Urban Conservation Policy Handbook

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The Mid-America Association
of Conservation Districts

MAACD

Missouri Department
of Natural Resources

The United States
Environmental Protection Agency,
Region VII

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Urban Conservation Policy Handbook

PREFACE

***The Mid-America Association of Conservation Districts (MAACD)** led the effort to develop this handbook. It is their mission to promote environmentally sound resource conservation for urban development. Its members are representatives from nine county conservation district boards from Kansas and Missouri in and around the Kansas City metropolitan area.*

Committee members who wrote this handbook included representatives from conservation districts, city officials, city staff, lake associations and consulting engineers. The project coordinator was Douglas G. Gahn, Urban Resource Conservationist with the USDA Natural Resources Conservation Service.

The purpose of the handbook is to provide urban development decision makers the following information:

- **Why urban erosion and sediment control is needed**
- **How to write an erosion and sediment control ordinance**
- **How to implement the ordinance through erosion and sediment control planning**

Urban development can be conducted in an environmentally friendly manner by using cost effective conservation practices. However, urban development usually causes economic and environmental damage if the developer is not required to install and maintain conservation practices. This handbook will help local leaders develop environmental policies which meet the social, economic and environmental needs of the community.

Another handbook called “Protecting Water Quality” complements this handbook by going into more detail about installation and maintenance of specific urban conservation practices. MAACD sponsored this updated version of the original handbook developed by the St. Charles Soil and Water Conservation District. It is particularly useful to consulting engineers, contractors and government staff who are responsible for implementing the erosion and sediment control plan required by an ordinance.

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Authors and Reviewers

USDA Natural Resources Conservation Services:

Douglas Gahn, Urban Resource Conservationist
Clifford Thornton, Urban Resource Conservationist
Coleen Davison, Soil Conservationist
Debra Sumner, District Conservationist
Robert Brejcha, Resource Conservationist
Mary Beth Jungk, Resource Conservationist
Alan Boerger, Resource Conservationist
Bob Plinsky, Soil Scientist
Robert Stutzman, District Conservationist

Missouri Department of Natural Resources:

Linda Vogt, Environmental Specialist
Troy Chockley, Environmental Engineer
Ruth Wallace, Environmental Specialist

Public Works Administration:

Kate Grover, Topeka, Kansas
Charles "Mac" Andrew, Independence, Missouri

Public Works Department:

Michael Hale, Overland Park, Kansas
Heath Courtney, Platte County, Missouri

Others:

Stephen Bone, Lakewood Property Owners Association
Bob Daly, Bonner Springs, Kansas City Commissioner
Julie Lorenz, Public Involvement Specialist, Woodward-Clyde
Phylis Hancock, Mid-America Association of Conservation Districts

Sponsors:

Mid-America Association of Conservation Districts (MAACD)
Great Rivers Chapter of the International Erosion Control Association
Kansas Department of Health and Environment (KDHE)
Missouri Department of Natural Resources (MDNR)
USDA-Natural Resources Conservation Service in Kansas and Missouri (NRCS)
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Introduction & Background Information

A. Purpose

Existing ordinances may need to be rewritten if land conservation and water quality are to be considered in the face of ever-expanding community development. Specifically, ordinances may need to be revised to address water quantity, sedimentation and water quality. The current trend is for local governments to consider entire watersheds when making these changes to local ordinances. Also, planners and developers who are required to submit Erosion and Sediment Control Plans may need guidance.

Long term planning needs to be encouraged. Large cities are being challenged to establish thousands of new living units per year. Some developers are planning whole communities with large open lots, while others are planning for communities with intensive housing and large open "neighborhood" spaces.

The key in either situation is long term planning. Planners and developers need to be given the latitude to work with natural landforms. Some are willing to reduce impervious areas, plant more trees and incorporate features such as wetlands (with observation platforms) to address stormwater management. Incentives could be provided for those planners and developers who are willing to address long-term environmental concerns.

Outdated ordinances can often serve as roadblocks to environmentally sound development. Developers have identified roadblocks such as the 66-foot road right-of-way requirement, the maximum 6% grade requirement and the cul-de-sac limits. Research has indicated that the 66-foot road right-of-way requirement was based on a historical measurement, being the length of one chain. A Michigan developer, who was planning a 10-year, 300-acre project with numerous wetlands, was able to work with the city to reduce road width to allow for minimal impervious surfaces. He was also able to increase maximum grades to allow for the use of natural landforms and to use cul-de-sacs that would accommodate snowplows.

"A planned development can consume about 45% less land, cost 25% less for roads, 15% less for utilities and 5% less for housing."

Watershed Protection Techniques — June 1997

This handbook was created to help interested communities improve water quality and comply with federal, state and local laws and regulations regarding stormwater runoff. Specifically this handbook will help:

County Conservation District Boards promote the development of environmental policies to improve stormwater runoff control.

Local community leaders develop public policies to reduce erosion and prevent sediment from leaving construction sites. A variety of approaches are used by local governments to develop erosion and sediment control ordinances. A summary of these approaches from across the country is included to help local officials determine an approach that will best fit their community.

Site planners and plan reviewers select conservation practices in order to achieve an acceptable level of control on a project.

Contractors, developers and consultants select erosion control practices and prepare plans to reduce erosion on construction sites. This handbook also contains information regarding erosion and sediment control plan recommendations ranging from small to large tracts of land. Successfully mitigating soil losses on urban construction sites reduces on-site and off-site environmental damage and provides substantial economic savings to developers and the general public. When implemented properly, erosion and sediment control measures:

- Control soil movement to a point where there is only minimal loss of this very precious resource;
- Reduce appreciable damage which occurs to off-site receiving channels; and
- Enhance project aesthetics before, during and after development and fewer complaints are received from concerned government agencies and citizens because of sediment in streets, streams and lakes.

The remainder of this chapter highlights the economic costs and benefits of erosion and sediment control, provides a brief technical review of the problem and finally suggests approaches to creating public awareness of the problem.

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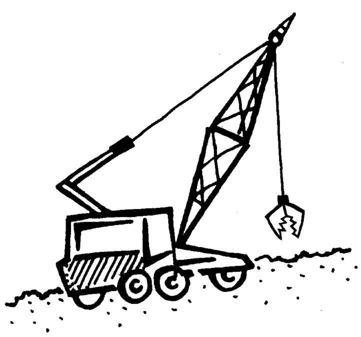
B. Economics of Erosion and Sediment Control

1. Costs of Uncontrolled Erosion and Sedimentation

Sediment from urban erosion is often an overlooked cost. It is a direct expense to taxpayers, adjacent landowners and developers as demonstrated below.

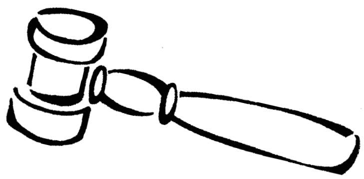
■ ***Taxpayers*** fund the vast majority of sediment cleanup expenses caused by urban construction. Waterways and navigable waters are filling with sediment at an accelerated rate. The United States Army Corps of Engineers spends about $500 million each year on dredging costs. The Environmental Protection Agency estimates that as much as $13 billion of taxpayer's money is spent every year to mitigate the offsite impacts of erosion. Public maintenance crews must clean road ditches and storm drains when the capacity is reduced by sediment deposits. For example, the direct cost of cleanup of sediment due to urban construction sites in Lawrence, Kansas, during 1994 was over $25,000. Public water supplies are also impacted when water treatment expenses increase due to excessive sediment.

In addition to these direct costs of cleanup, other costs are difficult to measure monetarily. The reduced capacity of road ditches, streams and lakes leads to increased flooding. Sediment, along with attached pesticides, herbicides and nutrients negatively affects water quality which directly impacts vegetation, wildlife habitat and recreation areas. These ecological costs directly impact the quality of our environment.



■ ***Landowners*** located downstream of construction sites incur the expense of cleaning up sediment deposits. Accelerated sediment loads reduce the capacity of streams, ponds and lakes. Direct expenses are incurred when excessive sediment loads must be dredged to restore the capacity of the lake. For ex ample, Weatherby Lake Association, Platte County, Missouri, incurred the expense of dredging the lake to remove sediment. Within five years the same areas had to be dredged again due to construction activities upstream. The Weatherby Lake Association spends an average of more than $100,000 annually to maintain the capacity of the lake. This expense includes the dredging operations plus the cost of additional land necessary for sediment disposal. The cost of removing the sediment, transporting it off site and disposing of it averaged over $8 per cubic yard. Additionally, silt layers can destroy lawns and a safety hazard is created when sediment covers streets and sidewalks.

■ ***Developers*** incur expenses when no plans are made for erosion control. Topsoil is a precious commodity because it provides a quality growing medium for vegetation. When topsoil is lost due to uncontrolled runoff, developers must purchase additional topsoil. They pay to have the new topsoil hauled and spread onto the site. The cost to regrade an area when gullies form during a rainstorm is an expense that could have been avoided with low cost erosion control measures.



Erosion and sediment from work sites is more than just a nuisance for workers. Safety hazards are created and productivity is reduced when workers must contend with blowing dust, flooded job sites and sediment deposits.

