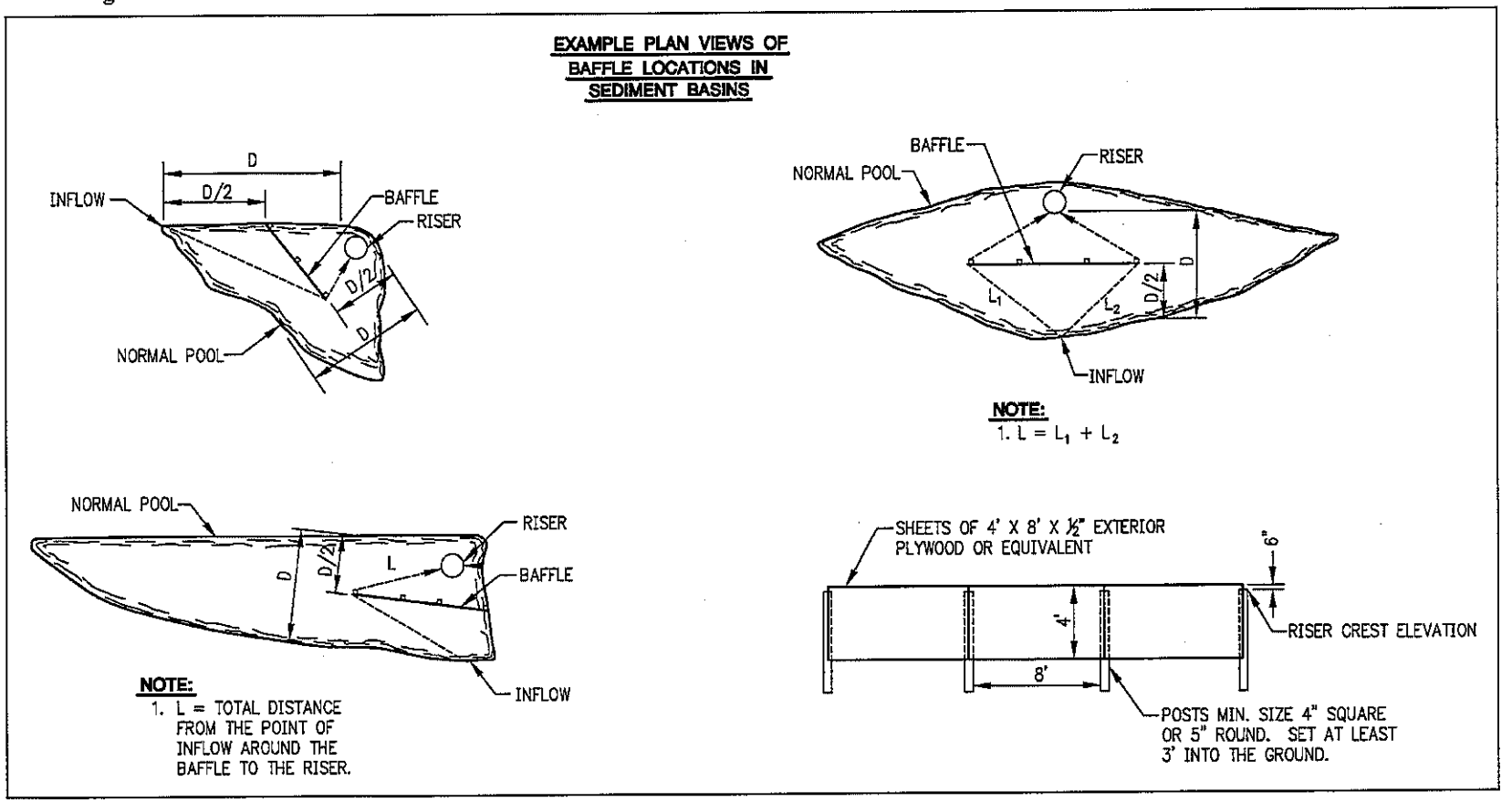
Figure 5108-1: Plan Views of Baffle



Source: VA. DCR, 1992

E. **Principal Spillway:** For maximum effectiveness, the principal spillway should consist of a vertical pipe or box of corrugated metal or reinforced concrete with a minimum diameter of 15 inches, joined by a watertight connection to a horizontal outlet pipe, or barrel extending through the embankment and outletting beyond the downstream toe of the fill.

1. **Principal Spillway Design:**

   a. If an emergency spillway is included, the principal spillway must at least pass the peak rate of runoff from the basin drainage area for a 2-year, 24-hour storm.

      Q_p = the 2-year peak rate of runoff

   b. If an emergency spillway is not included, the principal spillway must pass the peak rate of runoff from the basin drainage area for a 25-year storm.

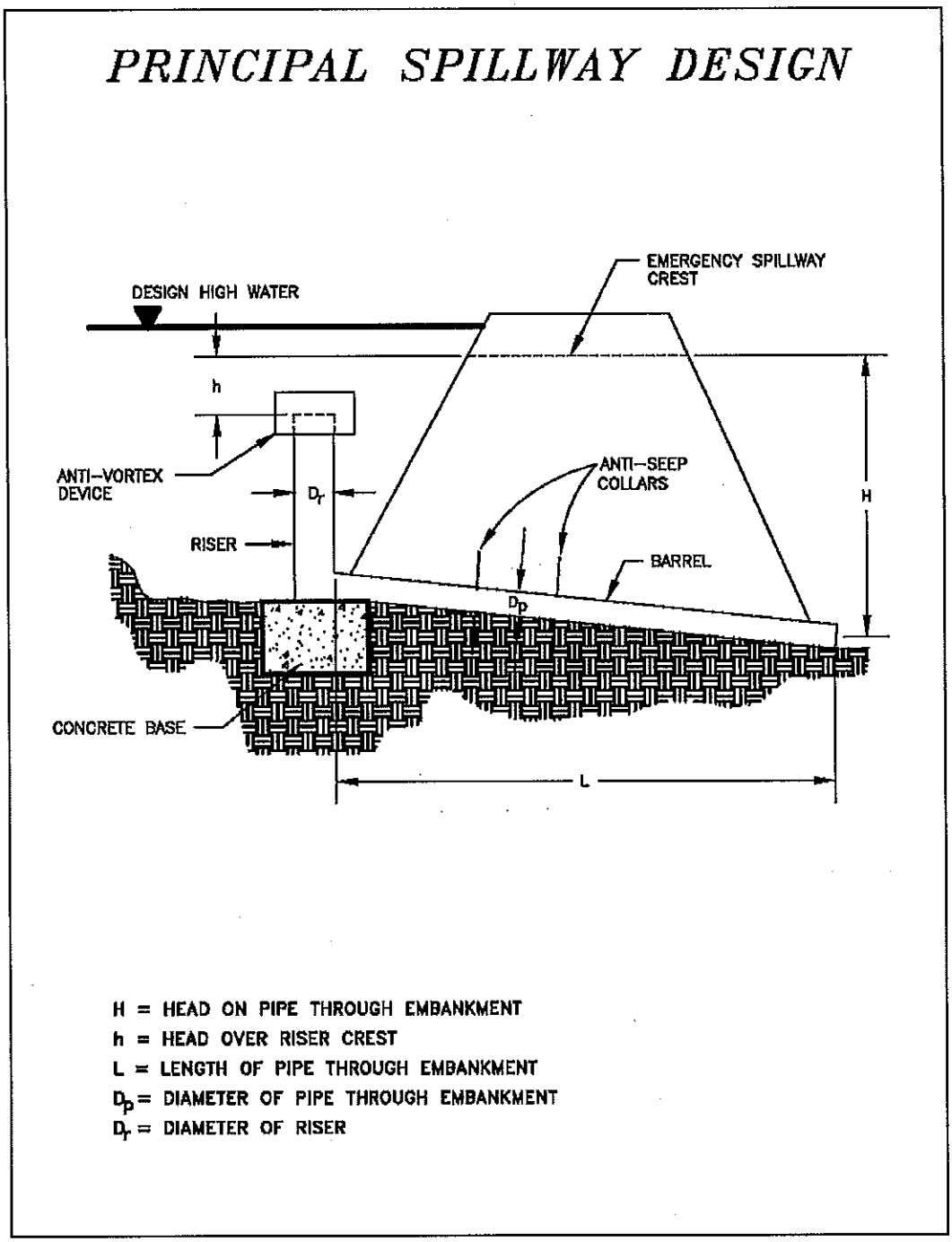
      Therefore, Q_p = the 25-year peak rate of runoff

   c. Refer to Figure 5108-2, where h is the difference between the elevation of the crest of the principal spillway and the elevation of the crest of the emergency spillway.

   d. Determine the riser diameter from the Riser Inflow Curves chart in Section 5600. Choose the smallest riser which will pass the required flow with the available head, h.

   e. Refer to Figure 5108-2 where H is the difference in elevation of the centerline of the outlet of the barrel and the crest of the emergency spillway. L is the length of the barrel through the embankment.

Figure 5108-2: Principal Spillway Design



Source: VA. DCR, 1992

f. Determine the barrel size by using the Pipe Flow Charts in Section 5600. Choose the smallest size barrel which will pass the flow provided by the riser. If L is other than 70 feet, make the necessary correction.

2. **Design Elevations:** The crest of the principal spillway shall be set at the elevation corresponding to the total storage volume required. If the principal spillway is used in conjunction with an emergency spillway, this elevation shall be at least 1.0 foot below the crest of the emergency spillway. A minimum freeboard of 1.0 foot shall be provided between the design high water and the top of the embankment. See Figure 5108-3. If no emergency spillway is used, the crest of the principal spillway shall be at least 3 feet below the top of the embankment; a minimum freeboard of 2.0 feet shall be provided between the design high water and the top of the embankment.

3. **Anti-Vortex Device and Trash Rack:** An anti-vortex device and trash rack shall be attached to the top of the principal spillway to improve the flow characteristics of water into the spillway and prevent floating debris from blocking the principal spillway. The anti-vortex device shall be of the concentric type as shown in Figure 5108-4.

   a. This design procedures for the anti-vortex device and trash rack refer 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 that are part of project-specific design and will frequently be a part of permanent structure.

   b. Refer to Figure 5108-4 and Table 5108-5. Choose cylinder size, support bars, and top requirements from Table 5108-5 based on the diameter of the riser pipe.

4. **Dewatering:** Provisions shall be made to dewater the basin down to the permanent pool elevation. It is necessary to provide a drawdown time of at least 6 hours in the dry storage area in order to achieve up to 60 percent removal of sediment.

   Dewatering of the dry storage should be done in a manner which removes cleaner water without removing the sediment-laden water found in the wet storage area or any appreciable quantities of floating debris. A skimmer device could be used or another drawdown device as a section of perforated vertical tubing, which is connected to the principal spillway at two locations. See Figure 5108-5 which depicts the orientation of such a device. By virtue of the potential for the dewatering device or orifice to become clogged.

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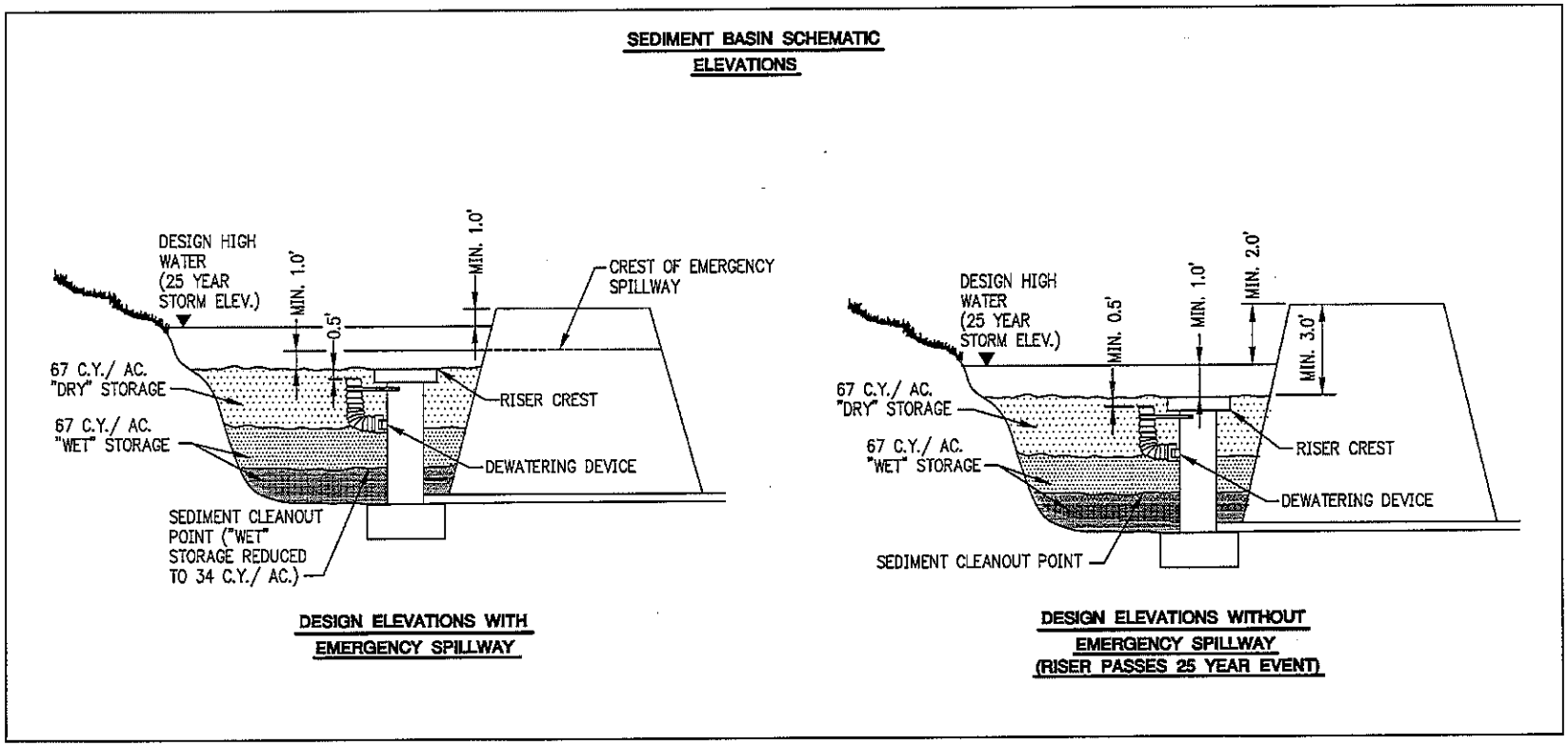
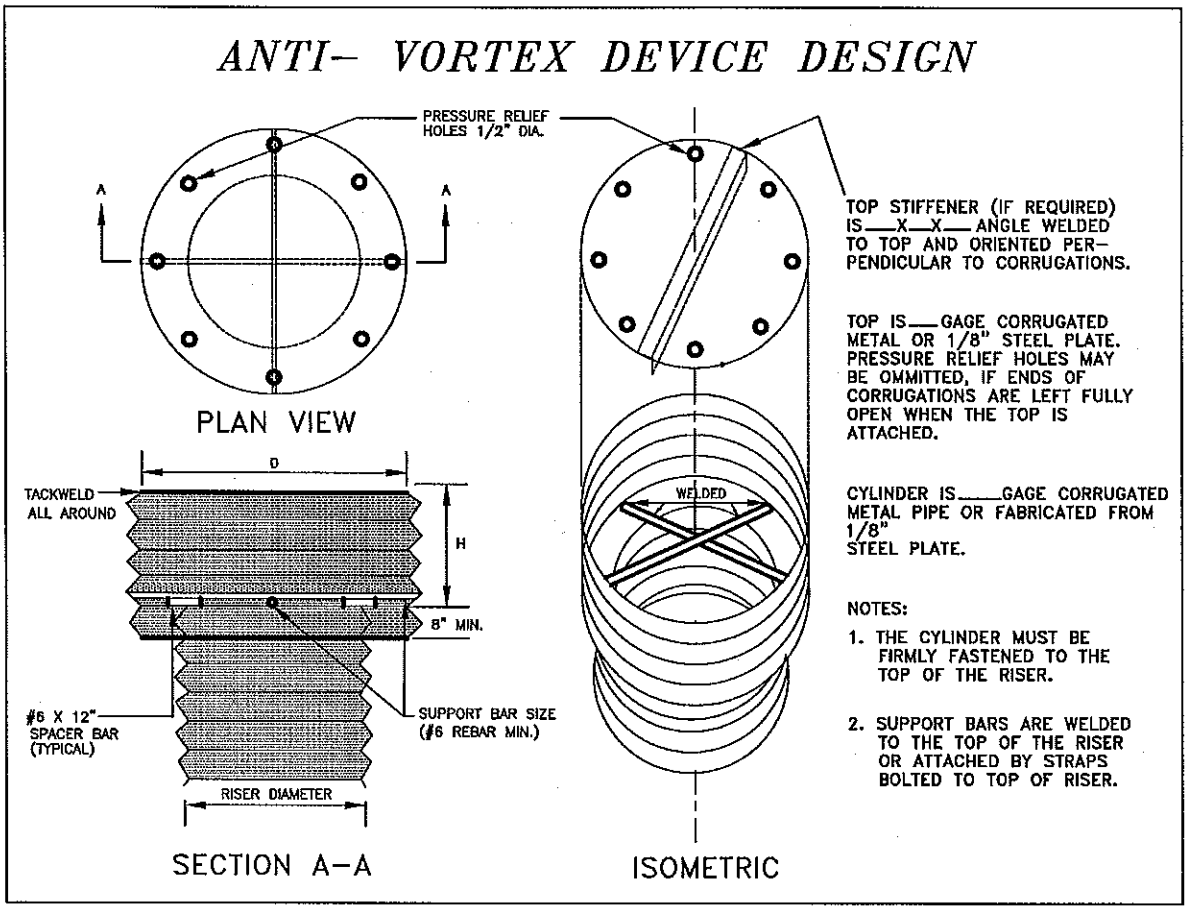
Figure 5108-3: Sediment Basin Elevations