Other costs involved with uncontrolled sediment from work sites include litigation expenses which are becoming increasingly common. Developers and builders who do not meet the minimum sediment control and water quality standards established by federal, state or local statutes face lawsuits from homeowners and lake associations.

2. Benefits of Erosion and Sediment Control

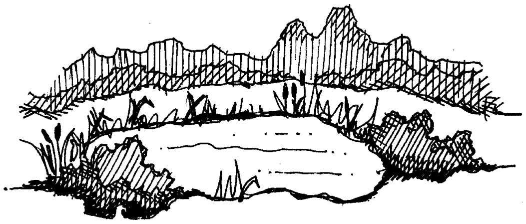
Urban erosion and sediment control provide benefits that are shared by everyone. Properly installed erosion control practices provide direct benefits to the developer. Sites are more aesthetically pleasing without barren areas, sediment deposits and gullied areas. Work sites are more efficient and safer when the hazards of blowing dust, and flooded and muddy work sites are eliminated. Complaints from downstream neighbors are reduced, and potential expenses due to litigation are avoided.

In fact, erosion and sediment control practices can actually add value to property. A practice becoming more prevalent is for site developers to create ponds, lakes or wetlands to control flooding and reduce the impacts of urban runoff on neighboring natural streams, lakes or coastal areas. When designed and sited correctly, artificial lakes or wetlands can help developers reduce negative environmental impacts caused by the development process and increase the value of the property. A 1991 American Housing Survey conducted by the Department of Housing and Urban Development and the Department of Commerce also concurs that “when all else is equal, the price of a home located within 300 feet from a body of water increases by up to 27.8%.”

...erosion and sediment control practices can actually add value to property.

Although there is a limited number of natural waterfront sites adjacent to lakes, rivers and streams, many opportunities exist to create waterfront property. Homes and businesses can be sited along hydroelectric or water supply impoundments or near the banks of artificial lakes created for wildlife, recreation or aesthetic reasons. In Wichita, Kansas, the owner of 72 acres of land had planned to import soil to fill in a wetland before building a subdivision. Persuaded to enhance the natural wetlands instead, the owner constructed a lake which created a deep water wetland habitat. These water-bodies became an important feature and selling point of the development. The lake waterfront lots sell at a premium of up to $21,000 more than comparable lots with no water view.

Urban runoff “wet ponds” are another important erosion control practice. Wet ponds, as their name implies, are runoff holding facilities that have water in them all the time. Like wetlands, wet ponds serve two important functions. They control the peak flow rates of water released from a site, thereby controlling downstream flooding, and they also allow pollutants to be removed from the water. Storm flows are held in the pond temporarily and then released to maintain healthy downstream habitats. Sediment and other pollutants settle out of the water and are not discharged to the receiving waters. Wet ponds can be highly effective in removing sediment and reducing nutrients if they are properly constructed and maintained.



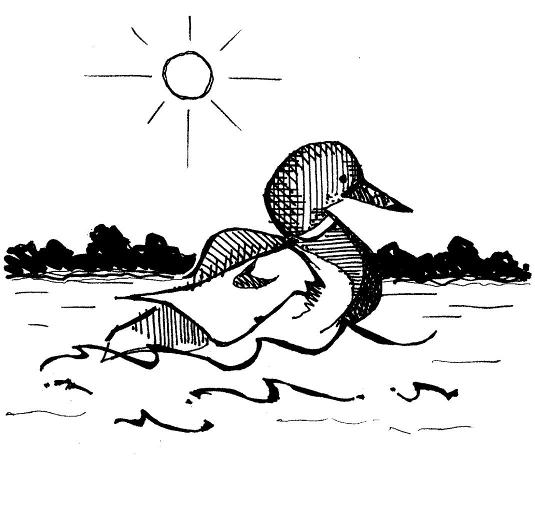
Many ponds planned for urban runoff control are also designed to resemble natural systems and can provide recreation facilities. Ponds are often surrounded by walking trails, picnic areas, gazebos and birdhouses, and provide excellent areas for birdwatching and enjoying all types of wildlife. This natural setting creates a home for a variety of wildlife that homeowners find appealing.

A survey of the residents in Columbia, Maryland, showed that residents preferred urban runoff ponds that contain permanent pools of water, wetlands and wildlife over the dry ponds many municipalities prescribe for their subdivisions. Overwhelmingly, 94% of residents believe that managing future runoff basins for fish and wildlife as well as flood and sediment control would be desirable. Perhaps most importantly, 75% of residents felt that permanent bodies of water added to real estate values and 73% said they would pay more for property located in a neighborhood with stormwater control basins designed to enhance fish or wildlife use.

Value, added by well designed runoff controls, occurs for both residential dwellings and commercial buildings. County tax records reveal that land values in Franklin Farms, an established residential neighborhood in northern Virginia, are highest when located within view of the five acre urban runoff detention area, which is surrounded by a walking path furnished by the developer. Waterfront homes in the neighborhood sold for 10% to 20% more initially and again at resale than land with no water view.

Commercial property in Laurel, Maryland, has created an attractive wet pond system. Office space fronting the water rents at a premium of $100-200 per month depending on the size and layout of the office space. Real estate brokers agree that, when all else is equal, commercial waterfront office space rents considerably faster than space that doesn't front water. In a saturated real estate market, property with a water view might not rent for a premium, but it will always sell or be rented more quickly which provides a more steady flow of income and fewer vacancies for the realtor.

Most local governments require some form of urban runoff management for new development. Landscape design can be incorporated into sediment control and stormwater management planning to enhance the value and quality of the development. Homeowners enjoy the beauty and tranquility of water and wildlife. The natural surrounding increases real residential property values while also enhancing the quality of life.



C. Environmental Impacts

1. Introduction

Soil erosion occurs as the surface of the land is worn away by wind, water, ice and gravity. Natural or geological erosion has been occurring at a relatively slow rate since the earth was formed and has been a tremendous factor in creating the earth as we know it today.

Although there has always been a certain amount of erosion that occurs naturally, there are many human activities which accelerate soil erosion. This handbook focuses on accelerated erosion from urban construction sites which often causes considerable economic, ecological and social damage. The principle effect that land development activities have on the natural erosion process comes from exposing soils to precipitation and surface stormwater runoff. The physical properties of the soil itself are changed when the protective vegetation is removed, excavations are made and the topography is altered. The exposed soil also becomes compacted by heavy equipment and is less porous.

Rainfall on unprotected soil causes serious erosion and results in sediment being deposited in waterways. Soil erosion from unprotected construction sites can result in rills, gullies, damaged slopes and loss of organic matter and nutrients. The construction site is damaged when the soil is detached and removed and the environmental problems are compounded when the soil is deposited as sediment in another area. The typical construction site erodes at a rate of up to 100,000 tons per square mile per year. This rate is 200 times greater than erosion from cropland and 2,000 times greater than erosion from woodland. Sediment from construction sites can plug drainage structures and culverts and flood work areas. Stream channels can become so filled with sediment that the flow elevation is raised enough to flood areas adjacent to the stream.

Sediment can destroy an area for its intended use. For example, sediment buries crops and lawns, kills trees, fills ditches and impedes drainage systems. Sediment reduces the storage capacity of reservoirs and fills small ponds and lakes. It also degrades water quality and damages aquatic life. Sediment that reaches waterways such as the Mississippi River requires the navigation channels to be cleared on a continuous basis.

...urbanization significantly increases pollutants in runoff.

Almost without exception, urbanization significantly increases pollutants in runoff. Runoff from rain or snow in urban areas occurs more rapidly, thus increasing erosion potential. It washes pollutants off the land and into storm sewers or other drainage areas. Sediment in runoff from construction sites can serve as a carrier of trace metals, nutrients, bacteria and chemicals. Urban runoff may contain salt, heavy metals and organic chemicals (oils and grease) from streets and parking lots, fertilizer, pet wastes, leaves and grass clippings from residential areas.

Many people believe that runoff from urban areas is "clean" and does not harm water quality. This perception is understandable since the amount of pollution from any one spot is usually so small that it would be insignificant if it were the only source. But when all the small amounts are combined, they can cause big water quality problems. Urbanization also introduces contaminants such as lawn chemicals and motor oil drippings that were not present before.

2. Effects of Urbanization on Soil and Water Quality

When phosphorus and nitrogen from fertilizer, pet wastes, leaking sewers and other sources reach streams and lakes, they serve as nutrients that enable abundant algae growth. Algae blooms are aesthetically displeasing and they cause taste and odor problems. Also, when algae decays, it utilizes the dissolved oxygen in streams. When dissolved oxygen is reduced, fish and other aquatic life become susceptible to illness or even death. It takes very little phosphorus to cause algae to grow and ultimately reduce dissolved oxygen levels. Excessive quantities of salts, heavy metals and organic chemicals from pesticides, oils and grease can also be hazardous to fish, macroinvertebrates and wildlife that depend on quality water. Increased contaminants in streams or groundwater that serve as public water supplies result in an increased need for treatment before the water is acceptable for consumption. Excessive disinfection can result in chlorine by-products such as trihalomethanes and haloacetic acids. Some of these compounds are listed on EPA's health advisory listings as probable human carcinogens.

FIGURE 1-1: **Typical Impervious Cover Percentages**

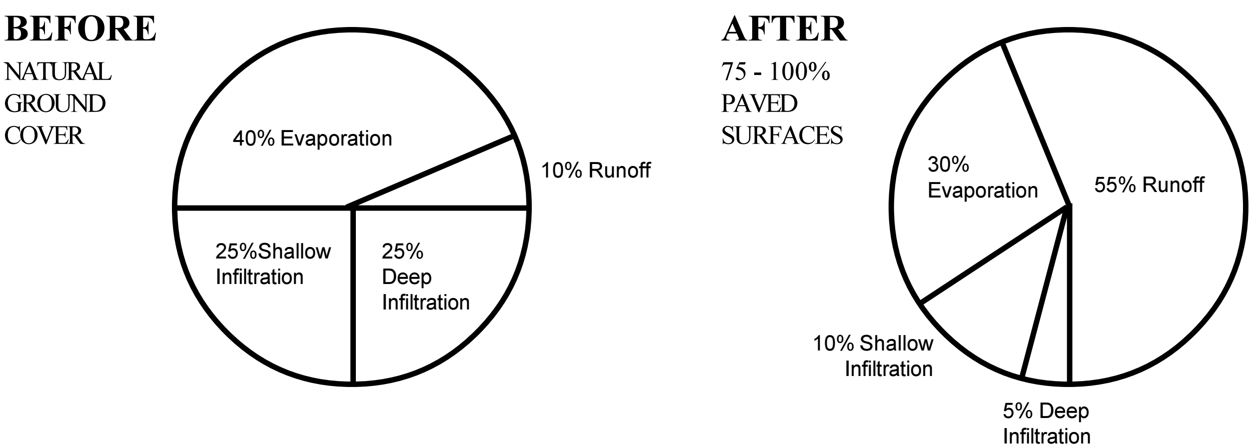
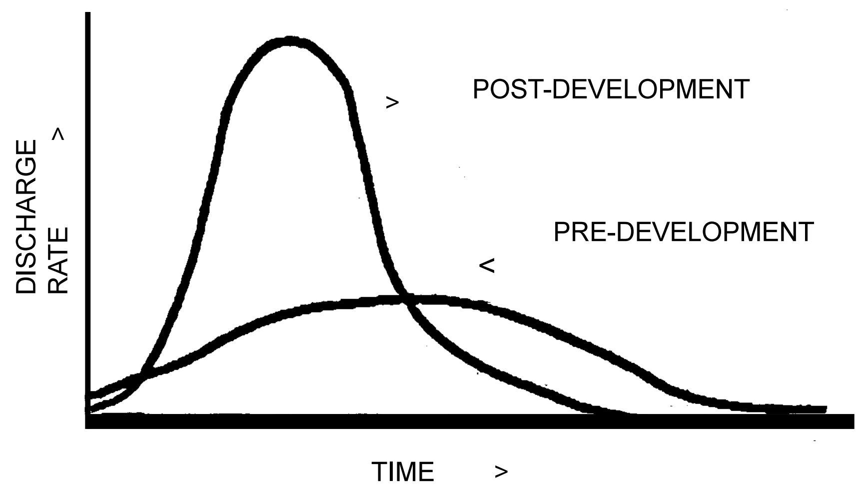


TABLE 1-1: **Typical Impervious Cover Percentages**

LAND USE	PERCENT IMPERVIOUS COVER
Business District or Shopping Center	95-100
Residential, High Density	45-60
Residential, Medium Density	35-45
Residential, Low Density	20-40
Open Areas	0-10

There are two main reasons why urbanization increases pollutant loads in runoff. First of all, the volume and rate of runoff are typically increased as an area is developed, providing a larger capacity to transport pollutants. The second reason is that some materials are made more available for loss in runoff as the intensity of the land use increases. **Studies by the Center for Watershed Protection indicate that even relatively low levels of impervious surface coverage – only 10% to 15% of the land area – can make it difficult to maintain stream quality.** The following section describes these hydrologic effects and the pollutants commonly associated with urban watersheds.

FIGURE 1-2: **Pre- and Post-Developmental Hydrographs**



Although many of the effects discussed here relate to surface water quality, it is important to remember that groundwater quality can also be adversely affected by urbanization. The greatest potential for groundwater pollution comes from pollutants that are soluble in water and are not readily trapped or treated by the soil during percolation.

Drastic changes in the local hydrology results from development. As land is covered with roads, buildings and parking lots, the amount of rainfall that can infiltrate into the soil is reduced. This increases the volume of runoff from the watershed. Figure 1-1 shows the relationship of runoff, infiltration and evaporation for watersheds with varying degrees of impervious cover. Typical impervious cover percentages are shown in Table 1-1.

When an urban area is developed, natural drainage patterns change as runoff is channeled into roar gutters, storm sewers and paved channels. These changes increase the velocity of runoff, which decreases the time required to convey it to the mouth of the watershed. This results in higher peak discharges and shorter times to reach peak discharge. Figure 1-2 shows typical pre-development and post-development runoff. The area below the line represents the volume of runoff. The increased volume of runoff after development is significant because of the increased pollutant loading it can deliver as well as potential flooding and channel erosion.

Higher flows can cause flooding and have adverse effects on natural streams. In addition to regular flood damage, higher flows cause previously stable channels to erode and widen. Sediment from streambank erosion eventually settles and silts in streams, rivers and lakes. These changes in hydrology, combined with increased pollutant loadings, can have a dramatic negative effect on water quality.

3. Factors Influencing Erosion

Water and wind erosion are influenced by several factors as summarized in Table 1-2. Those factors are described below.

TABLE 1-2 **Various Factors Influencing Water and Wind Erosion**

	SOIL ERODIBILITY	CLIMATE	VEGETATIVE COVER	TOPOGRAPHY	SEASON	UNSHELTERED DISTANCE	RIDGE ROUGHNESS
WATER EROSION	✗	✗	✗	✗	✗		
WIND EROSION	✗	✗	✗	✗		✗	✗

Soil Erodibility. The soil type determines how vulnerable the soil is to erosion. Properties determining how easily a soil erodes include: texture, structure, organic matter content and permeability. The most erodible soils generally contain a high percentage of fine sand and silt. The presence of clay or organic material tends to bind soil particles together and resist erosion. But, while clays resist erosion, they are easily transported once they have eroded. Well-graded and well-drained gravels are usually the least erodible soils.

Climate. Rainfall characteristics such as frequency, intensity and duration directly influence the amount of runoff that occurs. As the frequency of rainfall increases, water has less of a chance to drain through the soil between storms. When this happens, the soil will remain saturated for longer periods of time and the volume of stormwater runoff may be greater. Erosion risks are high where rainfall is frequent, intense or lengthy. Wind erosion risks increase as wind velocities and precipitation increases.

Vegetative Cover. Vegetative cover is an extremely important factor in reducing erosion from a construction site. Vegetation protects soil from the forces of raindrop impact and runoff scour. While the top growth shields the soil surface from the raindrop impact, the root mass holds the soil particles in place. Grass buffer strips can be used to filter sediment from surface runoff. Grasses also slow the speed of runoff and help maintain the infiltration capacity of the soil. Establishing and maintaining vegetation are the most important factors in minimizing erosion during development. Vegetative cover is very effective in reducing erosion from wind. The cover reduces wind velocities at the soil surface, and the root mass holds the soil in place.

Topography. Slope length and steepness influence both the volume and velocity of surface runoff. Long slopes produce more runoff. Steep slopes increase runoff velocity. Both situations increase the potential for water erosion to occur. Short but steep slopes on the prevailing wind direction side will increase the wind erosion potential.

Season. Frozen soils are relatively erosion resistant. However, a high erosion potential may exist in the spring when the surface soils first thaw and the ground underneath remains frozen. A low intensity rain may cause serious erosion because the frozen subsoil prevents water infiltration. Erosion increases during the summer months because of more frequent, intense rains.