Source: VA. DCR, 1992

Figure 5108-4: Anti-Vortex Device



Source: VA. DCR, 1992

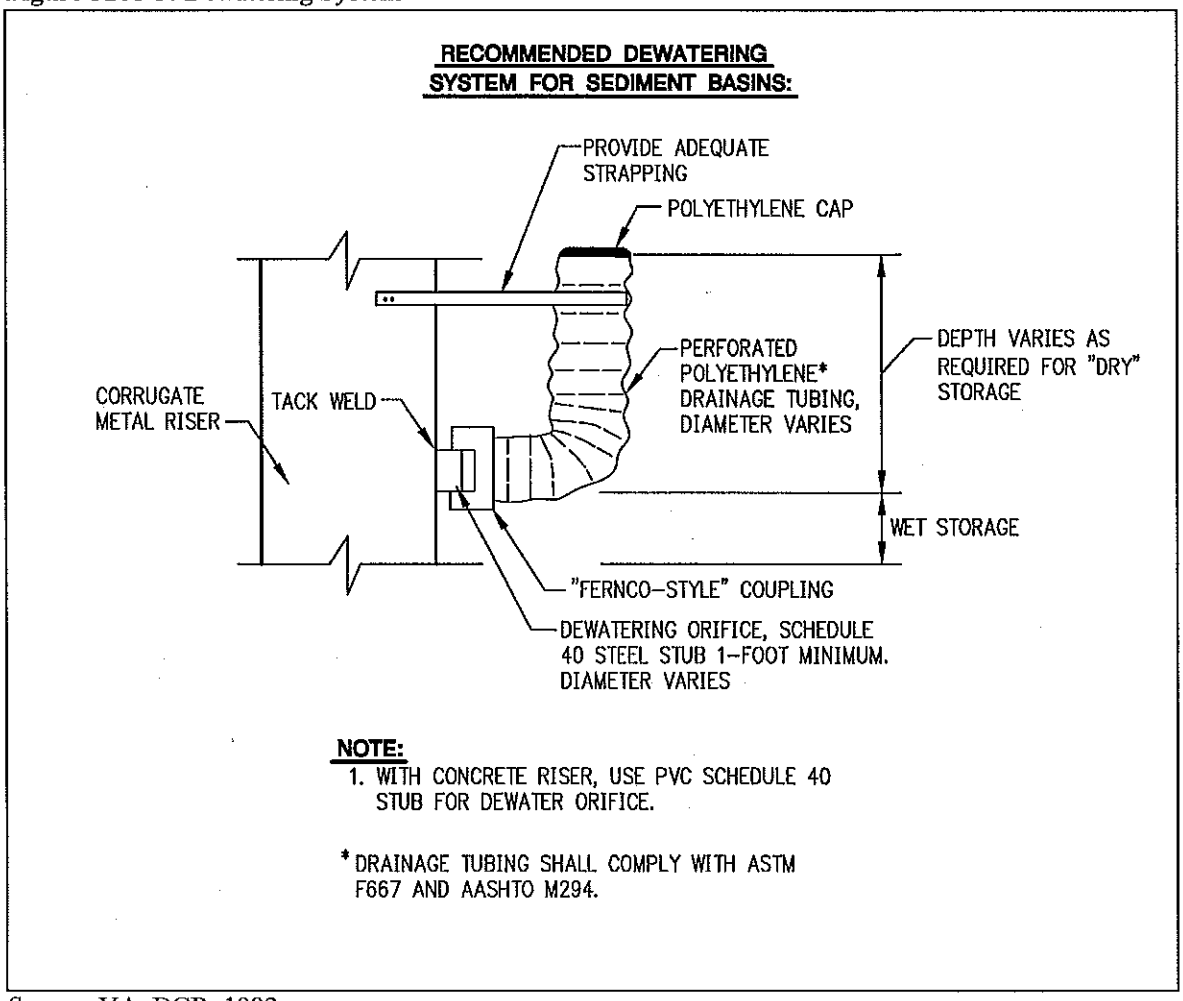
Table 5108-5: CONCENTRIC TRASH RACK AND ANTI-VORTEX DEVICE DESIGN

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 1/2 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	15	" "	" "	--
36	54	14	17	#8 Rebar	14 ga. (C), 12 ga. (F)	--
42	60	16	19	" "	" "	--
48	72	16	21	1 ¼" pipe or 1 ¼ x 1 ¼ 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 ¼ angle	12 ga. (C), 8 ga. (F)	2 x 2 x 1/4 angle
72	102	14	36	" "	" "	2 ½ x 2 ½ x 1/4 angle
78	114	14	39	2 ½" pipe or 2 x 2 x ¼ angle	" "	" "
84	120	12	42	2 ½" pipe or 2 x 2 x ¼ angle	" "	2 ½ x 2 ½ x 5/16 angle

Note 1: 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.
Note 2: Corrugation for 12"-36" pipe measures 2 2/3" x ½"; for 42"-84" the corrugation measures 5" x 1" or 8" x 1".
Note 3: C = corrugated; F = flat

Source: VA. DCR, 1992

Figure 5108-5: Dewatering System



Source: VA. DCR, 1992

To calculate 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 principal spillway divided by 2), in feet
Q = volumetric flowrate through orifice needed to achieve approximate 6-hour drawdown, in cubic feet per second
S = dry storage volume, in cubic feet

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

$$A = \frac{Q}{\left(64.32 \times \frac{h}{2}\right)^{\frac{1}{2}}(0.6)}$$

Then, substitute in calculated A and find d:

$$d^* = 2 \times \left(\frac{A}{3.14}\right)^{\frac{1}{2}}$$

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

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

5. **Base:** The base of the principal spillway must be firmly anchored to prevent its floating. If the riser of the spillway is greater than 10 feet in height, anchoring requirements must be determined. A minimum factor of safety of 1.25 shall be used (downward forces = 1.25 x upward forces).

   For risers 10 feet or less in height, the anchoring may be done in one of the two following ways:

   a. A concrete base 18 inches thick and twice the width of riser diameter shall be used and the riser embedded 6 inches into the concrete.

   b. A square steel plate a minimum of ¼-inch thick and having a width equal to twice the diameter of the riser shall be used; it shall be covered with 2.5 feet of stone, gravel, or compacted soil to prevent flotation.

6. **Principal Spillway:** The principal spillway must be firmly anchored to prevent its floating.

   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).

7. **Barrel:** The barrel of the principal spillway extending 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 barrel must be watertight. The outlet of the barrel must be protected to prevent erosion and scour of downstream area.

8. **Anti-Seep Collars:**

   a. Anti-seep collars shall be used on the barrel of the principal spillway within the normal saturation zone of the embankment to increase the seepage length by at least 10 percent if either of the following conditions is met:

      1) The settled height of the embankment exceeds 10 feet.

      2) The embankment has a low silt-clay content and the barrel is greater than 10 inches in diameter.

   b. The anti-seep collars shall be installed within the saturated zone. The maximum spacing between collars shall be 14 times the projection of the collars above the barrel. Collars shall not be closer than 2 feet to a pipe joint. Collars should be spaced to allow space for hauling and compacting equipment. Precautions should be taken to ensure that 95 percent compaction is achieved around the collars. Connections between the collars and the barrel shall be watertight. Details for two types of anti-seep collars is located on Detail ESC-34, Anti-Seep Collar, in Division III of this manual.

   c. Anti-seep collars are used to increase the seepage length along the barrel by 10 percent.

   d. Determine the length of the barrel within the saturated zone to determine how many collars to use. This may be done by solving the following equation:

$$Ls = Y(Z+4)\left(1+\frac{S}{0.25-S}\right)$$

   where,

   L_s = length of barrel in the saturated zone, feet
   Y = the depth of water at the principal spillway crest, feet
   Z = slope of the upstream face of embankment in Z feet horizontal to one vertical
   S = slope of the barrel in feet per foot

9. **Alternatives to Anti-Seep Collars:** Anti-seep collars are designed to control seepage along the barrel by increasing the effective flow length and thus making any flow along the barrel effectively travel a longer distance. However, due to the constraints that collars impose on embankment fill placement and compaction, collars may sometimes be ineffective or actually result in an increase in seepage.

   Alternative measures have been developed and are being incorporated into embankment designs. These measures include construction of a filter

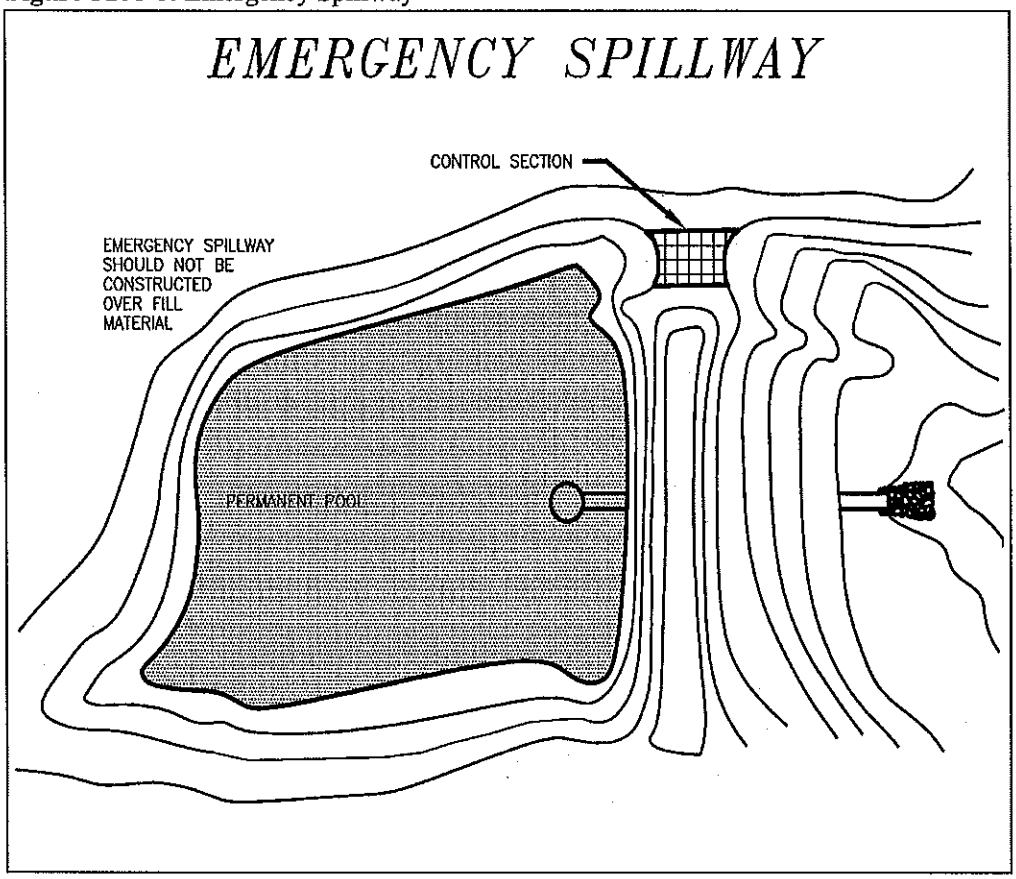
diaphragm. A filter diaphragm consists of a layer of sand and fine gravel which runs through the embankment perpendicular to the barrel. Typically, the layer is 4 to 5 inches in width, approximately one foot in height, and located at the barrel elevation at its intersection with the upper bounds of the seepage zone. It controls the transport of embankment fines, which is the major concern with piping and seepage. Any undesirable flow is channelized through the fine-graded material, and any embankment material being transported is trapped. The flow is then conveyed out of the embankment through a perforated toe drain.

The critical design element of the filter diaphragm is the grain-size distribution of the filter material which is determined by the grain-size distribution of the embankment fill material. The use and design of these measures should be based on site-specific geotechnical information and should be supervised by a qualified professional.

F. **Emergency Spillway:** The emergency spillway acts as a safety release for a sediment basin, or any impoundment-type structure, by conveying the larger, less frequent storms through the basin without damage to the embankment. It acts in case of an emergency such as excessive sedimentation or damage to the riser which prevents flow through the principal spillway. The emergency spillway shall consist of an open channel constructed adjacent to the embankment over undisturbed material, not fill. Where conditions will not allow the construction of an emergency spillway on undisturbed material, a spillway may be constructed of a non-erodible material such as riprap. The spillway shall have a control section at least 20 feet in length. The control section should be a level portion of the spillway channel at the highest elevation in the channel. See Figure 5108-6 for a typical design.

An evaluation of site and downstream conditions must be made to determine the feasibility of and justification for the incorporation of an emergency spillway. In some cases the site topography does not allow a spillway to be constructed in undisturbed material, and the temporary nature of the facility may not warrant the cost of disturbing more acreage to construct and armor an emergency spillway. The principal spillway should then be sized to convey all design storms. If the facility is designed as a permanent facility with downstream restrictions, the added expense of constructing and armoring an emergency spillway may be justified.

Figure 5108-6: Emergency Spillway



Source: VA. DCR, 1992

1. **Emergency Spillway Design**

   a. The emergency spillway must pass the remainder of the 25-year peak rate of runoff not carried by the principal spillway.

   b. Compute flow the emergency spillway is required to pass:
   $Q_e = Q_{25} - Q_p$

   c. Refer to Figure 5108-7 and Section 5600 to determine correct width of emergency spillway.