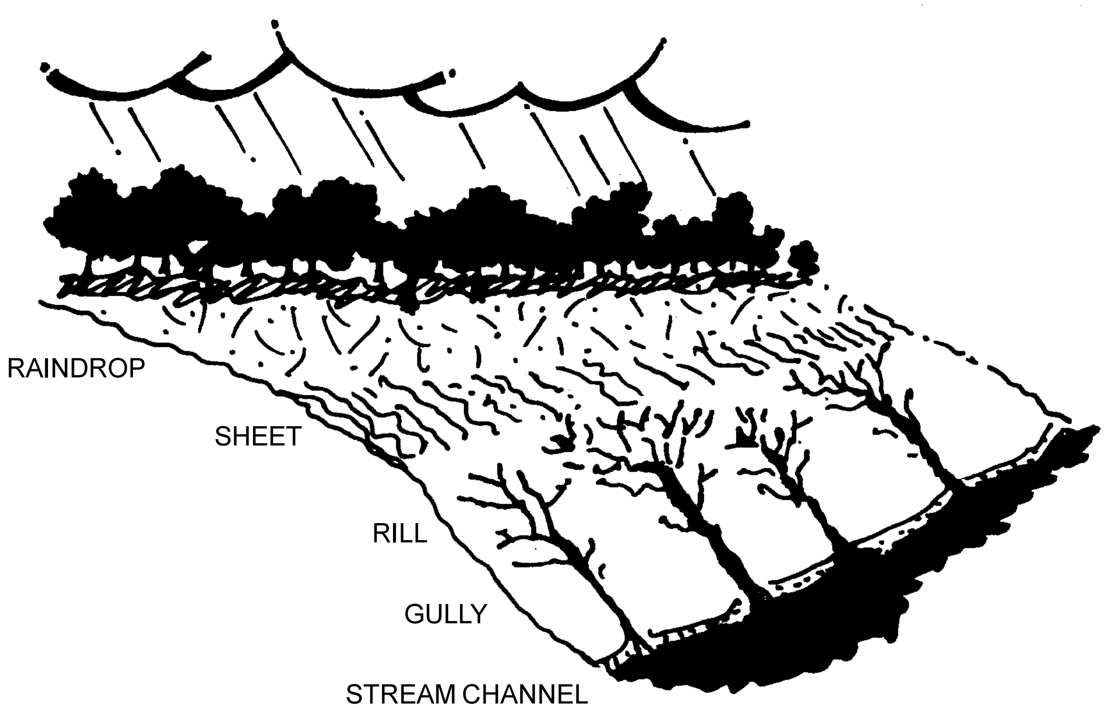
Unsheltered Distance. The unsheltered distance along the prevailing wind direction of an area is important when wind erosion is a hazard. The distance is determined by the downwind edge of the given area to a sheltered or stable point in the direction of the prevailing wind. A buffer or barrier may include dense trees, grass, roads and buildings.

Ridge Roughness. The soil ridge roughness is important when wind erosion is a hazard. The ridge roughness relates to the height and spacing of furrows made by tillage and planting implements. The size of soil aggregates or "clods" is also included as a factor for soil roughness. The roughness helps reduce wind velocities at the soil surface. Clods larger than one half inch are less susceptible to wind erosion.

4. Types of Erosion

In order to effectively deal with erosion problems, five major types of water erosion and three major types of wind erosion must be understood so that appropriate control measures can be selected.

Five Major Types of Soil Erosion on an Exposed Slope



a. ***Raindrop Erosion (Water)*** When the vegetative cover is destroyed, the soil becomes directly exposed to the impact of raindrops. The soil particles are separated as raindrops strike the bare soil. The pounding action of the rain destroys the soil structure. As the soil dries, a hard crust often forms. This crust slows plant growth and reduces water infiltration, which then increases future runoff and erosion. Raindrop erosion is related to rain intensity and raindrop size. Some splashed particles may rise as high as 30 inches and move as much as 60 inches horizontally.

b. ***Sheet Erosion (Water)*** The movement of soil particles which are suspended in water and flowing over the soil surface is referred to as sheet erosion. The shallow moving sheets of water are not usually a detaching agent, but the flow of water does transport soil particles that have become detached by raindrop impact. The shallow water usually moves as a uniform sheet for only a few feet before concentrating in low spots and other uneven spaces.

c. ***Rill Erosion (Water)*** Rill erosion begins when the shallow flow begins to concentrate in the low areas of the soil surface. When the flow begins to change from a sheet flow to a deeper flow in the low areas, the turbulence and velocity of the water in the low areas increase. This deeper flow now has the energy to both detach and transport the soil particles. The small channels cut in the soil surface by this action are called rills. For the most part, rills are well-defined channels which are only a few inches deep.

d. ***Gully Erosion (Water)*** Rills become gullies when runoff cuts much deeper and wider channels or when two or more rills are combined into a large channel. Gullies can become enlarged both up or down slope. In some soils, a heavy rain can change a rill into a major gully in a very short time. Gullies are difficult to stabilize and costly to control.

e. ***Channel Erosion (Water)*** Channel erosion occurs when the velocity of the flow in a stream is increased or when the bank vegetation is damaged or destroyed. This type of erosion is most common at bends in the stream or where the flow is restricted. Damage may also occur where storm drainage is discharged into the main streams. Stream banks are difficult and expensive to repair.

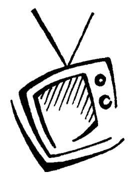
f. ***Saltation (Wind)*** Fine and medium sand-sized particles move mainly by saltation. They are lifted only a short distance into the air and then fall back to the ground and dislodge more soil. Referred to as the “bouncing particles,” they are lifted off the ground at a 50- to 90-degree angle and travel a distance of 10 to 15 times the height they are lifted. The spinning action and forward/downward movement of these particles give them extra power to dislodge other soil particles when they hit the ground and to break down large clods into smaller pieces of soil that can be carried by the wind. Saltation also destroys stable surface crusts creating a more erodible condition. This process accounts for 50% to 80% of the total soil movement.

g. ***Surface Creep (Wind)*** Surface creep is the movement of larger (sand-sized) soil particles along the surface of the soil. These particles are loosened by the impact of saltating particles, but they are too large to be lifted off the ground in most winds. They move along the soil surface in a rolling motion. Surface creep can account for up to 25% of the soil moved by the wind.

h. ***Suspension (Wind)*** Suspension refers to the process by which very fine soil particles are lifted from the surface by the impact of saltation, carried high into the air and remain suspended in air for long distances. This “dust” can be blown hundreds of miles. The diameter of suspended soil particles is only about one-eighth the thickness of a dime or less. Although they account for only a small part of the total soil moved by wind, these small particles are the most fertile part of the eroded soils.

D. Creating Public Awareness

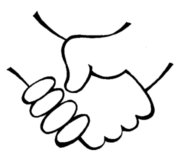
The following are suggested activities that county conservation district boards and local community leaders have used to create public awareness and garner support for developing and implementing environmental policies.



Media

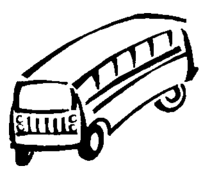
Encourage radio stations, television stations and newspapers to cover local stories about sediment control. Newsletters from conservation districts, homeowners associations and wildlife organizations can also help spread the word about urban erosion and sediment control.

Adopt-A-Legislator



Contact the local legislators personally and on a regular basis to keep them informed of local issues that need to be addressed. Use your personal contacts with local policymakers to impress upon them the significance of urban erosion and sediment problems.

Tours



Target specific groups and focus the content of the tour on the audience. A legislator's tour could focus on local conditions with the emphasis on the cost of sediment cleanup. A tour for developers could include information on construction techniques and erosion control product prices and availability. A tour for the general public could focus on the contrast between development sites with and without properly applied sediment control practices.

Success Stories

Neighboring cities that have effectively implemented a sediment control ordinance can serve as good examples. Request a guest speaker to explain how their program works, provide an estimate of the amount of tax money saved due to the ordinance and the projected savings based upon reduced sediment loads.

Conservation Awards

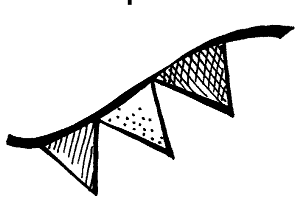
Create an awards program to publicly recognize individuals, groups or organizations that are innovative in their use of sediment control products and techniques.

Meetings/Seminars/Conferences

Attend local, regional and national conferences focusing on urban sediment control issues, technology transfer and education both for professionals and the general public.

Special Events

Sponsor well planned community events that bring awareness to urban conservation issues such as street fairs, a run for conservation (10 K road race or fun run), community dinners or self-guided tours.



Direct Mailings

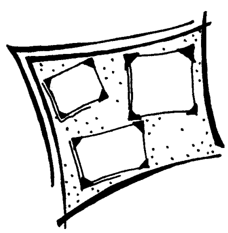
Secure the support of neighborhood groups and lake associations who are directly affected by the lack of sediment control. Produce and mail educational material to those groups.

Volunteers

Utilize volunteers to monitor environmental activities. For example, the Natural Resources Conservation Service has an Earth Team volunteer program. The Kansas Department of Health and Environment has a Kansas Water Monitor Program to address pollution prevention for lakes. Kansas Water Watchers and Missouri Stream Teams are volunteer groups that collect water samples to examine water quality changes over time. Schools, youth organizations and corporations can sponsor and organize volunteer programs.

Guest Speaker

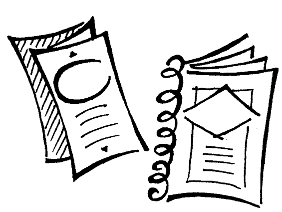
Serve as a guest speaker on sediment control issues. Civic and service organizational gatherings such as the conservation district's annual meeting is also a public meeting where urban concerns could be addressed.



Board Displays

Photographs of treated and untreated conditions have a strong impact on the general public, particularly if the photographs are taken locally. Set up the display in well traveled public places to increase visibility.

Handouts/Brochures/Pamphlets



Produce education materials which focus on local issues and provide them to the public at events such as county fairs; flower, lawn and garden shows and Earth Day activities.

These are only a few methods successfully used to create awareness of environmental issues. This is by no means a complete list. Ways to create awareness are limited only by your imagination.

It is important to network with other agencies and groups to create a sense of ownership in the sediment control ordinance. The more ideas generated, the better the chance for success, so include as many groups as reasonable and productive. In order to work effectively with the groups involved, you must be able to see the issue from their vantage point and to describe benefits from their perspective. For example, conservation district boards can promote erosion control in the following ways:

- Assist local policymakers to focus on why an erosion control ordinance is needed, what benefits it will provide and how the program will be funded;
- Encourage constituents to verify that sedimentation problems are not being controlled by voluntary efforts;
- Contact the Public Works Department to get an estimate of the expense required to clean up the sediment from construction sites;
- Contact neighboring cities with an established sediment control ordinance for a description of the benefits realized since the ordinance was adopted; and
- Work with the local planning department and the builders associations during the early stages of developing a sediment control ordinance. The planning staff can provide assistance in developing an ordinance that can be consistently and effectively enforced. The developers and builders will be directly impacted, so it is important to request their input early in the process to minimize possible future conflicts.

Work with the local planning department and the builders associations during the early stages of developing a sediment control ordinance.

Guide for Developing Policies/ Ordinances: Addressing Stormwater Erosion & Sediment Control

...a one-size-fits-all approach or model ordinance does not adequately recognize the economic, ecological and social diversity found within local governments.

This chapter will help local community leaders develop ordinances for erosion and sedimentation control by summarizing the different approaches used by governments from across the country. This guide is based on the assumption that a one-size-fits-all approach or model ordinance does not adequately recognize the economic, ecological and social diversity found within local governments. Several policy options will be briefly described under each major section of a typical ordinance, including:

- ***purpose;***
- ***definition;***
- ***general principles;***
- ***applicability;***
- ***design and performance standards; and***
- ***site plan reviews and enforcement.***

If more specific information about an option is needed, the "For Additional Information" section of this handbook identifies a local contact for the city or state where the option is being used. This information can be useful as policy makers decide which approach would best fit the needs of the local community. As an alternative to writing an ordinance, a unit of government may address the erosion/sedimentation concern by adding to or revising their existing subdivision zoning or land use regulation.

Procedures and requirements; i.e., standards, specifications and control measures, should be as detailed or refined as deemed necessary. Small or rural communities may find that issuing a construction erosion/sedimentation resolution will also suffice. Erosion/sedimentation controls are also contained in Chapter 30, 1994 edition of the Missouri Uniform Building Code. The Uniform Building Code is used by many cities and can be revised, modified or adopted in whole or part by any local government at the discretion of local officials.

It is important to work with the state agency responsible for implementing the Clean Water Act federal regulations for the National Pollution Discharge Elimination System (NPDES). In Kansas the state agency responsible for issuing NPDES permits is the Kansas Department of Health and Environment. In Missouri, NPDES is administered by the Missouri Department of Natural Resources, Water Pollution Control Program, Permit Section. Local regulations must be at least as strict as the NPDES requirements.

The United States Environmental Protection Agency has delegated the authority to issue and enforce NPDES permits to both the states of Kansas and Missouri. The states cannot delegate this authority furthur to a local government. However, local governments may provide review of erosion and sediment control planning and implementation and develop their own authority. In Missouri the local authority can also provide their erosion and sediment control plan for state approval. If approved, adherence to that plan can be used to meet NPDES permit requirements. This guide provides information for local governments to write a local erosion and sediment control ordinance to establish local standards to complement state programs.

A. Purpose

Most ordinances briefly describe why the ordinance is necessary. The purpose of an erosion and sediment control ordinance is to protect the soil resource and reduce sediment pollution. This section can be tailored to include specific problems the local community is currently facing. A review of Chapter 1 of this handbook may be helpful. Below is a summary of often used points for this section of the ordinance.

1. The Erosion Process

Soil erosion is the process by which the land's surface is worn away by the action of wind, water, ice and gravity. Natural or geological erosion has been occurring at a relatively slow rate since the earth was formed, and is a tremendous factor in creating the earth as we know it today. Except for some cases of stream channel erosion, natural erosion occurs at a very slow and uniform rate and remains a vital factor in maintaining environmental balance.

2. Accelerated Erosion

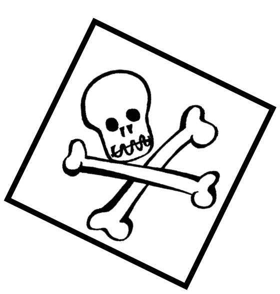
There are many human activities which accelerate soil erosion. The principle effect that land development activities have on the natural erosion process consists of exposing disturbed soils to precipitation and to surface storm runoff. When the protective vegetation is removed, excavations are made and the topography altered, the physical properties of the soil itself are changed. The exposed soil also becomes compacted by heavy equipment and is less porous. As a result, measurements of sediment yields in streams have indicated that developing watersheds contribute from 5-200 times as much sediment as stable, urbanized watersheds.

3. Erosion and Sediment Hazards

Uncontrolled erosion and sediment from development areas often causes considerable economic, ecological and social damage. Potential hazards associated with development include:

a. Increases in sedimentation yield higher levels of nutrients and toxicants into our streams and rivers. Sediment acts like a magnet for toxicants, trace metals and nutrients which can have a profound effect on the environment. It has been demonstrated that urbanization and associated sedimentation reduces the diversity of fish populations in streams as well as the organisms that fish feed on.

b. An estimated four billion tons of sediment reach the ponds, rivers and lakes of our country each year. Approximately 10% of this amount is contributed by erosion from land undergoing highway construction or land development. Although this amount may appear to be small compared to the total, it is significant because it represents more than one-half of the sediment load carried by many streams draining small subwatersheds which are undergoing development.



c. Sediment fills drainage channels and plugs culverts and storm drainage systems which require frequent and costly maintenance.

d. Municipal and industrial water supply reservoirs lose storage capacity.

e. Sediment in an aquatic environment drastically reduces the kinds and amount of organisms and their viable eggs.

f. The abrasive action of coarser-grained material in the sediment accelerates scour erosion.

g. Sediment on roadways and blowing dust endangers the health and safety of users by decreasing traction of road vehicles and the visibility of drivers.

h. Sedimentation and its attached contaminants limit the use of water and waterways for beneficial uses, including water supply, navigation, recreation, fisheries resources, drainage and flood control.

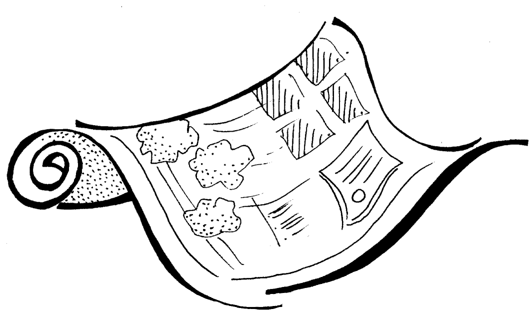
i. Rivers, streams and drainage channels clogged with sediment will increase the frequency and severity of flooding due to the decreased capacity.

B. Definitions

This section of the ordinance defines the key words used within the ordinance. The names of local departments, titles of local officials and the policies and regulations referred to within the ordinance are commonly defined. Please refer to the glossary in this handbook for definitions of technical terms.

C. General Principles

A section describing general principles is often used in ordinances to help guide the procedures used to implement the ordinance. The following are often used guidelines to follow for reducing the hazards of erosion and sediment from a construction site.



1. It is always less expensive to prevent erosion and water quality degradation at the source than it is to clean up problems caused by sediment. Effective sediment control begins with a comprehensive erosion and sediment control site plan. Sediment control should be an integral component of any construction plan. The continuing maintenance requirements of erosion and water quality control practices should be considered during the design phase.

2. Evaluate the topography and soils. Development should be related to the site to create the least potential for erosion. Areas of steep slopes where excessive cuts and fills are required should be avoided whenever possible and natural contours should be followed as closely as possible. Avoid potential problems posed by the soil's limitations such as flooding hazards or limited suitability for use as septic tank absorption fields, building foundations or roadways.

3. Provisions should be made to accommodate the increased runoff caused by changed soil and surface conditions during and after development. Drainageways should be designed so that the final gradients and the resultant velocities and rates of discharge will not cause additional erosion onsite or downstream.

4. Install perimeter sediment control practices before any land is disturbed. Sediment and runoff control measures such as sediment basins, traps, filter barriers or diversions should be installed and functional prior to site clearing and grading. These practices should be maintained on a regular basis to remove sediment that accumulates from runoff waters.

5. Protect critical areas. Limit the disturbance of natural vegetation wherever possible, especially areas adjacent to natural watercourses and wetlands. In Missouri, the NPDES permit requires a 50 foot buffer area be maintained beside bodies of water described as Valuable Resource Waters. (See Appendix C)

6. Schedule construction activities to limit disturbance to the smallest practical area for the shortest practical time. Do not disturb the entire area if only part of the site will be developed initially. Maintain the remainder of the site in natural vegetation until it is necessary to disturb it.

7. Reseed or mulch exposed soil as soon as possible. Protect areas with a temporary or permanent layer of vegetation or mulch to reduce the erosion hazard. (See "Protecting Water Quality" handbook printed by the Missouri Department of Natural Resources.)