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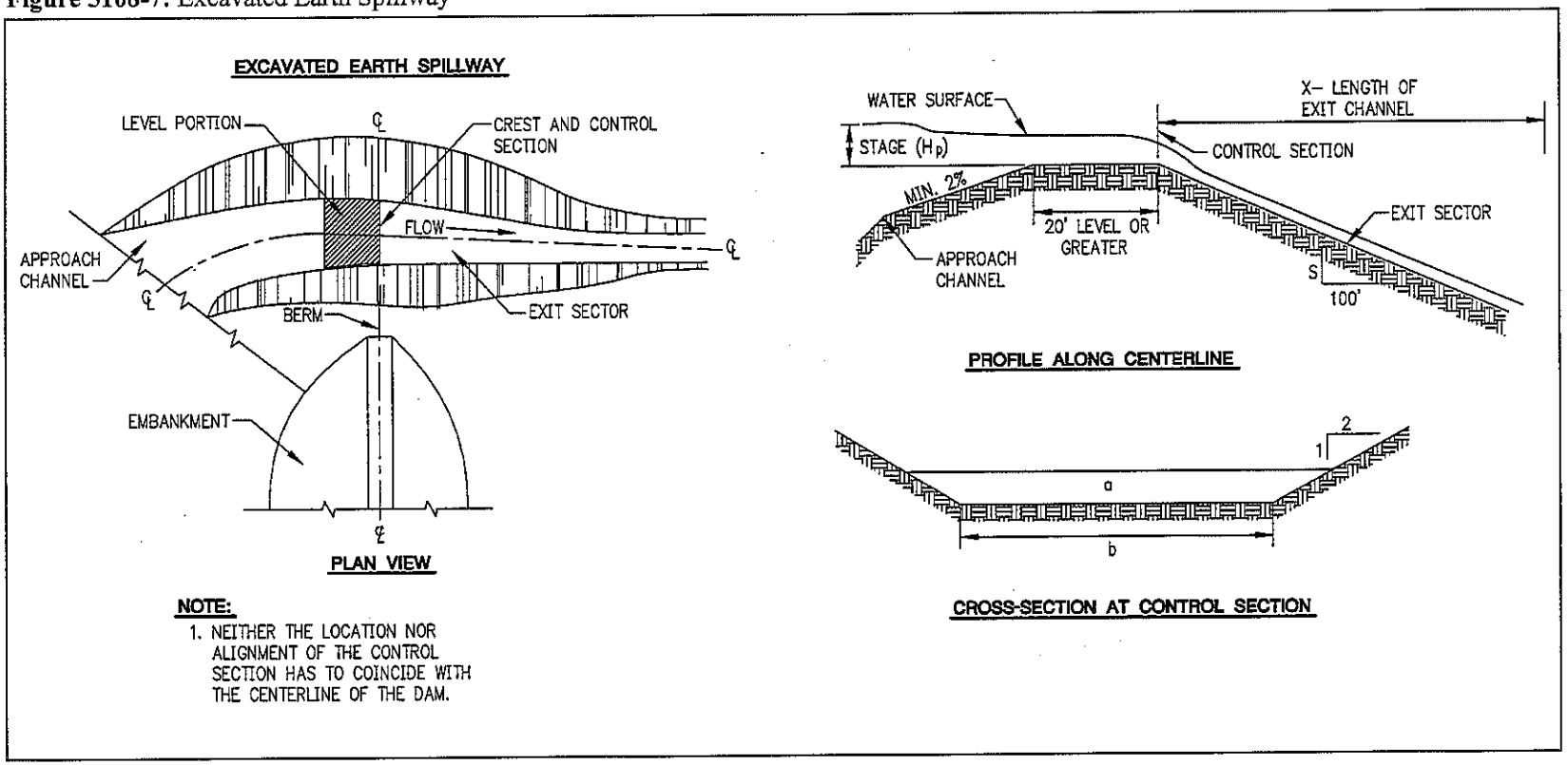
Figure 5108-7: Excavated Earth Spillway



Source: VA. DCR, 1992

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Table 5108-6: 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
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	3.8	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
	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	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	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	2	023	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	4
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	45	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	61	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	49	49	49	49	49	49	49
1.0	Q	20	24	29	33	38	42	47	51	56	61	63	68	72	77	81	86	90
	V	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	S	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	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
	Q																	

Source: USDA-SCS

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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. Choose an exit channel cross section which passes the required flow and meets the other constraints of the site.

f. The maximum permissible velocity for vegetated waterways must be considered when designing an exit channel.

g. For a given 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 design procedures should be used to verify the adequacy of the exit channel.

h. 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.

2. **Capacity:** The emergency spillway shall be designed to carry the portion of the peak rate of runoff expected from a 25-year storm that is not carried by the principal spillway.

3. **Design Elevations:** The 25-year storm elevation through the emergency spillway shall be at least 1.0 foot below the top of the embankment. The crest of the emergency spillway channel shall be at least 1.0 foot above the crest of the principal spillway.

4. **Location:** The emergency spillway channel shall be located so that it will not be constructed over fill material. The channel shall be located so as to avoid sharp turns or bends. The channel shall return the flow of water to a defined channel downstream from the embankment.

5. **Maximum Velocities:** The maximum allowable velocity in the emergency spillway channel will depend upon the type of lining used in the channel. For vegetated channels, allowable velocities are listed on Detail ESC-07 with the use of a turf reinforcement mat at up to 20 feet per second. for short periods of time. For non-erodible linings, such as concrete or riprap, design velocities may be increased. However, the emergency spillway channel shall return the flow to the receiving channel at a non-eroding velocity.

6. **Stabilization:** The embankment of the sediment basin shall receive temporary or permanent seeding immediately after installation as specified in Section 2151.1. If excavation is required in the basin, side slopes should not be steeper than 1.5H:1V.

7. **Disposal:** Sediment shall be removed from the basin when the sediment level is no higher than 1 foot below the bottom of the dewatering orifice or one half of the permanent pool volume, whichever is lower. Plans for the sediment basin shall indicate methods for disposing of sediment removed from the basin. Possible alternatives are the use of the material in fill areas on site or removal to an approved off-site location.

   Sediment basin plans shall indicate demolition of the sediment basin after the upstream drainage area is stabilized. The plans shall include methods for the removal of excess water lying over the sediment, stabilization of the basin site, and the disposal of any excess material. Where the sediment basin has been designed as a permanent stormwater management basin, plans should address the steps necessary for the conversion from sediment basin to a permanent detention or retention facility.

8. **Safety:** Sediment basins can be attractive to children and can be dangerous. They should therefore be fenced or otherwise made inaccessible to persons or animals unless this is deemed unnecessary by the plan-approving authority due to the remoteness of the site or other circumstances. Strategically placed signs around the impoundment reading "Danger-Quicksand" should also be installed. In any case, local ordinances and regulations regarding health and safety must be adhered to.

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

(with or without emergency spillway)

Project _____

Basin # _____ Location _____

Total area draining to basin: _____ acres.

Basin Volume Design

Wet Storage:

1. Minimum required volume = 67 cu. yds. X Total Drainage Area (acres).

   67 cu. yds/acre x _____ acres = _____ cu. yds.

2. Available basin volume = _____ cu. yds. at elevation _____. (From storage – elevation curve).

3. Excavate _____ cu. yds. to obtain required volume*.

   *Elevation corresponding to required volume = invert of the dewatering orifice.

4. Available volume before cleanout required:

   33 cu. yds/acre x _____ acres = _____ cu. yds.

5. Elevation corresponding to cleanout level = _____. (From Storage – Elevation Curve).

6. Distance from invert of the dewatering orifice to cleanout level = _____ ft. (Min. = 1.0 ft.)

Dry Storage:

7. Minimum required volume = 67 cu. yds. x Total Drainage Area in acres.

   67 cu. yds. X _____ acres = _____ cu. yds.

8. Total available basin volume at crest of riser* = _____ cu. yds. at elevation _____. (From Storage – Elevation Curve).

   *Minimum = 134 cu. yds./acre of total drainage area.

9. Diameter of dewatering orifice = _____ in.

10. Diameter of flexible tubing = _____ inc. (diameter of dewatering orifice plus 2 inches).

Preliminary Design Elevations:

11. Crest of Riser = _____

    Top of Dam = _____

    Design High Water = _____

    Upstream Toe of Dam = _____

Basin Shape:

12. $\frac{\text{Length of Flow}}{\text{Effective Width}}$ $\frac{L}{W_e}$ = _____

    If > 2, baffles are not required _____

    If < 2, baffles are required _____

Runoff:

13. Q_2 = _____ cfs

14. Q_{25} = _____ cfs

Principal Spillway Design:

15. With emergency spillway, required spillway capacity $Q_p = Q_2$ = _____ cfs.
    (riser and barrel)

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

16. With emergency spillway:

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

h = Crest of Emergency Spillway Elevation – Crest of Riser Elevation

Without Emergency spillway:

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

H = Design High Water Elevation – Crest of Riser Elevation

17. Riser diameter, D_r = _____ in. Actual head, h = _____ ft.

    Note: Avoid orifice flow conditions

18. Barrel length, l = _____ ft.

    Head, H, on barrel through embankment = _____ ft.

19. Barrel diameter = _____ in.

20. Trash rack and anti-vortex device

    Diameter = _____ inches.

    Height = _____ inches.

Emergency Spillway Design:

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

22. Bottom width, b = _____ ft.; the slope of the exit channel, s = _____ foot/ foot; and the minimum length of the exit channel, x = _____ ft.

Anti-Seep Collar Design:

23. Depth of water at principal spillway crest, Y = _____ ft.

    Slope of upstream face of embankment, Z = _____ : 1

    Slope of principal spillway barrel, S_b = _____ %

    Length of barrel in saturated zone, L_s = _____ ft.

24. Number of collars required = _____ dimensions = _____

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Final Design Elevations:

25. Top of Dam = _____

    Design High Water = _____

    Emergency Spillway Crest = _____

    Principal Spillway Crest = _____

    Dewatering Orifice Invert = _____

    Cleanout Elevation = _____

    Elevation of Upstream Toe of Dam or Excavated Bottom of "Wet Storage Area" (if excavation was performed) = _____

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5108.13 TEMPORARY SLOPE DRAIN

A. **Description:** A temporary slope drain is a flexible tube or conduit extending from the top to the bottom of a cut or fill slope. A detail is located on Detail ESC-32, Temporary Slope Drain in Division III of this manual.

B. **Application:** It temporarily conducts concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion on or below the slope.

C. **Planning Considerations:**

1. There is often a significant lag between the time a cut or fill slope is completed and the time a permanent drainage system is installed. During this period, the slope is usually not stabilized and is particularly vulnerable to erosion. This situation also occurs during slope construction before final grade is reached. Temporary slope drains can provide valuable protection for exposed slopes until permanent drainage structures can be installed or vegetation can be established.

2. Temporary slope drains can be used in conjunction with diversion dikes to convey runoff from the entire drainage area above a slope to the base of the slope without erosion. It is very important that these temporary structures be installed properly since their failure will often result in severe gully erosion on the site and sedimentation below the slope. The entrance section must be securely entrenched; all connections must be watertight; and the conduit must be staked securely.

D. **Design Criteria:**

1. **Drainage Area:** The maximum allowable drainage area per slope drain is 5 acres.

2. **Flexible Conduit:** The slope drain shall consist of heavy-duty, flexible material designed for this purpose. The diameter of the slope drain shall be equal over its entire length. Reinforced hold-down grommets shall be spaced at or less than 10-foot intervals. Slope drains shall be sized as listed in the table below to be adequate for a 10-year, 24-hour storm event with a runoff coefficient of 0.6. If an area has a runoff coefficient of more than 0.6, the designer will have to provide the proper pipe diameter to accommodate the excess flow.

Table 5108-7: Size of Slope Drain

Maximum Drainage Area (acres)	Pipe Diameter (inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

3. **Entrance Sections:**

   a. The entrance to the slope drain shall consist of a standard flared end-section for metal pipe culverts with appropriate inlet protection as set forth in Section 5108.9, Culvert Inlet Protection. If ponding will cause a problem at the entrance and make such protection impractical, appropriate sediment-removing measures shall be taken at the outlet of the pipe. Extension collars shall consist of 12-inch long corrugated metal pipes. Watertight fitting shall be provided.

   b. End-sections made of heavy-duty, flexible material may be utilized if determined by the plan-approving authority to provide a stable inlet or outlet section.

4. **Dike Design:**

   a. An earthen dike shall be used to direct stormwater runoff to the temporary slope drain and shall be constructed as set forth in Section 5108.10, Diversion.

   b. The height of the dike at the centerline of the inlet shall be equal to the diameter of the pipe plus 6 inches. Where the dike height is greater than 18 inches at the inlet, it shall be sloped at the rate of 3H:1V or flatter to connect with the remainder of the dike.

5. **Outlet Protection:** The outlet of the slope drain must be protected from erosion as set forth in Section 5108.16, Outlet Stabilization Structure.

5108.14 TRIANGULAR SILT DIKE™

A. **Description:** Triangular Silt Dike™ is triangular shaped having a height of at least eight to ten inches. The triangular shaped inner material shall be urethane foam. The outer cover shall be a woven geotextile fabric placed around the inner material and allowed to extend beyond both sides of the triangle by two to three feet.

B. **Application:** Triangular Silt Dike™ should be used to contain sediment along the contoured terraces, at the perimeter of a site, or as a ditch check to minimize erosion and contain sediment.

C. **Planning Considerations:** The dike shall be used either as a continuous line barrier just off the toe of slope or right-of-way line to contain sediment or as a ditch check placed perpendicular to the flow of water in a defined drainage ditch to minimize erosion and contain sediment.

D. **Design Criteria:** See Detail ESC-16, Triangular Silt Dike™, in Division III of this manual.

5108.15 GRASS-LINED CHANNELS WITH SOD OR SEED AND TRM

A. **Description:** Grass-lined channels are constructed for the purpose of handling concentrated surface runoff in such a way as to prevent damage from erosion and sedimentation.

B. **Application:** This practice applies to sites where:

1. Concentrated runoff will cause erosion damage;
2. A vegetative lining provides sufficient stability for the channel as designated;
3. Channel grades are less than 5 percent; and
4. Space is available for a relatively large cross section.

Typical uses include roadside ditches, channels at property boundaries, outlets for diversion, and other areas requiring stabilization of concentrated flow.

C. **Planning Considerations:** Prior to the start of construction, grass-lined channels should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process. The channel should be built according to planned alignment, grade, and cross section.

D. **Design Criteria:**

1. **Cross section:** Trapezoidal or parabolic
2. **Side slopes:** 3H:1V or flatter for trapezoidal channels
3. **Channel stabilization:** Use mulch, erosion control blankets, turf reinforcement mats, or other appropriate practices as specified in the design plan.

4. **Outlet:** Channels should empty into sediment traps, detention or retention basins, or stable outlets.

5. **Subsurface Drain:** Use in areas with seasonally high water tables or seepage problems.

A detail for Trapezoidal Grass-Lined Channel is located on Detail ESC-30 in Division III of this manual.

5108.16 OUTLET STABILIZATION STRUCTURE

A. **Description:** This is a structure constructed to control erosion at the outlet of a channel or conduit. A rock outlet is an apron constructed of rock riprap designed to prevent scour at stormwater outlets and to minimize the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

B. **Application:** This practice applies when discharge velocity of a pipe, box culvert, diversion or other water conveyance structure exceeds the permissible velocity of the receiving area.

C. **Planning Considerations:** Prior to the start of construction, the concrete apron should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process. The rock outlet should be built according to plan alignment, grade, cross section and length.

D. **Design Criteria:**

1. **Grading:** There should be a smooth transition between the concrete apron and the receiving channel; the elevation of the rock apron at the downstream end should be at the same elevation as the bottom of the receiving channel.

2. **Alignment:** The alignment of the rock outlet should be straight throughout its length. If a curve is required, it should be located in the upstream section of the outlet.

3. **Riprap:** Riprap should consist of a well-graded mixture of rock. Larger rock should predominate, with sufficient smaller sizes to fill the remaining. The diameter of the largest rock size should be not larger than 1.5 times the d_{50} size.
4. **Riprap Thickness and Length:** Minimum thickness of riprap should be 1.5 times the maximum rock diameter. The length of riprap pad must be designed such that erosion of the receiving material at the outlet is minimal.

5. **Rock Quality:** Select rock for riprap from field stone or quarry stone. The rock should be hard, angular, and highly chemical and weather resistant. The specific gravity of the individual stones should be at least 2.5.

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6. **Filter:** Install or construct a filter between the rock riprap and the subgrade to prevent undermining of the structure due to movement of fine-grained subgrade soil. The filter can consist of either a properly graded sand or gravel layer, a manufactured geotextile fabric, or a combination of both.

7. **Toewalls:** Construct according to the design plan; these may be needed around th full perimeter to prevent maintenance problems.

8. Delivered riprap shall be free of soil and organic material.

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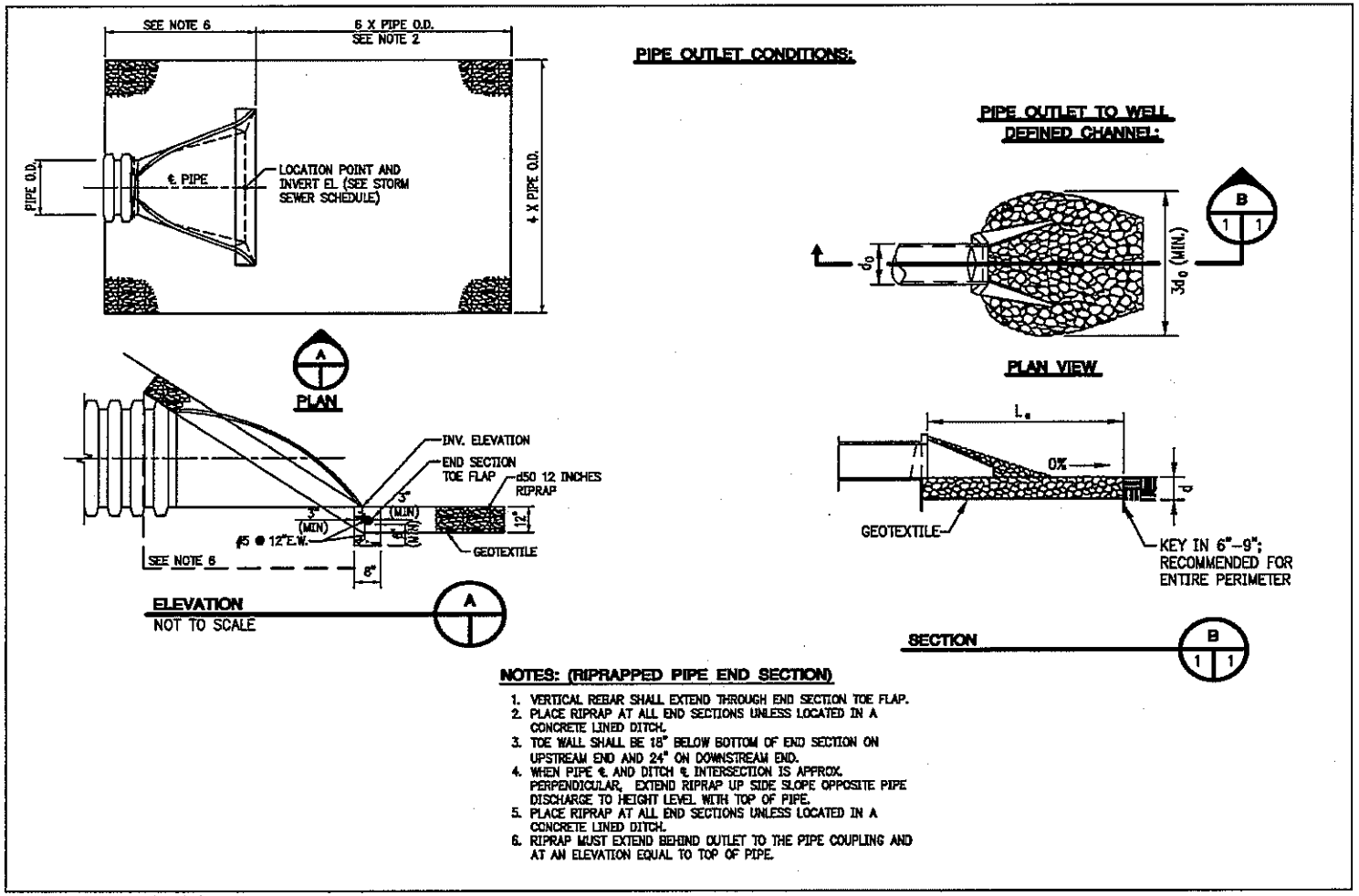
Figure 5108-8: Riprap Detail



Source: Modified from VA. DCR, 1992.

5108.17 INFILTRATION BASIN

A. **Description:** An infiltration basin is a dam designed to detain stormwater, allowing it to slowly infiltrate into the soil. Infiltration basins can be constructed to reduce the peak flow rate from the design storm, recharge groundwater in the vicinity of the basin, filter contaminants, and increase flows during low stream flow conditions. The basins are effective in removing pollutants from stormwater runoff in urban settings. Their usage is best suited to larger, more intensively developed sites.

B. **Application:**Infiltration basins should be considered at sites where the soil is permeable and the groundwater elevation is well below the soil surface. Disadvantages of infiltration basins include standing water, mosquitoes in summer, frequent maintenance, unsuitable soils, and the possibility of transporting soluble pollutants to the groundwater.

C. **Planning Considerations:** Infiltration basins should be designed by a registered design professional. Plans and specifications should be referred to by field personnel throughout the construction process. A detailed soils investigation is required to determine the minimum infiltration rate and soil suitability for this practice. The basin should be built according to planned grades and cross sections.

D. **Design Criteria:**

1. Drainage Area should be up to 15 acres.

2. Detention time should be between 24 and 72 hours.

3. Soils in the Basin: a permeability between 0.5 and 2.4 inches per hour to ensure proper infiltration and adequate treatment of runoff; less than 30% clay content; less than 40% silt content.

4. Principal and Emergency Spillways: Sized to pass the design storm(s).

5. Basin Floor: The basin floor should be as level as possible to spread inflow evenly over the floor of the basin.

6. Vegetation: A good stand must be established on the floor of the normally dry basin.

7. Collector Channels: Channels leading to the basin should be capable of settling out as much coarse grained sediment as possible to keep the floor of the basin from becoming clogged.

8. Sediment Collection: Inflow into the basin should be diverted through a riprap apron or other sediment collection structure to settle out coarse grained sediment.

9. Anti-seep Devices: Either of the following is recommended:

    a. At least two watertight anti-seep collars should be used around the outlet conduit; collars should project 1 to 3 feet from the pipe, or
    b. A sand diaphragm.

10. Embankment Slopes: 2.5H:1V or flatter; 3H:1V where maintained by tractor or other equipment.

11. Basin Slopes: No steeper that 3H:1V.

12. Filter Strip: A minimum width of 25 feet around the basin.

13. Settlement: Allow at least 10% of extra fill.

14. Site Access: Reserved for the passage of heavy equipment and to remove and dispose of sediments.

15. Location: In an area of mild topography in soils with good permeability; at least 25 feet from field drains, septic tanks, and drinking water supplies

5108.18 INFILTRATION TRENCH

A. **Description:** An infiltration trench is a shallow excavated trench that has been backfilled with stone designed to filter pollutants from stormwater runoff and allow runoff to infiltrate back into the groundwater. Infiltration trenches are effective in removing pollutants from stormwater runoff in urban settings. Sediments must be screened before runoff enters the trench to prevent the trench from becoming clogged. Infiltration trenches provide a good source of groundwater recharge in areas with permeable soils and bedrock well below the bottom of the trench. They require careful construction and regular maintenance. Infiltration trenches cut off the flow of subsurface drainage and work well in areas where there is not sufficient land available for infiltration basins.

B. **Application:** Infiltration trenches are normally constructed 3 to 8 feet deep, lined with filter fabric or a sand filter, and backfilled with clean stone or gravel. Grass filter strips or inlets can be designed to filter sediments before entering the trench.

C. **Planning Considerations:** Prior to the start of construction, infiltration trenches should be designed by a registered design professional. Field personnel should refer to plans and specifications throughout the construction process. The infiltration trench should be built according to planned grades and dimensions.

D. **Design Criteria:**

1. Detention time should be between 24 and 72 hours.

2. Trenches should be sized to store either ½ inch of runoff per impervious acre, or the volume of runoff produced by a 1-inch storm over the contributing watershed.

3. Contributing Slopes: 5% or flatter.

4. Soils: Permeable soils with combined silt/clay contents of 40% or less in NRCS hydrologic groups A, B or C.

5. Water Table: Minimum of 2 to 4 feet of clearance from the seasonal high water table to the bottom of the trench.

6. Drainage Area: Less than 5 acres.

7. Collector Channels: Capable of settling out as much coarse-grained sediment as possible to keep the trench from becoming clogged.

A detail for an infiltration trench is located on Detail ESC-31, Infiltration Trench, in Division III.

5108.19 TEMPORARY WATERWAY CROSSING

A. **Description:** A temporary waterway crossing is a small waterway crossing required when in-stream utility construction is involved or when construction vehicles need to cross.

B. **Application:** There are generally applicable to flowing streams with drainage areas less than one square mile. Structures or methodology for crossing streams with larger drainage areas should be designed by methods which more accurately define the actual hydrologic and hydraulic parameters which will affect the functioning of the structure. Crossings serve to help protect sediment from entering the stream from construction within approach areas, minimize the amount of disturbance within the stream itself, and allow vehicle access across the waterway.

1. **UTILITY CROSSINGS**

a. **Planning Considerations:** Utility construction, by virtue of its sprawling, linear nature, frequently crosses and impacts live streams. There is a potential for excessive sediment loss into a stream by both the disturbance of the approach areas and by the work within the streambed and banks.

It is often a difficult task to decide what type of control to use at a utility stream crossing. A method such as the boring and jacking of pipe below a streambed, which would prevent disturbance within the watercourse, is a preferred method if it is practical. However, in cases where in-stream work is unavoidable, consideration must be

given to providing adequate mitigation of sediment loss while minimizing the amount of encroachment and time spent working in the channel. Sometimes there is less damage to the environment by providing substantial controls for the approach areas and refraining from installing extensive measures in the stream itself. However, when the installation of the utility line within streambed and banks will take an extended period of construction time, consideration should be given to substantial in-stream controls or stream diversion in order to prevent excessive erosive damage.

As a result of the difficulty in choosing the right method for a utility stream crossing, designers and plan reviewers should always make site visits to proposed crossing to ensure that the most appropriate method is chosen. The designer and plan reviewer should also be aware that such modifications are subject to State and federal construction permits.

There are several methods for dealing with utility stream crossings which allow for work to be completed under dry conditions to prevent excessive sediment damage. By no means are these methods all-inclusive. As with other control measures, site-specific design and innovative variations are encouraged. See Details ESC-36 and ESC-38 in Division III of this manual for Diversion Channel Crossing, Flume Pipe Crossing, and Cofferdam Crossing.

b. **Design Criteria:**

1) The drainage area should be no greater than one square mile.

2) All geotextile used in the construction of the utility crossing must conform to physical requirements noted in Section 2605, Riprap.

3) Water-diverting structures should be used at all trenching and construction road approaches at points 50 feet on either side of the crossing.

2. **VEHICULAR CROSSINGS**

a. **Planning Considerations:** Temporary stream crossings are necessary to prevent construction vehicles from damaging streambanks and continually tracking sediment and other pollutants into the flow regime. They should be planned to be in service for the shortest practical period of time and to be removed as soon as their function is completed. The designer must also be aware that such structures are subject to the rules and regulations of the U.S. Army Corps of Engineers for in-stream modifications (i.e., the 404 permit).

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A temporary bridge crossing is a structure made of wood, metal, or other material which provides access across a stream or waterway. It is the preferred method for temporary waterway crossings. Normally, bridge construction causes the least amount of disturbance to the stream bed and banks when compared to the other types of crossings. They can also be quickly removed and reused. In addition, temporary bridges pose the least chance for interference with fish migration when compared to the other temporary access waterway crossings. A temporary culvert crossing is a structure consisting of stone and sections of circular pipe, pipe arches, or oval pipes of reinforced concrete, corrugated metal, or structural plate which are used to convey flowing water through the crossings. Temporary culverts are used where the channel is too wide for normal bridge construction or the anticipated loading of construction vehicles may prove unsafe for single span bridges. The stone, along with the temporary culverts, can be salvaged and reused.

b. **Design Criteria:**

1) **Temporary Bridge Crossing**

a) Structures may be designed in various configurations. However, the materials used to construct the bridge must be able to withstand the anticipated loading of the construction traffic.

b) The temporary waterway crossing shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary 15 degrees from a line drawn perpendicular to the center line of the stream at the intended crossing location.

c) The centerline of both roadway approaches shall coincide with the crossing alignment centerline for a minimum distance of 50 feet from each bank of the waterway being crossed. If physical or right-of-way restraints preclude the 50-foot minimum, a shorter distance may be provided. All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing floodplain elevation.

d) A water diverting structure such as a dike or swale shall be constructed across the roadway on both roadway approaches at a maximum distance of 50 feet from the top of either bank of the waterway.

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e) This will prevent roadway surface runoff from directly entering the waterway. Design criteria for this diverting structure shall be in accordance with Temporary Right of Way Diversion or Temporary Diversion Dike. See Detail ESC-29. If the roadway approach is constructed with a reverse grade away from the waterway, a separate diverting structure is not required.

f) Appropriate perimeter controls such as sediment fence or turbidity curtains must be employed when necessary along banks of stream parallel to the same.

g) All crossings shall have one traffic lane. The minimum width shall be 12 feet with a maximum width of 20 feet.

2) **Temporary Culvert Crossing**

a) Where culverts are installed, 3 to 6-inch coarse aggregate or larger will be used to form the crossing. The depth of stone cover over the culvert shall be equal to one-half the diameter of the culvert or 12 inches, whichever is greater.

b) If the structure will remain in place for up to 14 days, the culvert shall be large enough to convey the flow from a 2-year storm without appreciably altering the stream flow characteristics. If the structure will remain in place 14 days to 1 year, the culvert shall be large enough to convey the flow from a 10-year storm. In this case, the hydrologic calculation and subsequent culvert size must be determined for the specific watershed characteristics. If the crossing must remain in place over 1 year, it must be designed as a permanent structure by a qualified professional.

c) Multiple culverts may be used in place of one large culvert if they have equivalent capacity. The minimum-sized culvert that may be used is 18 inches.

d) All culverts shall be strong enough to support their cross sectioned area under maximum expected loads.

e) The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes.

f) The slope of the culvert shall be at least 0.25 inch per foot.

g) The temporary waterway crossing shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary 15 degrees from a line drawn perpendicular to the centerline of the stream at the intended crossing location.

h) The centerline of both roadway approaches shall coincide with the crossing centerline alignment for a minimum of 50 feet from each bank of the waterway. If physical or right-of-way restraints preclude the 50-foot minimum, a shorter distance may be provided. All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing floodplain elevation.

i) The approaches to the structure shall consist of pads constructed of 3 to 6-inch stone that are a minimum of 6 inches thick and at least as wide as the structure:

j) A water diverting structure such as a swale shall be constructed across the roadway on both roadway approaches a maximum of 50 feet on either side of the top of the waterway bank. This will prevent roadway surface runoff from directly entering the waterway. Design criteria for this diverting structure shall be in accordance with Section 5108.10, Diversions. If the roadway approach is constructed with a reverse grade away from the waterway, a separate diverting structure is not required.