D. Applicability

This section will describe three options to identify the situations where the ordinance shall apply. All the options should include a statement exempting "normal agricultural production practices." (See clarification of Exemption of Agricultural Activities, Missouri Regulations, May 1994, Appendix D)

Option 1: Provide local review and enforcement of a National Pollutant Discharge Elimination System (NPDES) permit. An NPDES permit is authorized and enforced by the Environmental Protection Agency or a designated state agency. In Kansas, NPDES is implemented by the Kansas Department of Health and Environment (KDHE) and in Missouri by the Missouri Department on Natural Resources. In most states, including Kansas and Missouri, this permit is required for development sites five acres or greater. A local site plan review, along with the NPDES permit review, would provide a more consistent planned level of erosion and sediment control in the community. Local enforcement would also provide consistent enforcement of the site plans.

Option 2: Provide local review and enforcement to developed areas less than what NPDES would require. For example, any development project five acres or less would need a permit which would be reviewed and enforced locally. The EPA or the designated state agency would permit and enforce all projects greater than five acres. A word of caution: this option could cause inconsistencies with site planning and enforcement within the same community.

Option 3: Provide local review of all land disturbance projects 5,000 square feet or larger (Delaware). Communities often use between 500 square feet (Oregon) and 10,000 square feet (Virginia) for projects needing a permit. The size is determined by the severity of the sediment pollution problem in the community. Some projects would need both an NPDES and a local permit.

E. Design and Performance Standards

1. Performance standards are the most commonly used methods to define what pollution limits will trigger a violation. However, the scientific data used to identify potential health risks at a specific pollution limit is often questioned. Performance standards are more reactive in approach and significant pollution damage may have occurred before a solution is implemented. To help ensure that a minimum level of protection is provided, some ordinances include a design standard along with the performance standard. An example of some of the performance standards various states have implemented are listed below:

Missouri:

- 2.5 ml of settleable solids per liter per hour
- 0.5 ml of settleable solids per liter per hour if project is near a "Valuable Resource Water"

Iowa:

- 5 tons/acre Universal Soil Loss Equation (USLE)

Portland, Oregon:

- 1 ton/acre USLE

Delaware:

- Achieve 80% of preconstruction conditions

2. Design standards are becoming more widely used because they are easier to understand and enforce. They state the conditions when a specific conservation practice or set of practices are to be used.

The following examples of design standards are from Illinois:

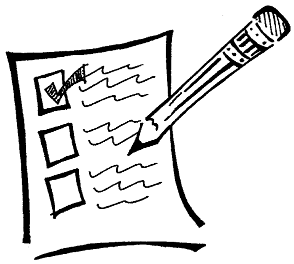
a. For disturbed areas draining less than one acre, filter barriers including filter fences, straw bales or equivalent control measures shall be constructed to control all off-site runoff. Vegetative filter strips, with a minimum width of 25 feet may be used as an alternative only where runoff in the sheet flow is expected.

b. For disturbed areas draining more than one but less than five acres, a sediment trap or equivalent control measure shall be constructed at the down-slope point of the disturbed area. The design for sediment basins will include the detention of stormwater runoff as well as sediment.

c. For disturbed areas draining more than five acres, a sediment basin or equivalent control measure shall be constructed at the down-slope point of the disturbed area.

F. Site Plan Reviews

The process of reviewing a permit request submitted in response to a local erosion and sediment control ordinance is referred to as a site plan, a plat review or an erosion and sediment control plan review. Most ordinances identify who is responsible for conducting the site plan review.



Sometimes the ordinance will provide the authority to establish a permit fee structure to collect the necessary resources to pay for the equipment and staff needed to implement the ordinance. This is highly recommended because it has been observed that effective erosion and sediment control programs collect permit fees for staff to do the work. Programs which do not have designated funding for site plan reviews and inspection usually do not achieve the goals set by the ordinance.

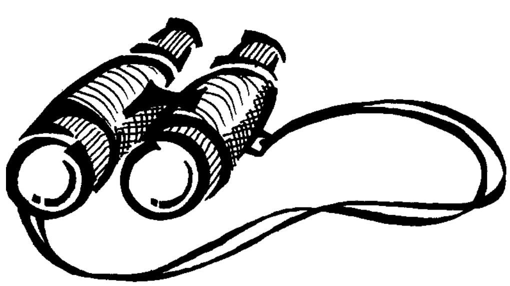
For example, in many eastern states such as Virginia, Maryland and New Jersey, local governments are authorized to establish a permit fee structure to support erosion and sediment control programs. A state review board must approve the local fee structure. Some state statutes prohibit the collection of funds beyond the level needed to support the erosion and sediment control program.

Most permit fees are collected on a per acre basis. For example, in Prince Georges' County Soil and Water Conservation District in Maryland they used the following permit fee structure in 1996:

	Total Amount
Application Fee ($15.00)	**$15.00**
First Disturbed Acre ($75.00)	**$75.00**
1 through 5 Acres ($50.00 per acre) ....ac. X $50.00 =	__________________
5 through 200 Acres ($15.00 per acre) ....ac. X $15.00 =	__________________
Total Fee Due:	**$**

G. Enforcement

Each state has different methods of inspection and enforcement of erosion and sediment control ordinances. Some have public inspectors, some have self inspectors and others have private inspectors. The frequency and method of inspection may also vary from state to state. For example, Missouri requires fewer inspections from the permittee than Kansas. Notice the differences in the following ordinances:



■ **Missouri -** The permittee shall ensure the land disturbance site is inspected on a regular schedule and within a reasonable time period (not to exceed 72 hours) following heavy rains. Regularly scheduled inspections shall be at a minimum once per month. For disturbed areas that have not been finally stabilized, all installed BMP's and other pollution control measures shall be inspected for proper installation, operation and maintenance. Locations where stormwater leaves the site shall be inspected for evidence of erosion or sediment deposition. Any deficiencies shall be noted in a report of the inspection and corrected within seven calendar days of the inspection. The permittee shall promptly notify the site contractors responsible for operation and maintenance of BMP's and deficiencies.

A log of each inspection shall be kept. The inspection report is to include the following minimum information: inspector's name, date of inspection, observation relative to the effectiveness of the BMP's, actions taken or necessary to correct deficiencies and listing of areas where land disturbance operations have permanently or temporarily stopped. The inspection report shall be signed by the permittee or by that person performing the inspection if duly authorized to do so.

■ **Kansas -** The permittee shall ensure the construction site is inspected on a regular schedule and within twenty-four hours of a storm which results in precipitation of 0.5 inch or greater. Regularly scheduled inspections shall be at least once per month. The permittee shall increase the frequency of inspections with the increase of construction activities. The state agency, KDHE, will conduct random field checks of all permits and all permits where someone has registered a complaint.

■ **Iowa -** Iowa law allows the owners or operators of the land being damaged by sediment runoff from eroding land to file a written and signed complaint with the Soil and Water Conservation District (SWCD). Upon receipt, the SWCD commissioners inspect the complainant's property to determine if the allegations are true. If the investigation finds sediment damage is occurring as a result of erosion in excess of the adopted limits, the SWCD commissioners will take action to have the erosion problem corrected.

State laws also allow district commissioners to file complaints if they believe excessive erosion is causing sediment damage to public property where public improvements have been made.

"Educate While You Regulate"

■ **Delaware -** Projects reviewed and approved by the Department of Natural Resources and Environmental Control for sediment control and stormwater management, in general, shall have a certified construction reviewer when the disturbed area of a project is in excess of 50 acres.

The certified construction reviewer shall function under the direction of a registered professional engineer licensed to practice engineering in the state of Delaware.

Individuals designed as certified construction reviewers shall attend and pass a departmental sponsored construction review training course. The course will contain, at a minimum, information regarding the following items:

1. Basic hydrology and hydraulics;
2. Soils information including texture, limitations, erodibility and classifications;
3. Types of vegetation, growing times and suitability;
4. Erosion, sediment control and stormwater management practices;
5. Inspection and problem referral procedures;
6. Aspects of state law, regulations, local ordinances and approval procedures; and
7. Sediment and stormwater management plan content.

If the Secretary of State determines that the certified construction reviewer is not providing adequate site control or is not referring problem situations to the department, the Secretary may suspend or revoke the certification of the construction reviewer. In the event this does happen, the certified construction reviewer has the opportunity for a hearing before the Secretary.

Penalities: The range of penalties for noncompliance and/or pollution discharges to the waters of the states may vary, much like the responsible parties for monitoring the construction sites. Penalties could range from $25 to $50,000 per violation depending on the state. The following are examples of the possible range of penalties.

- **New Jersey -** Not less than $25 nor more than $3,000 per day.

- **St. Charles, Missouri -** Anyone found guilty shall be punished for all violations adjudicated in Circuit Court. Ten percent of the Performance Guarantee will be held to ensure erosion control measures are maintained.

- **Kansas -** Anyone in violation will be fined up to $10,000 per offense/day. Anyone intentionally violating the ordinance will be fined up to $25,000 per violation per day.

- **Maryland -**
  Noncompliance
  Administrative - $1,000 per violation, $20,000 maximum.
  Judicial - Two times the cost for replacement and maintenance of the controls as well as mitigation for any damages.
  Criminal - $5,000 per violation and/or one year in jail, no limit on the fine.

  Pollution Discharge
  Administrative - $10,000 per violation, $100,000 maximum
  Judicial - $25,000 per violation, no maximum
  Criminal - $50,000 per violation and/or one year in jail (two years for repeat offenders).