5108.20 DEWATERING

A. **Description:** Dewatering is a method by which water is discharged from construction activities.

B. **Application:** Dewatering treats sediment-laden water prior to the water being discharged off-site when sediment-laden water must be removed from a construction site by means of pumping.

C. **Planning Considerations:** Water pumped from a construction site usually contains a large amount of sediment. A dewatering structure is designed to remove the sediment before water is released off-site.

This practice includes several types of dewatering structures having different applications depending upon site conditions and types of operation. Other innovative techniques for accomplishing the same purpose are encouraged, but only after specific plans and details are submitted to and approved by the plan-approving authority.

A dewatering structure may not be needed if there is a well-stabilized, vegetated area on site to which water may be discharged. The area must be stabilized so that it can treat sediment and at the same time withstand the velocity of the discharged water without eroding. A minimum length of 75 feet of stabilized vegetation must be available in order for such a method to be feasible.

D. **Design Criteria:**

1. A dewatering structure must be sized and operated to allow pumped water to flow through the treatment device without overtopping the structure.

2. Material from any required excavation shall be stored in an area and protected in a manner that will prevent sediments from moving off site.

3. An excavated basin may be lined with geotextile fabric to help reduce scour and to prevent the inclusion of soil from within the structure.

4. Design criteria more specific to each particular dewatering device can be found on Details ESC-41 through ESC-43 in Division III of this manual.

5108.21 TURBIDITY CURTAIN

A. **Description:** A turbidity curtain is a floating geotextile material which minimizes sediment transport from a disturbed area adjacent to or within a body of water. It provides sediment protection for a watercourse from up-slope land disturbance or from dredging or filling within the watercourse.

B. **Application:** It is applicable to watercourses where intrusion by construction activities and subsequent sediment movement is unavoidable.

C. **Planning Considerations:** Soil loss into a watercourse results in long-term suspension of sediment. In time, the suspended sediment may travel long distances and affect wide-spread areas. A turbidity curtain is designed to deflect and contain sediment within a limited area and provide enough residence time so that soil particles will fall out of suspension and not travel to other areas.

Turbidity curtain types must be selected based on the flow conditions within the water body, whether it be a flowing channel, lake, or pond. The specifications contained within this practice pertain to minimal and moderate flow conditions where the velocity of flow may reach 5 feet per second or a current may reach

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approximately 3 knots. For situations where there are greater flow velocities or currents, a qualified engineer and product manufacturer should be consulted.

Consideration must also be given to the direction of water movement in channel flow situations. Turbidity curtains are not designed to act as water impoundment dams and cannot be expected to stop the flow of a significant volume of water. They are designed and installed to trap sediment, not to halt the movement of the water itself. In most situations turbidity curtains should not be installed across channel flows.

In moving water, provisions must be made to allow the volume of water contained within the curtain to change. In addition to allowing for slack in the curtain to increase and decrease, water must be allowed to flow through the curtain if the curtain is to remain in roughly the same spot and maintain the same shape. Normally this is achieved by constructing part of the curtain from a heavy woven filter fabric. The fabric allows the water to pass through the curtain but retains the sediment pollutants. Consideration should be given to the volume of water that must pass through the fabric and sediment particle size when specifying fabric permeability.

Sediment which has been deflected and settled out by the curtain may be removed if so directed by the on-site inspector or the plan-approving authority. However, consideration must be given to whether this will create more of a sediment problem by resuspending particles or accidental dumping of material by the equipment involved. It is recommended that the soil particles trapped by a turbidity curtain only be removed if there has been a significant change in the original contours of the affected area of the watercourse. Regardless of the decision made, soil particles should always be allowed to settle for a minimum of 6-12 hours prior to their removal by equipment or prior to removal of a turbidity curtain.

It is imperative that the other sediment controls be used to keep sediment out of the watercourse in every erosion control plan. However, when proximity to the watercourse makes successfully mitigating sediment loss impossible, the use of the turbidity curtain during land disturbance is essential.

D. **Design Criteria:**

1. Type I configuration should be used in protected areas where there is no current and the area is sheltered from wind and waves.

2. Type II configuration should be used in areas where there may be a flow of up to 2 knots or 3.5 feet per second or where wind and wave action may affect the curtain.

3. Type III configuration should be used in areas where a current up to 3 knots or 5 feet per second may be present or where the curtain is potentially subject to wind and wave action.

4. Turbidity curtains should extend the entire depth of the watercourse whenever the watercourse is not subject to significant wind and wave forces.

5. In wind and wave action situations, the curtain should never be so long as to touch the bottom. A minimum 1-foot gap should exist between the weighted lower end of the skirt and the bottom of the channel. Movement of the lower skirt over the bottom due to wind and wave action on the flotation system may fan and stir sediment already settled out.

6. In wind and wave action situations, it is seldom practical to extend a turbidity curtain depth lower than 10 to 12 feet below the surface, even in deep water. Curtains which are installed deeper than this will be subject to very large loads with a consequent strain on curtain materials and the mooring system. In addition, a curtain installed in such a manner can billow up towards the surface under the pressure of the moving water which will result in an effective depth which is significantly less than the skirt depth.
7. Turbidity curtains should be located perpendicular to the direction of flow of a moving body of water. Turbidity curtains should not be placed across the main flow of a significant body of moving water.

8. When sizing the length of the floating curtain, allow an additional 10-20% variance in the straight line measurements. This will allow for measuring errors, make installing easier and reduce stress from potential wave action during high winds.

9. An attempt should be made to avoid an excessive amount of joints in the curtain; keep a minimum continuous span of 50 feet between joints.

10. For stability reasons, keep a maximum span of 100 feet between joints or anchor or stake locations.

11. The ends of the curtain, both floating upper and weighted lower, should extend well into the shoreline, especially if high water conditions are expected. The ends should be secured firmly to the shoreline, preferably to rigid bodies such as trees or piles, to fully enclose the area where sediment may enter the water.

12. When there is a specific need to extend the curtain to the bottom of the watercourse in moving water conditions, a heavy woven pervious filter fabric may be substituted for the normally recommended impervious geotextile. This creates a flow-through medium which significantly reduces the pressure on the curtain and will help to keep it in the same relative location and shape during the rise and fall of water.

13. Typical alignments of turbidity curtains can be seen in the details. The number and spacing of external anchors may vary depending on current velocities and potential wind and wave action; manufacturer's recommendations should be followed.

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The details for Type I, Type II, and Type III are shown on Detail ESC-44 in Division III of this manual. Different installation methods are shown on Detail ESC-45 in Division III of this manual.

SECTION 5109 DEFINITION OF TERMS

Accelerated Erosion:
Erosion caused or increased by human activity such as agriculture or construction.

Acid Soil:
A soil with a pH value less than 7.0. Usually applied to surface layer or root zone, but may be used to characterize any horizon.

Acre:
An area of measurement equal to 43,560 square feet.

Aggregate:
Sand, gravel, crushed stone, or slag usually having a known range of particle sizes. Used with a cementing medium to form concrete or alone as in a roadway bed or railroad ballast.

Alkaline:
Having a pH greater than 7.0.

Alluvial Soil:
Soil formed from materials transported in suspension by flowing water and deposited by sedimentation.

Anchor Trench:
A long, narrow ditch in which the edges of a sediment fence, erosion control blanket, or geotextile are buried to hold it in place.

Anti-Seep Collar:
A device constructed around a pipe or other conduit and placed through a dam, levee, dike, or embankment for the purpose of reducing seepage losses and piping failures.

Application Rate:
The mass, volume, or depth of material applied per unit area.

BMP:
Best Management Practice. The preferred methods and products that will correct or control erosion, sedimentation, or water quality degradation on a specific site for particular site conditions.

Backfill:
The process of placing soil, gravel, rock, or other material to replace what was removed during construction.

Bank:
The part of the soil next to a stream, lake, or body of water where the soil elevation adjacent to the water is higher than the water level; embankment.

Bearing Capacity:
The maximum force per unit area a material can support before failing.

Berm:
(1) A ridge of earth constructed to direct the flow of surface water. (2) A shelf that breaks the continuity of a slope. (3) The embankment of a pit or pond which may be wide and solid enough for vehicular traffic.

Binder:
(Emulsion, Tackifier) Natural or synthetic additive that causes an otherwise non-cohesive material to become bound into a cohesive matrix.

Biodegradable:
Ability of a material to breakdown or decompose under natural conditions and processes, within an acceptable time frame, without polluting the environment.

Bioengineering:
A method of construction, using living plants or plant materials in combination with inorganic materials. The practice brings together biological, ecological, and engineering concepts to produce living, functioning systems used to prevent erosion, to control sedimentation, or to provide wildlife habitat.

Blanket:
Rolled erosion control materials consisting of coir, jute, straw, wood fiber, or various synthetic materials used to prevent erosion, trap sediment, protect seed, and promote the growth of vegetation. They can be either degradable or permanent.

Broadcast:
The application of material by scattering or spraying it on the soil surface. Broadcast seeding is a uniform distribution of seeds over the entire planted area.

Buffer:
A small area of permanent vegetation bordering a field, stream, or lake, running through cropland, protecting the soil from wind and rain erosion, slowing water runoff, and trapping sediment and other pollutants.

CPESC:
Certified Professional in Erosion and Sediment Control. This certification can be obtained from CPESC, Inc. at www.cpesc.net

Canopy:
The foliage of a tree, shrub, or herbaceous plant. The area covered by the plant canopy is protected from splash erosion.

Catch Basin:
A receptacle for diverting surface water to a sewer or subdrain, and having at its base a sediment bowl to prevent the admission of coarse material into a sewer or stream.

Catchment:
An area confined by drainage divides usually having only one stream flow outlet.

Certified Seed:
Seed that has been analyzed by a State association test laboratory for percent germination, weed seed content, and purity.

CFR:
Code of Federal Regulations.

CFS:
Cubic feet per second.

Channel:
A natural stream or excavated ditch that conveys water.

Channel Stabilization:
Protection of the sides and bed of a channel from erosion by controlling flow velocities and directions or by lining the channel with vegetation, rip-rap, concrete, or other material.

Check Dam:
Small dam constructed in a gully or other small channel to decrease the flow velocity, minimize channel scour, and promote deposition of sediment.

Chute:
A high-velocity, open channel for conveying water to a lower level without erosion.

Clay:
(1) Mineral particles less than 0.002 mm in equivalent diameter. (2) A soil containing more than 40 percent clay. Clay soils exhibit plasticity when moist, but are hard when dry.

Cohesive Soil:
An unconfined soil that has considerable strength when air-dried and has significant resistance to disintegration when submerged in water.

Coir:
Organic fiber from the outer shell of the coconut used as mulch and in the manufacture of erosion control blankets, geotextiles, and tubes.

Completion of Construction:
All building construction has ceased, all equipment has left the site, All Best Management Practices (BMPs) have been removed, and all permanent soil stabilization has occurred.

Compost:
Organic residue or a mixture of organic residues and soil that has undergone biological decomposition until it has become relatively stable humus.

Concentrated Flow Path:
Depressed areas where overland stormwater flows toward and concentrates in thereby increasing volume and velocity as it moves down slope.

Conservation:
The protection, improvement, and use of natural resources according to principles that will assure their highest economic or social benefits.

Contour:
An imaginary line connecting points of the same elevation.

Cool-Season Turfgrass:
Species of turfgrass used primarily in the northern U.S. such as bluegrass, fescue, bentgrass, and ryegrass. These grasses grow primarily in the spring and fall going dormant during the summer. Planting season is from March through May and September through October for these grasses.

Critical Areas:
Regions highly susceptible to erosion such as areas subjected to concentrated water flow.

Cut-and-Fill:
A process of moving earth by excavating part of an area and using the excavated material for adjacent embankments or deposit areas.

d_{50}:
The sieve opening size which allows 50 percent of a given sample to pass through.

DOT:
Department of Transportation (Federal or State).

Dam:
A barrier to confine or raise water for storage or diversion, to create a hydraulic head, to prevent gully erosion, or to retain soil, rock, or other debris.

Degradation:
(1) The loss of desirable properties as a result of some process or physical or chemical phenomenon. (2) The progressive general enlarging of a stream channel by erosion.

Design Standards:
The defined conditions where a specific conservation practice or set of practices are to be used.

Design Storm:
A selected rainfall pattern of specified intensity, duration, and frequency that is used as a basis for design.

Detention:
Managing stormwater runoff or sewer flows through temporary holding and controlled release.

Dike:
A structure designed either to reduce the water velocity as stream flow passes through so that sediment deposition occurs instead of erosion, or to deflect erosive currents away from the stream bank.

Discharge:
A volume of fluid passing a given point per unit time. The flow rate of stormwater is commonly expressed as cubic feet per second.

Diversion:
A channel and adjacent ridge of earth constructed to redirect surface runoff water from one area to another for disposal at a non-erosive velocity.

Drainage:
(1) Interception and removal of groundwater or surface water by artificial or natural means. (2) The frequency and duration of periods during which the soil is not saturated.

Dredging:
The process of removing sediment from a water source such as a river or reservoir.

EPA:
Environmental Protection Agency. Federal agency responsible for the enforcement of the Clean Water Act.

ESC:
Erosion and Sediment Control.

Emergency Spillway:
A vegetated earth channel used to safely convey flood discharges in excess of the capacity of the principal spillway.

Energy Dissipater:
A structure installed at the outlet of a channel, drop structure, or pipe to absorb the force of high-velocity flow.

Erodible:
Susceptible to erosion.

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Erosion:

The process by which soil particles are detached, transported, and deposited by wind, water, ice, or gravity. The following terms are used to describe different types of erosion:

1. Accelerated Erosion: Erosion much more rapid than natural or geologic erosion, primarily as a result of human activities.

2. Channel Erosion: The erosion process whereby a concentrated flow wears away the bed and banks of a well-defined channel.

3. Geological Erosion: The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plans, etc.

4. Gully Erosion: The process whereby runoff water accumulates in narrow channels and over relatively short time periods removes the soil to considerable depths.

5. Natural Erosion: Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate and vegetation. Erosion not caused by human activity.

6. Rill Erosion: The process whereby numerous small channels only several inches deep are formed. Commonly occurs on recently disturbed and exposed soils.

7. Saltation: The movement of soil particles by rolling or a series of short bounces along the ground surface due to the wind.

8. Sheet Erosion: The gradual removal of a fairly uniform layer of soil by runoff water.

9. Shoreline Erosion: The loss of soil materials due to the wave action of a permanent water body such as a pond, lake, or ocean.

10. Splash Erosion: The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.

11. Suspension: The transport of soil particles by the wind for relatively long distances.

Erosion Control:

The prevention or reduction of soil particle movement. Erosion control reduces soil detachment, transport, and deposition.

Fertilizer:

Adding soil nutrients to the soil to stimulate plant growth. The percentage of available nutrients in bulk fertilizer is labeled as percent nitrogen, percent phosphorus, and percent potassium.

Fill:

Soil, rock, gravel, or other matter that is placed at a specified location to bring the ground surfaces up to a desired elevation.

Filter:

Layer of fabric, sand, gravel, or graded rock placed between the bank revetment or channel lining and soil for one or more of three purposes: (1) to prevent the soil from moving through the revetment. (2) to prevent the revetment from sinking into the soil. (3) to permit natural seepage from the stream bank preventing buildup of excessive ground water pressure.

Filter Strip:

A long, narrow vegetative planting used to retard or collect sediment for the protection of watercourses, diversions, drainage basins, or adjacent properties.

Final Stabilization:

The site shall be considered stabilized when perennial vegetation, pavement, and buildings or structures using permanent materials cover all areas that have been disturbed. Perennial vegetation shall be considered established and completed for stabilization when it has established a healthy growing stand with an overall density of at least 70 percent over the entire area it was planted.

Finished Grade:

The final elevation of the ground surface conforming to the approved construction plan.

Flood:

Any relatively high stream flow overtopping the natural or artificial banks of any river or body of water.

Floodplain:

The lowland that borders a stream and is subject to flooding when the stream overflows its banks.

Frequency of Storm:

The anticipated period in years that will elapse before a flow of a given magnitude will recur based on average probability of storms in the design region.

GIS:

Geographic Information System. System that links spatial information such as satellite images and maps with alphanumeric information to produce a geographically referenced database.

Gabion:
Baskets usually made of wire filled with rock or broken pieces of concrete used as a protecting agent, or revetment.

Geotextile:
A woven or non-woven water permeable material either natural or synthetic used to filter liquids, prevent the movement of sediment, and separate reinforce, or strengthen different materials.

Grade:
(1) To level off to a smooth horizontal or sloping surface. (2) A reference elevation. (3) Particle size distribution of an aggregate. (4) The slope of a plane.

Grading:
Any stripping, cutting, filling, stockpiling, or any combination thereof including the land in its cut-and-filled condition.

Gravel:
Rock particles ranging from 1/5 inch to 3 inches in diameter.

Grassed Waterway:
A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to conduct surface water at a reduced flow rate.

Greenbelt:
A strip of trees and shrubs growing parallel to a stream that prevents overuse of the top bank area by people, animals, and machinery; retards rainfall runoff down the bank slope and provides a root system that binds soil particles together.

Groundwater Flow:
Water that moves through the subsurface soil and rocks.

Head:
Pressure measured as an equivalent height of water; measured in feet or pounds per square inch.

Headcut:
The uphill end of a gully where water falls to a lower level and active erosion occurs.

Hydraulic Mulch:
Processed materials such as wood and paper products, cotton, or straw fibers that are applied by special equipment utilizing a water-based slurry, and sprayed onto the soil surface.

Hydric Soil:
Soils that are wet long enough to periodically produce anaerobic conditions, thereby negatively or positively influencing the growth of plants.

Hydroseeding:
A method of seeding accomplished by mixing seed with water and fertilizer and spraying the solution onto a seedbed.

IECA:
International Erosion Control Association. The Great Rivers Chapter serves Iowa, Kansas, Missouri and Nebraska. Contact IECA at www.ieca.org.

Impermeable Material:
A soil or material whose properties prevent movement of water through it.

Impervious Surface:
Hard ground cover that prevents or retards the entry of water into the soil and increases runoff such as asphalt, concrete, and rooftops.

Indirect Runoff:
That portion of runoff that does not come from point discharges from storm sewer systems or general surface runoff.

Infiltration:
The portion of rainfall or surface runoff that moves downward into the subsurface rock and soil.

Inorganic:
Composed of matter that is not of plant or animal origin.

Intermittent Stream:
A stream, or portion of a stream, that flows only in direct response to precipitation. It receives little or no water from springs and no continuous water supply from melting snow or other sources. It is dry for a large part of the year, ordinarily more than three months.

Internal Soil Drainage:
The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers and by the height of the water table, either permanent or perched.

KDHE:
Kansas Department of Health and Environment. The state agency in Kansas that regulates the NPDES Program including stormwater runoff permitting.

Land-Disturbing Activities:
Activities that destroy or remove the vegetation that covers the soil at a construction site. These activities include clearing, grubbing, and grading.

Landscaping:
The placement of sod, seed, trees, and other vegetation after final grading is complete.

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Leachate:
Liquid that has percolated through a material and contains soluble components removed from that material.

Legumes:
Any member of the pea or bean family, including peas, beans, clovers, alfalfas, lespedezas, and vetches. Most are nitrogen-fixing plants.

Lime:
A soil amendment containing calcium carbonate and other materials used to neutralize soil acidity and furnish calcium for plant growth.

Loam:
A soil textural classification in which the proportions of sand, silt and clay are well balanced. Loams have the best properties for cultivation of plants.

MS4:
Municipal separate storm sewer system.

MDNR:
Missouri Department of Natural Resources; the state agency that administrates the NPDES program for Missouri.

Mineral Soil:
Inorganic soil; soils with less than 20% organic matter.

Moisture Content:
The percentage by weight of water contained in the pore space of a solid material with respect to the total weight of the material.

Mulch:
A natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, reduces erosion, and aids in the establishment of plant cover.

NPDES:
National Pollutant Discharge Elimination System; mandated by Congress under the Clean Water Act, a two-phased, national program to address nonagricultural sources of stormwater discharge and prevent harmful pollutants from being washed into local water bodies by stormwater runoff.

NRCS:
Natural Resources Conservation Service; a federal agency that provides technical assistance on natural resource management issues.

NPS:
Non-point Source Pollution; pollution that enters a water body from sources that are diffuse. A point source, by contrast, can be easily identified as distinct such as an industrial or sanitary sewer pipe.

Nutrient:
A substance necessary for the growth and reproduction of organisms; in water, those substances that promote growth of algae and bacteria.

Open Channel:
A drainage course which has no restrictive top; it is open to the atmosphere and may or may not permit surface flow to pass over its edge and into another channel in an unrestricted manner.

Ordinance:
A law set forth by a governmental authority.

Organic Matter:
Humus; the portion of soil resulting from the decomposition of plant and animal materials.

Outfall:
The point where drainage discharges from a drainageway or conduit to a receiving stream or body of water.

Outlet:
The point of water disposal from a stream, river, lake, or artificial drain.

Outlet Channel:
A waterway constructed or altered primarily to carry water from structures such as smaller channels, tile lines, dams, and diversions.

PLS:
Pure Live Seed; a measure of seed quality expressed as a percentage. The product of the percentage of seed purity and the percentage of germination divided by 100.

Peak Discharge:
The maximum instantaneous flow from a given storm at a specific location.

Percolation:
The downward movement of water through the soil horizons. The percolation rate of soil is usually expressed as inches per hour.

Perennial Stream:
A stream that maintains water in its channel throughout the year.

Permanent Seeding:
The establishment of perennial vegetation on disturbed areas for periods longer than 12 months.

Permeability:
The property of the soil that expresses the ease with which water moves downward through the profile; the rate at which a saturated soils transmits water.

Pervious:
A property of a material through which water passes relatively freely.

pH:
A measure of the acidity or alkalinity of a substance; a pH value of 7.0 is neutral, less than 7.0 is acidic, greater than 7.0 is alkaline.

Point Source:
Direct pollution from a pipe from industries and sanitary sewers.

Pollution:
The presence of substances of such character and in such quantities that the natural quality of the environment is impaired, rendered harmful to health and life, or offensive to the senses.

Ponding:
Water backed up in a channel, depression, or ditch as the result of a constriction, obstruction, or lack of outlet.

Precipitation:
Process by which water in liquid or solid state is discharged out of the atmosphere upon a land or water surface.

Rational Method:
A means of computing storm drainage flow rates, Q, by use of the formula $Q = CIA$, where C is a coefficient describing the imperviousness of the 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.

Residual Soil:
Soil derived in place by the effects of weathering.

Retention Structure:
A natural or artificial basin that maintains a permanent water supply.

Riprap:
A layer, facing, or protective mound of stones randomly placed to prevent erosion or scour at a structure or embankment.

Riser:
The inlet portions of a drop inlet spillway that extend vertically from the pipe barrel to the water surface.

Runoff:
That portion of precipitation that flows on the land surface, in open channels, or in stormwater conveyance systems.

Sand:
Soil particles ranging from 0.05 to 2.0 mm in diameter; individual particles are visible to the unaided human eye.

Saturation Point:
In soils the point at which a soil or an aquifer will no longer absorb water without losing an equal amount.

Scour:
The clearing and digging action of flowing air or water; especially the downward erosion caused by water in sweeping away mud and silt from the outside bank of a curved channel or during a flood.

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 and has come to rest on the earth's surface either above or below sea level.

Sediment Basin:
Depressions, formed from the construction of a barrier or dam, created to retain runoff long enough to allow excess sediment to settle out.

Sediment Fence:
Temporary sediment barrier consisting of filter fabric, sometimes backed with wire mesh, attached to supporting posts and partially buried.

Seedbed:
The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Seepage:
Groundwater emerging on the face of a stream bank.

Silt:
Soil particles ranging from 0.05 and 0.002 mm in equivalent diameter.

Soil:
A dynamic, natural body composed of mineral and organic materials and living forms in which plants grow that has properties due to the integrated effect of climate and

living matter acting upon parent material, as conditioned by relief, over periods of time.

Soil Structure:
The relation of particles or groups of particles which imparts to the whole soil a characteristic manner of breaking; some types are crumbs, block, platy, and columnar.

Soil Texture:
Relative proportions of various soil separates (sand, silt, and clay) in a soil.

Spillway:
A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction; an open or closed channel, or both, used to convey excess water from a reservoir.

Straw Bales:
Temporary barriers made of straw bales sometimes installed across a slope or around the perimeter of a construction site to intercept, detain, and filter sediment transported by runoff.

Storm Frequency:
The time interval between major storms of predetermined intensity and volumes of runoff which sewers and other appurtenant structures are design to handle hydraulically without surcharging and back flooding (e.g. 5-year, 10-year, 20-year storm).

Storm Sewer:
A sewer that carries surface water, street wash, and other or drainage, but excludes sewage and industrial wastes; also called storm drain.

Subgrade:
The soil prepared and compacted to support a structure or a pavement system.

Subsurface Drain:
Underdrain; a perforated pipe used for subsurface drainage, usually surrounded by aggregate or wrapped in a geotextile filter fabric to prevent the migration of soil particles.

Swale:
An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water.

Tackifiers:
Material sprayed onto a soil surface to bind soil particles and prevent erosion.

Terrace:
An embankment or combination of embankments and channels across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

Tillage:
The practice of producing a rough soil surface to maintain surface residue, conserve soil moisture, and reduce wind erosion.

Toe of Slope:
The junction of a slope and the ground it is constructed upon; the bottom of the slope.

Topography:
General term to include characteristics of the ground surface such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.

Topsoil:
Surface soil usually containing organic matter; the soil most capable of growing vegetation and crops.

Turbidity:
The degree of cloudiness in water caused by suspended particles; turbidity can be precisely measured and is often used as an indicator of pollution.

Turf Reinforcement Mat:
Permanent synthetic erosion control blanket that resists erosion and reinforces the root zone of vegetation. Increases the ability of vegetation to resist the erosive force of flowing water.

USLE:
Universal Soil Loss Equation; an estimate of the amount of soil that moves due to water erosion based upon five factors: climate, soil erodibility, length and steepness of slope, vegetative cover, and structural or management practices.

Undermining:
A process of scour by hydraulic action that progressively removes earth support from a structure; undermining commonly occurs at the outlet of a culvert or sewer.

Vegetation:
Plant life or total plant cover of an area.

Warm Season Grasses:
A grass which experiences most of its growth during the warm summer months. Significantly more heat and drought tolerant than cool season grasses. These grasses are planted primarily in the southern U.S. and include bermudagrass, zoysia, and buffalo grass.

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Water Course:
A natural or artificial channel in which a flow of water occurs, either continuously or intermittently.

Water Quality:
The chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Watershed:
The region drained by or contributing water to a stream, lake, or other body of water.

Watershed Area:
All land and water within the confines of a drainage divide or a water problem area consisting in whole or in part of land needing drainage or irrigation.

Weir:
A structure that extends across the width of a channel and is intended to delay or alter the flow of water through the channel.

Wetland:
Land area that is wet or flooded by surface or groundwater often enough and long enough to develop characteristic hydric soil properties and to support vegetation that will grow in saturated soil conditions.

Appendix C
Erosion and Sediment Control Plan Review Checklist

Land Disturbance / Site Development Review Checklist - Update 08.06

1. Plan sets, revised in response to staff comments, must be accompanied by written documentation, composed of staff comments and applicants written response. Please include City of Lenexa application number on written documentation. To facilitate this request, an electronic copy of staff comments is available upon request. **Do not fax this response separately – send response with revised plan submittal.**
2. A preconstruction meeting between City staff, developer, contractor and site / project superintendent must take place prior to approval or issuance of any sanitary sewer, land disturbance, site development or building permits. Applicant is responsible for contacting staff to schedule meeting.
3. Please provide copies of NPDES, 404, and other applicable state and federal permit applications for the site or activity. Required for sites > or = to 1 acre.
4. Provide a graphic representation of the location of and legend of soil types present on site, accompanied by pertinent soil type engineering sheets (including source of information). Copies of applicable information from SCS Manual (Tables 14 – Physical & Chemical Properties and 15 - Soil & Water Features) will satisfy this requirement; If utilizing copies of electronic information insure soils designation number is clearly shown and include copies of Tables 19 -22. **OR** In addition to the fine graphic representation of the location of and legend of soil types please submit SCS Manual soil type engineering sheets for soils composing this site.
5. The signature and seal of a Professional Engineer, Registered Landscape Architect or a Certified Professional in Erosion and Sediment Control is required on each sheet.
6. Please add a statement on the plan, typically located on the cover page, stating that any land disturbance activity, construction or development, will be done pursuant to the plan. This statement must be accompanied by a date and signature line and must be signed by the owner, developer, operator, and/or contractor prior to permit issuance. **OR** Statement on the plan by the owner, developer, operator, and/or contractor that any land disturbance activity, construction or development, will be done pursuant to the plan, must be signed at the time of permit issuance.
7. Vicinity map is now required to show the location of the site in relation to the surrounding area's watercourses, water bodies and other significant geographic and natural features, as well as streets and other significant structures.
8. Existing and proposed topography of the entire site with contour lines drawn with one chosen interval in accordance with the following table:

Ground Slope	Contour Interval (in feet)
Flat; 0-2%	0.5 or 1
Rolling: 2-8%	1 or 2
Steep: 8%+	2, 5 or 10

9. Show and label limits of construction or disturbance. Indicate protective fencing at the limits of construction, to be installed prior to commencement of construction activities.
10. Site's property lines shown in true location with respect to the plan's topographic information;
11. Ensure a clear and definite delineation of any drainage, sanitary, utility, or other easement(s) on or near the site are reflected on plan;
12. Graphic representation of the location of all existing and proposed natural and man-made drainage facilities;

13. Surveyed location of stream setback must be delineated on plan **OR** provide a statement verifying stream setback ordinance does not apply. Stream setback ordinance requirements can be accessed through the city website at www.raintorecreation.org > *Ordinances/Codes – Development Community > Stream Setback.*
14. A clear and definite delineation of any wetlands, natural or artificial water storage detention areas, and drainage ditches on the site, **OR** a statement that there are no wetlands, detention areas or drainage ditches located on the property;
15. A clear and definite delineation of applicant's determination, based on the best available information and sound engineering principles of the existence of a regulatory 100-year floodplain, as defined in 4-1-N-3 and of any fully urbanized floodplain on or near the site as determined by a Johnson County watershed study **OR** a statement that there are no such floodplains located on the property;
16. Quantity of soil in cubic yards to be excavated, filled, stored, or otherwise utilized on-site;
17. Graphic representation of location of proposed excavations and fills, of on-site storage of soil and other earthen material, and of on-site disposal or spoil areas; **OR** FOR SS PLANS - Provide note on plans that "All storage of earthen material must be located within construction easement".
18. Location and legend of existing vegetative cover and the location and legend of vegetative cover to be left undisturbed; **OR** Clearly indicate on plan all trees to remain and all trees to be removed. Trees to remain must be protected with protection fencing indicated on plan and tree protection detail provided.
19. Please utilize current City standard Sediment Control General Notes. This information may be accessed, along with other City details and specifications, on line at www.ci.lenexa.ks.us. Go to *Departments > Public Works > Construction Specs. > English Details (in either PDF or ZIP format) > Erosion Control > Erosion Control Notes.*
20. A description of, details and specifications for the measures undertaken to reduce surface runoff and erosion control including, but not limited to, types and methods of applying soil protection blankets, mulches, designs and specifications for diversions, dikes, drain protection, seeding, berming and a schedule for their maintenance and upkeep;
21. A description of, details and specifications for, the measures undertaken to retain sediment on the site, including, but not limited to, designs and specifications for silt fences and sediment detention facilities, and a schedule for their maintenance and upkeep.
22. The location and description visually depicted on a map, including design details, of each temporary and permanent erosion, surface runoff and sediment control measure and structure. **OR** Provide an erosion and sediment control plan showing the location and description of each temporary and permanent erosion, surface runoff and sediment control measure and structure.
23. The location and description visually depicted on a map, including design details, of required stabilized construction entrance(s). **OR** Construction entrance detail must include drainage pipe. Calculations must be submitted for pipe sizing. (existing conditions / 10 yr. storm)
24. Construction Schedule must be updated to reflect current schedule.
25. Construction Activity information must be limited to activities covered by this permit only. I. E. Construction Activity information on schedule must be limited to activities covered by this permit only or must clearly reflect items included in this permit and those items covered under future permits. On this schedule items A – D will be allowed under this permit and must be clearly indicated as such. Staff suggests an item E be added indicating the "interim stabilization of disturbed areas". Items E – Q must be indicated as "NOT UNDER CURRENT PERMIT".