- **Delaware -** Any person convicted of violating the provisions shall be fined not less than $200 nor more than $2,000 for each offense. Intentional violators of any notice to comply will be fined not less than $500 nor more than $10,000 for each offense. Each day the problem continues is a separate offense. The Superior Court has jurisdiction of offenses under this sub-section.

Appeals: In some cases provisions are made for appeals of administrative decisions to a policy body of local government. The applicant would be allowed to appeal to anyone who has reviewed the permit application.

- **Virginia -** The applicant who is aggrieved by any action plan submitted has the right to apply for and receive a review by the town council, city council or board of supervisors. During the review the governing body shall consider evidence and opinions presented by the aggrieved applicant and agent. After reviewing the information the governing body may affirm, reverse or modify the action. The governing body's decision is final, subject only to a review by the Circuit Court.

- **Northeastern Illinois -** The applicant or any person or agency which received notice of the filing of the application may appeal the decision of the Site Development Plan to the board of appeals. Upon receipt of an appeal, the board of appeals shall schedule and hold a public hearing after giving 15 days notice thereof. The board shall render a decision within 30 days after the hearing.

Any applicant under the provision of this ordinance may appeal the decision or actions of the permitting authority and its agents showing disapproval of the decisions to the board of appeals. The board of appeals could consist of the town council, city council or board of supervisors.

In reviewing the applicant's action, the board of appeals shall consider evidence and opinions, the board of appeals' decision shall be final, subject only to review by the circuit court of locality. Any appeal hearing before the board of appeals shall be heard at the next regularly scheduled board of appeals meeting provided that the board and other involved parties have at least 30 days prior notice.

H. References

(*See "For Additional Information" page 73*)

Erosion & Sediment Control Planning

A. Site Planning Considerations

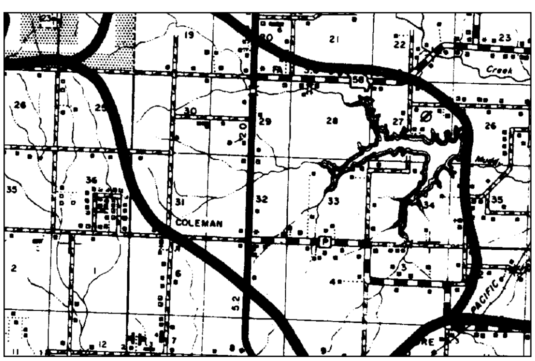
In new development, good site planning can significantly limit increases in runoff and reduce the potential for erosion and sedimentation problems. A good starting point is to identify goals and supporting practices and strategies to reduce the root causes of adverse impact on hydrology and water quality. Those goals include:

1. **Reproduce pre-development hydrological conditions.**
2. **Confine development and construction activities to the least critical areas.**
3. **Fit development to the terrain.**
4. **Preserve and utilize the natural drainage system.**
5. **Consider public acceptance.**

Developers, engineers and staff who review sediment control plans should take a close look at these goals. Understanding these goals will result in better erosion and sediment control planning and implementation.

1. Reproduce pre-development hydrological conditions.

This is a goal that can only be addressed comprehensively at the level of site planning (Schueler, 1987). It means looking at reproducing the full spectrum of hydrological conditions: *peak discharge, *runoff volume, *infiltration capacity, *base flow levels, *groundwater recharge *and maintenance of water quality. Capping peak discharges is a beginning, but it is only a beginning - a problem narrowly defined and easily solved by providing detention facilities. A comprehensive approach is more difficult and involves the whole context of site planning, especially in terms of standards and philosophical approach. The issues of runoff volume, infiltration recharge and water quality revolve around the amount of pavement and other impervious surfaces and their relationship to drainage paths and vegetative cover.



Watershed Map

In recent decades, the focus of stormwater management has been on reducing the frequency and severity of flooding, chiefly by limiting peak discharges from new development to pre-development levels. Concern for volume focused only on providing adequate storage volume to hold a cap on peak discharge; e.g., detention ponds. Waterways were specifically designed to increase hydraulic efficiency through higher velocities and smooth conveyances; e.g., storm sewers, paved gutters and waterways, so as to be self-cleaning. This approach implicitly accepted radical change from pre-development hydrological conditions as a reasonable and unavoidable consequence of land development.

As concern for water quality increases, developers are finding themselves in a conflicting regulatory environment. First, they face zoning codes and development standards which specifically require significant capital investment in site improvements that may reduce infiltration, degrade water quality, increase runoff volumes and boost peak discharges. Then in the same regulations they are also required to make further capital expenditures to infiltrate runoff, improve water quality, reduce runoff volumes and level peak discharges.

The urban conservation practices presented in this handbook provide good practices for minimizing problems that may not be addressed in the site planning process. However, care must be exercised to avoid simply layering them on top of existing requirements and standard practices. A thorough review of land development regulations and standards should also be made to remove archaic requirements that ultimately work against the goals of maintaining pre-development hydrologic conditions and improving water quality. The best approach is to avoid creating the problem in the first place. One important way to avoid problems is to rethink standard approaches in terms of the broad context.

2. Confine development and construction activities to the least critical areas.

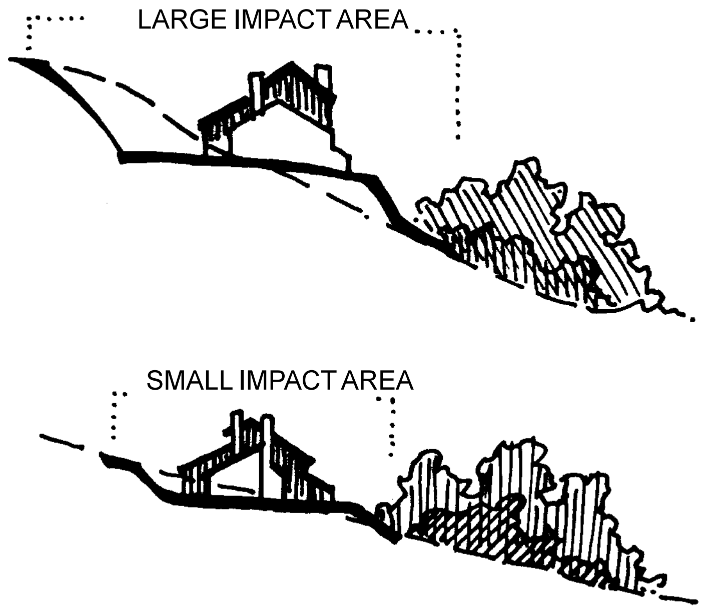
The best way to avoid the adverse impact of development on runoff and water quality is to develop comprehensive site plans that avoid creating construction activity in the most sensitive areas. Given the open space requirements found in most zoning codes, this is a real option which is still too often overlooked. Avoid siting improvements along the shoreline of lakes or streams, in the natural drainageways or in areas of the site which are dominated by steep slopes, dense vegetation, porous soils or erodible soils. The following is a brief listing of the issues and site planning responses associated with each of these sensitive areas.

Streambanks - Construction activity along streambanks is the most difficult to mitigate with respect to water quality. The vegetative riparian area along streambanks is a critical part of nature’s system for cleansing runoff water of pollutants. Also, once the vegetation is disturbed, streambank erosion is dramatically increased. Runoff from construction so close to the receiving waters is hard to control, making measures to reduce pollutant delivery much more difficult and expensive.

***Natural drainageways* -** Construction in natural drainageways destroys the natural vegetation protecting the soil from erosion (and with it the filtering capacity of the vegetation). This type of vegetation is among the most difficult to reestablish. Since natural drainageways contribute large amounts of runoff directly to receiving lakes or streams, once disturbed, they become high-energy, high-volume conduits for moving massive amounts of pollutants to receiving waters. Site plans that call for disturbing these areas result in much larger volumes of water to manage and treat (and much greater costs for urban conservation practices) than would be faced by using other areas of the site for the same purpose.

Steep slopes - Generally, the steeper the slope, the greater the erosion hazard. This is because the effects of gravity and reduced friction between soil particles on steep slopes means it takes less energy for water to dislodge and transport soil particles. In addition to this, the nature of steep slopes means that greater areas of soil are disturbed to locate facilities on them compared to

FIGURE 3-1: **Making flat areas for homesites on steep slopes disturbs more land area than on flat slopes.**



flatter slopes. This is because development generally means making flat areas out of steep areas for such things as roads, buildings and lawns. Creating flat areas on steep slopes exposes more soil surface area to erosion during construction than the same action on flat slopes (Figure 3-1). Good site planning avoids placing houses and roads on steep slopes.