26. A construction schedule is required on plans and must include: **OR** Construction must be amended to include the following corrections/additions: **OR** A construction schedule is required and must be included on plans. Schedule should include construction activities / tasks similar to those found below and an associated timeline. Additions / deletions to the following list to accurately reflect activities anticipated on your site.
    a. Identify and mark areas to be protected from disturbance.
    b. Clearing and grubbing for those areas necessary for installation of perimeter erosion control devices.
    c. Construction of perimeter erosion and sediment control devices.
    d. Installation of permanent and temporary stabilization measures.
    e. Remaining interior site clearing and grubbing.
    f. Street grading.
    g. Grading for the remainder of the site.
    h. Utility installation and statement of whether storm drains will be used or blocked after construction.
    i. Building, parking lot, and site construction.
    j. Final stabilization.
    k. Removal of temporary erosion control devices.
    l. Inspection and maintenance of all erosion and sediment control measures during the course of the project.
27. Please provide the total project site area for the purpose of permit fee and performance guaranty estimation.
28. The permit fee is based upon a per acre fee. Generally the total acres are based upon the total project area (project site). For certain linear instances (such as sanitary sewer installation), this fee will be calculated based upon a determined "disturbed" area (i.e. 40-ft construction limits by 3000 lineal feet of sewer main). Minimum $50.00
    i. The project site (or determined disturbed area) = X acres
    ii. The ESTIMATED Permit Fee is: $165.00 / acre x A acres = $ D
29. The required performance guaranty shall be in the amount of $5,000 per acre, up to a maximum guaranty of 25-acres or $125,000. (acreage amount determined by rounding up to the next whole acre) Minimum $5,000 For this project the ESTIMATED performance guaranty is $.

The City may require any additional information or data deemed appropriate and/or may impose conditions thereto as the Planning Director may deem necessary to ensure compliance with the provisions of this Article and to preserve public health and safety, which are not otherwise noted within this checklist.

ADDITIONAL NOTES and Miscellaneous Items to look for:

30. Perimeter silt fence must be located just outside the construction limits for each particular phase of construction. For this application, silt fence will need to be located on the down slope side of disturbed area rather than at perimeter of property. In addition, silt fence will be required between disturbed area and existing vegetation located down slope of construction activities.
31. Determined that there are no waterway crossings? (If so, additional information/requirements will be necessary.)
32. Determined that there are no Cut and fill slopes greater than 3:1.
33. Determined that there will be no clearing and grading of Natural Resources as previously defined by the City (such as designated natural stream assets, forests and wetlands, etc.)

34. Determined that there will be no disturbance within a flood plain, flood way, or other such designated drainage corridor.
35. Determined that Construction site access easements/agreements are not necessary.
36. Determined that stabilization to prevent erosion at the outlets of all pipes and paved channels is shown.
37. If velocities allow, a vegetative or TRM/vegetative alternative to rip rap is encouraged at the pipe discharge. If velocities indicate the need for rip rap, submit, for review and approval, sizing calculations for un-grouted riprap.
38. The grouted rip rap called out for the drainage swale areas is problematic and thus not acceptable. If velocities allow, a vegetative or reinforced vegetative alternative to rip rap is encouraged in swale areas. If velocities indicate the need for rip rap, it must be properly sized, to allow for un-grouted placement, and sizing calculations must be submitted for approval.
39.
40. Check cover over pipes.
41. Please review all areas of disturbance and ensure that silt fence is located properly based on the following spacing:
    3-5% slope > 75' o.c.
    5-10% slope > 50' o.c.
    10 – 15% slope > 25' o.c.

Any plan which includes Existing Ponds

1. Please verify there are no existing ponds on site or no plans to modify existing pond and dam structures.
2. What is intent for existing pond? Drain and fill? Drain, reshape and create water amenity?
3. Provide E&SC plan for this activity.
4. How will pond be drained? Breach? Pumpover?
5. Outflow calculations must be submitted and appropriately sized ditch checks placed prior to breach.

Sanitary Sewer projects

42. Lateral line installation must be delineated on plans within construction easement. Erosion and sediment control requirements apply to lateral line construction as well as main extensions.
43. Ensure width of proposed construction easement is adequate for installation of the line at the depth necessary. If construction easement width does not meet this requirement and width can not be expanded, the use of trench liners will be necessary and must be indicated on plans.
44. Any proposed replacement of existing sanitary sewer line must be included on permit drawings. This work is subject to the City of Lenexa's Erosion and Sediment Control Ordinance and Stream Setback Ordinance.
45. Proposed contours for any site grading outside limits of disturbance for sanitary sewer construction must be removed from plans.
46. Proposed sanitary sewer locations, not covered by this permit, must be removed from plans or screened to grey and clearly labeled as not part of this permit.
47. Check "Stream Assessment" to determine if proposed crossing is in an acceptable location (riffle).
48. A construction schedule is required and must include, but is not limited to, the following activities:

a. Identify and mark areas to be protected from disturbance.
b. Clearing and grubbing for those areas necessary for installation of perimeter erosion control devices.
c. Construction of perimeter erosion and sediment control devices.
d. Installation of orange construction fence, at limits of construction, just up hill of sediment control fence.
e. Excavation, installation and back fill for each section of sanitary sewer line.
f. Temporary stabilization of areas of completed line installation to be done by section.
g. Final stabilization.
h. Removal of temporary erosion control devices.
i. Inspection and maintenance of all erosion and sediment control measures during the course of the project.
j. NOTE – schedule of activities must be limited to only those covered by this permit.

49. Clearly delineate permanent sanitary sewer and temporary construction easements.
50. Provide an establishment plan for native grasses in permanent SS easement and a reestablishment plan for tree in the temporary construction easement.
51. Specific to PW review of JoCo SS Main extensions: Any required information not documented in plan set must be contained in the SWPPP document which must be submitted for review, comment and approval.
52. CHECK FOR CREEK CROSSINGS – SEE NOTES BELOW.

Additional notes for area with creeks and creek crossings.

1. Please provide a description of, and specifications for the measures undertaken to reduce surface runoff and control erosion in the area adjacent to the creek, including side slopes and protection of areas downstream from disturbance.
2. If a temporary creek crossing is necessary for vehicles or for SS construction, provide location and detail information. Double check "Stream Assessment" to determine appropriateness of proposed temporary crossing placement.
3. If stream flow does not warrant construction of a temporary stream crossing, we suggest the use of a "pump around" at the creek crossing. This will limit additional erosion and sediment control measures required for that area and allow construction through the area without water inundation.
4. PRIOR to issuance of Land Disturbance or Site Development permit, surveyed stream setback zone location, must be delineated on plan and must be FIELD LOCATED (staked at 50' spacing). Staking and proper placement of perimeter erosion and sediment control measures must be inspected by Erosion & Sediment Control Inspector, prior to commencement of grading operations.
5. Require note stating "inner zone of stream setback corridor, 25' each side from top of banks, be undisturbed".
6. Orange construction fence must be placed at limits of construction / disturbance (outside perimeter of stream setback area). Location of fencing material must be delineated and noted on plan and must be in place prior to commencement of grading operations.
7. Provide a stream assessment, indicating the location of pool/riffle sequence. Stream crossings at riffle locations are preferred and require only restoration of riffle after SS construction is complete. If SS crossing at a pool is required, riffles above and below must be permanently reinforced.
8. Construct temporary stream crossing or cross only at riffle location when dry conditions. Must be noted boldly on plan.

9. If a temporary creek crossing is necessary for vehicles or for SS construction, provide location and detail information.
10. Crossings at 'newberry riffles' most preferred – ref. 5600 for details.

Permits

1. In addition, Corp approval must be obtained if previous permits have not covered this activity and area. If approval is already granted, please submit copies of permits.

Easements

2. Approved construction easement must be dimensioned and reflected on plans.
3. Easements must be executed prior to issuance of permits.
4. FOR TEMPORARY CONSTRUCTION EASEMENTS (w/o permanent easement) ON CITY PROPERTY: Proposed easement forms and easement survey must be submitted for approval and execution. Please submit of 3 hard copy documents for staff review purposes. Temporary construction easements, which do not require any type of permanent easement, are the only easement types approvable by staff/administration. Easement documentation should be submitted to Erin Cope in Planning Department, Development Engineering Division for processing.
5. Temporary construction and permanent easement survey information requires review and approval of Development Engineering, Public Works and Parks & Rec, prior to approval of City Council. Please submit of 3 hard copy documents for staff review purposes. Staff review and approval must be completed a minimum of one week prior to Council meeting date; submittals should be received 2 – 3 weeks prior to meeting date. In addition, electronic copies of staff approved easements must be received by Legal Department at least one week prior to Council meeting date. Easement documentation should be submitted to Erin Cope in Planning Department, Development Engineering Division for processing.
6. Please provide copies of signed temporary construction easements for construction areas on adjacent private property.

Demolition and Moving of Existing Structures

1. Demolition or removal of any existing structures must be noted on plan and included in schedule. These activities are regulated by the City; permit application and fees are required. Questions regarding the demolition process should be directed to Jennifer Martin, Public Service Rep., at 913.477.7726. Demolition process must be complete prior to issuance of Land Disturbance or Site Development permit. Moving of structures will require a separate and additional permit. For information or to initiate this process contact Deb Madsen in Public Works. 913.477.7670.
2. Building Permit Review and Inspection staff was consulted regarding demolition of the shed structure and the determination was made that a permit will be required. As the shed is partially located within the construction limits for this project, the demolition permit must be acquired prior to or in conjunction with issuance of this Land Disturbance Permit. Information required with Demolition Permit application includes 1) an estimate for the cost of demolition work, 2) information addressing any potential utility clearance issues and 3) a site plan showing building location and proximity to surrounding structures. Requests for information regarding this determination or process should be directed to Mohammad Mosallaei at 913.477.7703.
3. Please verify there are no existing structures intended for removal or demolition as part of this project.

Erosion And Sediment Control Plan. DD5 – good example

BMP CONSTRUCTION @ Site Development

53. Construction / grading for water quality BMP's (bioretention cells), covered under this Site Development Permit, is limited to rough (or is it ruff) grading which must be two (2) feet higher in elevation than the final proposed BMP basin depth. Excavation to remove sediment fines, soil matrix placement, final grading, under-drain placement, inlet installation and landscaping will not be permitted until building construction is complete and surrounding area fully stabilized. Excavation of soils and fines must be completed by tract equipment, per BMP Manual specifications.
54.
55. If water quality BMP areas are to be utilized during construction as temporary sediment basins, the following requirements apply:
    a. Excavation of area for the purpose of temporary sediment basin must be two (2) feet higher in elevation than the final proposed BMP basin depth.
    b. BMP's must be dredged and further excavated to remove all fines prior to construction of BMP.
    c. BMP construction will not commence prior to completion of all grading and construction activities and full stabilization of disturbed areas.

AREAS WITH PRIVATE STORM SEWER SYSTEM CONNECTING TO PUBLIC.

56. If proposed private storm sewer system components (including Landscape Drain Basins) are to be operational at a time when surrounding area is not fully stabilized, sediment control measures must be shown on plan and utilized to protect this system.

PLANNING COMMENTS for site development plans:

57. Verify Park Fund requirements.
58. Compare submittal with approved final plans: site plan, engineering, lighting and landscaping to verify consistency.
59. Light fixture layout, for freestanding fixtures, must be included on Landscape Plan and cut sheets provided.
60. Applicable TIP fees and Park Fund fees will be due at the time of Building Permit application.
61. An irrigation plan must be submitted and approved during building permit process or prior to installation of the system.
62. Sign design information must be submitted for review and approval. A separate sign permit is required prior to installation.
63. Bicycle parking accommodations, as outlined in the K-10 Corridor Design Guidelines, must be addressed at the time of building permit application.

Section 4-1-N-11 Engineering Soils Report. Seldom required.

When required, this report shall be based on adequate and necessary test borings, giving an adequate description of the soils of the site with conclusions and recommendations regarding the effect of soils conditions on the proposed development, and giving opinions and recommendations covering the adequacy of site to be developed by the proposed land

disturbance activity with respect to soils conditions. Recommendations included in the report and approved by the Planning Director shall be required in the plan. The engineering soils report shall include:

- ❑ Data regarding the nature, distribution, strength, and erodibility of existing soils;
- ❑ If applicable, data regarding the nature, distribution, strength, and erodibility of soil to be placed on the site;
- ❑ Conclusions and recommendations for grading procedures;
- ❑ Conclusions and recommended designs for interim soil stabilization devices and measures, and for permanent soil stabilization after construction is completed;
- ❑ Design criteria for corrective measures when necessary;
- ❑ Opinions and recommendations covering the stability of the site;
- ❑ Subsurface conditions;
- ❑ Soil boring results; and
- ❑ Overview of geology of site.

Appendix D
Model Storm Water Pollution Prevention Plan (SWPPP)

Storm Water Pollution Prevention Plan (SWPPP)

(Project Title)

(Date)

Prepared by
(Author)

For
(Land Owner or Permittee)

Contents

Regulatory Background

The Kansas Department of Health and Environment (KDHE), Bureau of Water, Industrial Section has established a program to protect waters of the State from construction site storm water runoff. The storm water program requires owners or operators of any project, or combination of projects, who engages in construction activities disturbing one (1) or more acres to have authorization to discharge storm water runoff under the construction storm water general permit #S-MCST-0110-1. Owners or operators must submit a Notice of Intent (NOI) to comply with the general permit at least sixty (60) days before starting construction. The primary requirement of KDHE's general construction storm water permit is for the permittee to develop and implement a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must be kept onsite during construction activities and be available for review during inspections.

This SWPPP was developed to fulfill construction storm water permit requirements for the ***(list site name)*** project.

Site Location and Existing Conditions

The site is a ***(list # acres)*** parcel located at ***(provide street address, nearest cross streets, or general location)*** in Lenexa, Kansas. The City of Lenexa parcel number is ***(parcel number)***. The legal description for the parcel is ***(legal description)***. Existing site conditions include ***(describe current land use(s))***.

Drainage on the site flows ***(what direction)*** to ***(list water bodies)*** which are located ***(how far)(what direction)*** from the proposed construction boundaries. Soils onsite are primarily ***(describe soil horizons)*** which slope ***(describe grade steepness and slope direction)***. Existing vegetation consists of ***(describe vegetation)*** located ***(where onsite)***.

Proposed Construction and Land Disturbance Activities

Proposed construction activities include (describe general intent of construction). Storm water onsite will be conveyed (describe storm water infrastructure). Temporary detention and sediment removal will include (describe measures for temporary storm water conveyance/detention, as related to infrastructure).

Work Schedule/Project Phasing

Construction activities will commence (provide approximate start date) with an estimated completion date of (provide approximate end date). Onsite working hours will be from

(estimated work hours and days of the week). The project will be phased in the following manner to limit the amount and duration of exposed soils (describe project phasing).

Potential Storm Water Contaminants

Pollutants that result from clearing, grading, excavation, and building materials and have the potential to be present in storm water runoff are listed in Table 1. This table includes information regarding the material type, chemical and physical description, and the specific storm water pollutants associated with each material.

Table 1

Potential Construction Site Storm Water Pollutants

(add or remove pollutants as appropriate)

Trade Name Material	**Chemical/Physical Description[1]**	**Storm Water Pollutants[1]**
Pesticides (insecticides, fungicides, herbicides, rodenticides)	Various colored to colorless liquid, powder, pellets, or grains	Chlorinated hydrocarbons, organophosphates, carbamates, arsenic
Fertilizer	Liquid or solid grains	Nitrogen, phosphorous
Plaster	White granules or powder	Calcium sulphate, calcium carbonate, sulfuric acid
Cleaning solvents	Colorless, blue, or yellow-green liquid	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates
Asphalt	Black solid	Oil, petroleum distillates
Concrete	White solid	Limestone, sand
Glue, adhesives	White or yellow liquid	Polymers, epoxies
Paints	Various colored liquid	Metal oxides, Stoddard solvent, talc, calcium carbonate, arsenic
Curing compounds	Creamy white liquid	Naphtha
Wastewater from construction equipment washing	Water	Soil, oil & grease, solids
Sanitary wastes/sewage	Water, fecal matter	Bacteria, ammonia, nutrients
Wood preservatives	Clear amber or dark brown liquid	Stoddard solvent, petroleum distillates, arsenic, copper, chromium
Hydraulic oil/fluids	Brown oily petroleum hydrocarbon	Mineral oil

Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE
Diesel fuel	Clear, blue-green to yellow liquid	Petroleum distillate, oil & grease, naphthalene, xylenes
Kerosene	Pale yellow liquid petroleum hydrocarbon	Coal oil, petroleum distillates
Antifreeze/coolant	Clear green/yellow liquid	Ethylene glycol, propylene glycol, heavy metals (copper, lead, zinc)
Erosion	Solid Particles	Soil, sediment

[(1)]Data obtained from MSDSs when available

Storm Water Controls/Best Management Practices (BMPs)

The primary potential sources of storm water contamination for this project include erosion and construction material spillage ***(edit this statement as needed to include additional pollutants)***.

Erosion and Sediment Control

To prevent soil from washing into receiving water bodies, or the undisturbed areas of the site, the following BMPs will be implemented ***(Add to or delete the following BMPs as needed)(See Lenexa's Land Disturbance Ordinance and/or APWA 5100 for additional BMP information and design specifications)***.

- ***(silt fence or mulch berms)*** will be placed along the perimeter of the area to be cleared and graded before any clearing or grading occurs.
- ***(heavy duty silt fence or other controls)*** will be used on steep slopes at the following locations ***(define).***
- ***(a sediment basin (if appropriate) at what location)*** will be constructed before any construction begins.
- All cleared and graded soils will be sloped to the sedimentation basin ***(if applicable).***
- All ruts caused by equipment will be graded.
- Within 14 days of clearing and grading, areas not immediately affected by construction activities will be seeded and mulched with straw. The seed mix will be per the City of Lenexa Standard Specification. The straw mulch is to be tacked into place by a cultipacker or disk.
- Soil stockpiles will be stabilized with temporary seed and mulch no later than 14 days from the last construction activity in that area.
- ***(geotextiles, hydro seed/slurry tech, mulch berms, rock checks, etc.)*** will be applied to steep slopes and drainage ways to control gully and rill erosion.

- ***(Silt dikes, berms, or other appropriate products best suited for the phase of construction)*** will be placed to protect all storm sewer inlets on or near the site.
- Stabilized gravel construction entrances will be implemented and maintained to keep soils out of nearby streets.
- Dump trucks hauling material from the construction site will be covered with a tarpaulin.
- Paved streets outside the construction area will be swept to remove excess mud, dirt, or rock tracked from the site. During later phases of development (home building) the City may be responsible for street sweeping activities.

Erosion control BMPs, locations and design specifications are included in the Drawings (see Erosion and Sediment Control Plan).

Construction Materials

To prevent construction materials from washing into receiving water bodies, or the undisturbed areas of the site, the following BMPs will be implemented ***(add to or delete the following BMPs as needed)***.

- All waste materials will be collected and stored in a securely lidded metal dumpster. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied ***(how often)***.
- All sanitary wastes will be contained and collected from portable units a minimum of ***(how often)*** by a licensed sanitary waste management contractor.
- Fertilizers and other soil amendments will be applied only in the minimum amounts recommended by the manufacturer.
- Fertilizers will be covered or stored in sealable containers to avoid spills.
- All vehicles on site will be monitored for leaks and receive regular maintenance to reduce the chance of leakage.
- Petroleum products will be stored in tightly sealed containers which are clearly labeled.
- Spill kits will be included with all fueling sources and maintenance activities. Spill containment equipment may include brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, saw dust, containment booms, and metal trash containers. All spills will be cleaned up immediately upon discovery. Large spills must be reported to the City of Lenexa at 913-477-7680 or Johnson County Environmental at 913-715-6940. Large spills of flammable or hazardous materials should be reported immediately to the Lenexa Fire Department by calling 911.
- Above ground storage tanks will have secondary containment structures or berms. Secondary containment will be constructed of sufficiently impervious material with enough storage to contain the volume of the tank plus at least 6 inches freeboard.

- All paint containers and curing compounds will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm system, but will be properly disposed according to the manufacturer's instructions.
- Concrete washout will only occur in designated containment areas, away from receiving water bodies. Recycling of concrete wash water and disposal off site is encouraged by the City.
- Form release oil used for decorative stonework will be applied over a pallet covered with an absorbent material to collect excess fluid. The absorbent material will be replaced and disposed of properly, when saturated.

Coordination of BMPs with Construction Activities

Structural BMPs will be coordinated with construction activities so the BMP is in place before construction begins. The following BMPs will be coordinated with construction activities:

- Temporary perimeter sediment controls will be installed before any clearing and grading begins.
- Clearing and grading will not occur in an area until it is necessary for construction to proceed (see Project Phasing).
- The stabilized construction site entrance and sedimentation basin ***(if needed)*** will be constructed before clearing and grading begins.
- Once construction activity ceases permanently in an area, that area will be stabilized with permanent seed and mulch.
- Vegetated swales, bio-retention cells, and other post construction infiltration BMPs will not be constructed until the entire site is stabilized.
- After the entire site is stabilized, the accumulated sediment will be removed from the basin ***(if applicable)***. The sediment basin may be converted to a post construction BMP, as appropriate.

BMP Inspection and Maintenance Procedures

Visual inspections of all cleared and graded areas of the construction site will be performed daily and within 12 hours of the end of a storm with rainfall amounts greater than 0.5 inches. The inspections will be conducted by the SWPPP Coordinator or a designated team member. The inspection will verify that the structural BMPs are in good condition and are minimizing erosion. The inspection will also verify that BMPs used to contain construction materials and petroleum products are effective. The following inspection and maintenance practices will be used to maintain erosion and sediment controls: ***(add or delete inspection items as necessary)***

- Built up sediment will be removed from perimeter controls when it has reached one-half the height of the control.
- Silt fences will be inspected for depth of sediment, undermining, tears, and attachment to fence posts. Posts will also be inspected to make sure they are firmly in the ground.
- Straw wattles and mulch berms will be inspected for depth of sediment, undermining, and sound placement. Mulch berms will also be inspected for blow out.
- If failure is recurrent, some other sediment control must be substituted and noted in the SWPPP (note the location and type of substitute BMP on the Erosion and Sediment Control Plan).
- The sediment basin ***(if applicable)*** will be inspected for depth of sediment and built up sediment will be removed when it reaches ***(what depth).***
- Temporary and permanent seeding will be inspected for bare spots, washouts, and healthy growth.
- Stabilized construction entrances will be inspected to determine if soil is leaving the site. A layer of clean gravel should be placed whenever excess soil has accumulated on the surface of the construction entrance.

A Maintenance Inspection Report will be made after each significant rainfall event and attached to the SWPPP. Daily inspection activities can be documented as needed using other appropriate forms/logs, and attached to the SWPPP. If construction activities or BMPs change during this project, the SWPPP will be amended appropriately.

Project Contacts and Coordination

The construction site SWPPP Coordinator for (project name) is (name and phone number) with (contractor name). SWPPP Coordination duties include:

- implement the SWPPP with the aid of the SWPPP team;
- oversee maintenance practices identified as BMPs in the SWPPP;
- notify the City of Lenexa Erosion and Sediment Control Inspector after installation of perimeter sediment controls and prior to any significant deviations from the SWPPP;
- conduct or provide for inspection and BMP maintenance activities;
- identify other potential pollutant sources and make sure they are added to the SWPPP;
- identify any deficiencies in the SWPPP and make sure they are corrected; and
- ensure that any changes in construction plans or BMPs are addressed in the SWPPP.

Additional SWPPP team members include ***(list names and phone numbers)***. They will be responsible for the following activities ***(list SWPPP team duties as needed)***.

DRAWINGS

(attach Vicinity Map, Site Map, and Erosion and Sediment Control Plan)

PERMITS

(attach City Land Disturbance Permits, Building Permits, etc.)
(attach KDHE Notice of Intent (NOI) for coverage under State general construction storm water permit)
(attach any relevant federal permits including, but not limited to, Corp of Engineers 404 Dredge and Fill Permits)

SIGNATURES

SWPPP Certification *(the SWPPP must be prepared by a licensed engineer or a Certified Professional in Erosion and Sediment Control (CPESC))*

As the SWPPP preparer, I certify that appropriate BMPs have been recommended to effectively minimize negative impacts of this project's construction activities on storm water quality. The project owner and contractors are aware that selected BMPs must be installed, monitored, and maintained to ensure effectiveness.

Prepared by:_____

Title:_____

Date:_____

Owners Certification

I hereby certify that I am the owner of the property described in this plan, or the legally authorized agent, and that I assume full responsibility for the implementation and performance of this plan, and will comply with the requirements of any local, state, or federal permit required for this project.

Owner:_____

Title:_____

Date:_____

Erosion and Sediment Control Contractor Certification

I hereby certify under penalty of law that I understand the terms and conditions of the Kansas Water Pollution Control general permit (S-MCST-0110-1) that authorizes the storm water discharges associated with construction activity from the site identified below, and the Storm Water Pollution Prevention Plan (SWPPP) prepared for the project.

Name of Project:_____

Site Location/Address: _____

Company Name:_____ Phone Number:_____

Company Address:_____

Contractor's Signature:_____

Contractor's Name (typed or printed):_____

SITE INSPECTION FORMS/LOGS

(attach all site inspection forms, daily activity logs, etc.)

Maintenance Inspection Report

Date:_____

Project Name/Location:_____

Owner: _____

Weather Conditions:_____

Rain in last 24 hours (inches):_____

Inspector Name (print) and Signature:_____

Stage of Construction:

_____ Pre-construction Meeting
_____ Installation of Perimeter ESC Measures
_____ Clearing and Grubbing
_____ Rough Grading
_____ Temporary Stabilization
_____ Finish Grading
_____ Public Improvements
_____ Building Construction

Inspection Checklist:

BMP Condition	Yes	No	N/A	If "no", list locations needing BMPs and/or maintenance.
Storm Sewer Inlet Barriers (sand bags, gutter buddies, straw wattles)				
Are storm sewer inlet barriers properly placed?				
Are storm sewer inlet barriers in good condition?				
Are barriers controlling flows into the inlet?				
Is sediment height less than ½ the barrier height?				
Are all storm water inlets protected?				
Are storm sewer boxes and/or pipes free of sediment?				
Perimeter Controls (diversions, silt fence, straw wattles, mulch berms, etc.)				
Is offsite storm water drainage diverted?				
Are perimeter controls up				

and in good condition?				

BMP Condition	Yes	No	N/A	If "no", list locations needing BMPs and/or maintenance.
Perimeter Controls (continued)				
Have all offsite properties and drainages been protected by perimeter controls?				
Stabilized Construction Entrances				
Is there adequate clean gravel present?				
Is soil and gravel staying onsite?				
Are contractors using the stabilized construction entrance?				
Stream Crossings				
Are temporary crossings controlling erosion?				
Are culverts adequately sized?				
Temporary Stabilization				
Are seeded areas properly established?				
Is mulch crimped in and holding seed in place?				
Are erosion control blankets and mats in good condition?				
Are soil piles seeded, mulched and bordered down slope by sediment barriers?				
Sediment Basin				
Is the basin less than ½ full of sediment from original design?				
Are side slopes in good condition?				
Is the basin containing storm water flows?				
Is the outfall in good condition?				

BMP Condition	Yes	No	N/A	If "no", list locations needing BMPs and/or maintenance.
Swales and Drainage Ways				
Are ditch bottoms protected from undercutting and erosion?				
Are ditch checks properly maintained?				
Are outfalls properly stabilized?				
Slope Protection				
Are all slopes protected with vegetative cover, terraces or erosion control blankets?				
General Site Conditions				
Is trash and construction debris properly contained onsite?				
Are porta-potties properly located and maintained?				
Are all vehicles properly maintained to avoid leakage?				
Are all chemicals properly containerized and stored?				
Are concrete washout areas established and maintained?				

Corrective Measures: For all areas needing BMPs or maintenance, describe corrective measures and implementation timeframe?

_____

_____

_____

_____

_____

_____

_____

_____

Appendix E
Erosion and Sediment Control Inspection Form

Erosion and Sediment Control Inspection Report

Lenexa KANSAS

Inspected By: _____

Project _____

Contractor or Permit Holder _____ Date _____

Public Works Inspector _____ Time _____

Type of Construction

Land Disturbance Permit	☐	Public Improvement Permit	☐	Capitol Improvement Project	☐
Site Development Permit	☐	Building Permit	☐		

An Erosion and Sediment control inspection was conducted at the above referenced project and the following deficiencies were found.

Construction Entrance	☐	Sediment Basin	☐	Ditch Checks	☐
Silt Fence	☐	Stormwater Conveyance Channel	☐	Temp. Seeding	☐
Storm drain Protection	☐	Outlet Protection	☐	Dust Control	☐
Culvert Inlet Protection	☐	Rip Rap	☐	Mud Tracking	☐
Temp. Stream Crossing	☐	Concrete Washout	☐	Slope Protection	☐
Permiter Controls	☐	General Site Conditions	☐		
Other	_____				☐

An Erosion and Sediment Control Inspection on this project was conducted and no deficiencies were found ☐

Location and Description Comments of Failures/Violation areas noted above:

	Compliance Action	Date

When all corrective action has been completed the contractor must return a signed copy of this form to the public works inspector.

The below signed acknowedges that to the best of his/her knowledge, all corrective action listed above has been completed.

_____

Contractor or Permit Holder

Failure to correct the above compliance issues may result in enforcement actions under City of Lenexa Land Disturbance Provisions

A copy of this Inspection report must be maintained on site and available for review by City Inspectors.