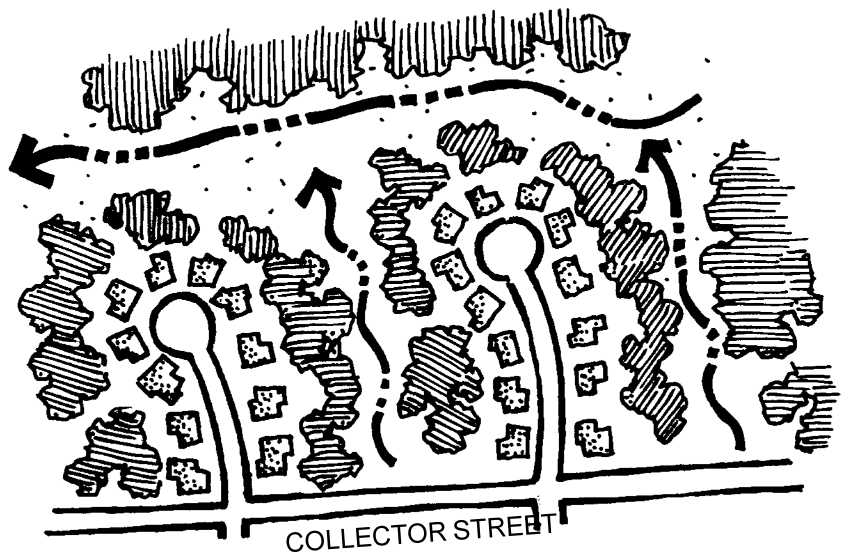
Dense vegetation - Good vegetative cover is another very important factor in preventing erosion. Disturbing areas with a well established dense vegetative cover dramatically increases the risk of erosion. Wooded areas with brush are the most runoff-absorbent types of cover in the landscape. Destruction of such vegetation adds significant expense to the construction budget for clearing and destroys an inherently valuable attribute of the site (mature trees have recognized value in real estate sales). There is a direct relationship between vegetative cover and the impact of development on runoff and water quality. Destruction of a given area with dense vegetative cover produces a greater impact than destruction of the same area of sparse vegetative cover. Destruction of a large area of a given vegetative cover produces greater effects than destruction of a small area of the same vegetative cover. A good site plan preserves large areas of existing dense vegetation.

Porous soils - Infiltration into the soil provides the cheapest and best type of stormwater storage available on a site. Infiltration reduces both the volume of runoff and the peak discharge from a given rainfall event, as well as providing treatment of water as it filters through the soil and recharges back to ground-water resources. Impervious roofs and pavements remove absorptive surface area from the site. Site planning that locates impervious surfaces in porous soil areas creates the greatest possible change in infiltration between pre-development and post-development conditions. Placing the same surfaces in tight soil areas produces the least change. By devising a site plan that avoids, as much as possible, the placement of impervious surfaces in highly porous soil areas, soil absorption of runoff in a given development can be maximized. Such a strategy will pay dividends to the developer in terms of reduced volumes and peak discharges of runoff which will require the use of urban conservation practices for on-site treatment. It will also significantly reduce the land area needed for detention facilities required for peak discharge storage.

Erodible soils **-** When stripped of vegetation during construction, areas with easily eroded soils yield greater volumes of transported soil than those with erosion resistant soils. To the extent that site planning can avoid disturbing erodible soils in the land development process, large erosion and sedimentation problems will also be avoided.

Through careful site planning, sensitive areas can be set aside as natural open space areas to meet open space area requirements. In many cases, such areas can be used as buffer spaces between land uses on the site or to buffer land

FIGURE 3-2: **Use sensitive areas such as natural drainage areas to form boundaries or buffer zones between clusters of housing.**



uses on adjacent sites (Figure 3-2). Mature woodlots can be used to provide visual screening and to establish entry character or boundary definition for the site. Other areas can be used to preserve views from home sites and to provide privacy separation between home sites, such as along back property lines.

3. Fit development to the terrain.

Choose road patterns to provide access schemes which match landforms. For example, in rolling or dissected terrain use strict street hierarchies with local streets branching from collectors in short loops and cul-de-sacs along ridgelines. This approach results in a road pattern which resembles the branched pattern of ridgelines and drainageways in the natural landscape. This facilitates the development of plans which work with the landform and minimizes disruption of existing grades and natural drainage.

In areas where the topography is characteristically flat, the use of fluid grids may be more appropriate. Historical examples of this include: landscape architects Frederick Law Olmsted and Calvert Vaux's 1869 plan for Riverside, Illinois, and landscape architect Wilbur D. Cook's 1906 plan for Beverly Hills, California, (Stern, 1981; Newton, 1971). In this type of scheme, natural drainageways are preserved by interrupting and bending the grid around them. Artificial grassed waterways may then be constructed on very flat slopes to maximize pollutant removal at the back of lots or along the street right-of-ways to channel runoff to natural drainageways without abrupt changes of direction.

4. Preserve and utilize the natural drainage system.

Reduce impervious areas where possible and practical. In addition to reducing road surface area, other ways to reduce impervious surfaces include: keeping sidewalks to one side of the street, reducing widths of sidewalks, replacing impervious sidewalks with permeable practices, allowing shared driveways, allowing alternative driveways, directing rooftops to porous areas and using cul-de-sacs with landscaped infiltration centers or using T-shaped turnarounds instead of cul-de-sacs.

Keep pavement and other impervious surfaces out of low areas, swales and valleys. This means site plans should keep roads and parking areas high in the landscape and along ridges wherever possible. (Figure 3-3). This is more difficult to achieve than it appears because some of the most well accepted development standards and approaches encourage the exact opposite pattern.

The best example of this is the seemingly desirable requirement for the use of curbing on streets and parking areas in low and medium density subdivisions. Curbs are widely held to be the signature of quality development; they provide a neat, "improved" appearance and also help delineate roadway edges. Because curb and gutter streets trap runoff in the roadbed, storm inlets and sewers are logical solutions providing good drainage for the roadbed. As a result of such thinking, several municipalities require the use of storm sewers and curb and gutter streets.

Unfortunately, this solution can create significant stormwater management problems when looked at in the broader context of devising an environmentally sound land development scheme. The problem scenario goes something like this. Because storm sewers operate on gravity flow principles, their efficiency is maximized if they are located in the lowest areas of the site. Since storm sewerage is the preferred technology for providing drainage for the curb and gutter streets, it is natural to locate the streets where the storm sewers are best located, that is, in the valleys and low areas which comprise the natural drainageways of any site (Figure 3-4). In this way, natural drainageways can become unintended targets for destruction, where the natural vegetative cover in the most hydrologically critical areas of the landscape is replaced by impervious pavement. Natural filtration and infiltration capacity is lost in the most strategic locations.

Furthermore, in most locations, storm sewers are designed only for short-duration, high-frequency storms with flood flows handled by street and gutter flows after the storm sewer capacity is exceeded. This often means that the floodways in the landscape are converted from slow-moving, permeable, absorptive, vegetative waterways to fast-moving, impervious, self-cleaning paved waterways. Hydraulic efficiency is increased, as are peak discharges and flood volumes. Since the natural waterways are paved and specifically designed to be quickly drained by storm sewers, channel storage time is minimized and base flow is reduced. The net effect of a seemingly beneficial decision to use curbs can, when thought through in the full integrated context of site planning decision making, initiate a snowball effect which amplifies the extremes in the hydrologic cycle, increasing flood flows and reducing base flows.

This scenario also has important effects on water quality. Trace metals from automobile emissions and hydrocarbons from automobile oil and fuel spillages are directly deposited on the now-paved surfaces of the site's waterways. For the most frequent rainfalls, the first flush of stormwater runoff washes these deposits into the storm sewer system. Pollutants are delivered via the runoff water to receiving waters where changes in velocity permit them to settle out. Nutrient-rich runoff from surrounding lawns is also quickly moved through the paved system with no opportunity to come in contact with plant roots and soil surfaces. The result is accelerated delivery of these materials to lakes and streams.

If natural vegetative drainageways are strictly preserved in the site planning process, flood volumes, peak discharges and base flows will be held closer to their pre-development levels. Trace metals, hydrocarbons and other pollutants will have a much greater opportunity to become bound to the underlying soil. The infiltration, which would occur along the entire drainageway, would not only contribute to the reduction of runoff volumes, but would also allow nutrients to be taken up by the vegetation lining the drainageway.

5. Consider Public Acceptance. In an urban environment, aesthetics are an important consideration for gaining public acceptance of urban conservation practices. In many cases, practices such as detention ponds can be an asset visually to the surrounding area. However, if a detention pond is designed in a square shape with uniform slopes, it will not appear natural and can detract from the surrounding area. Odor, insects, weeds, turbidity and trash are also problems for the residents who live near control structures. Often these problems are temporary, but with regular maintenance, usually they can be overcome.

FIGURE 3-3: **Place roads along ridge lines. Keep construction areas away from low areas and valley flow lines.**

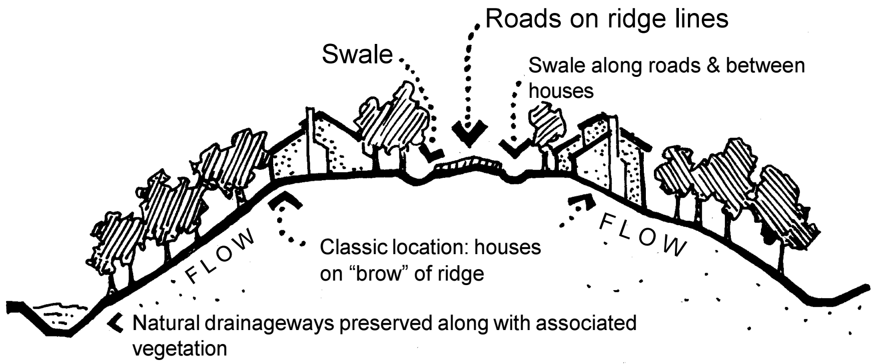
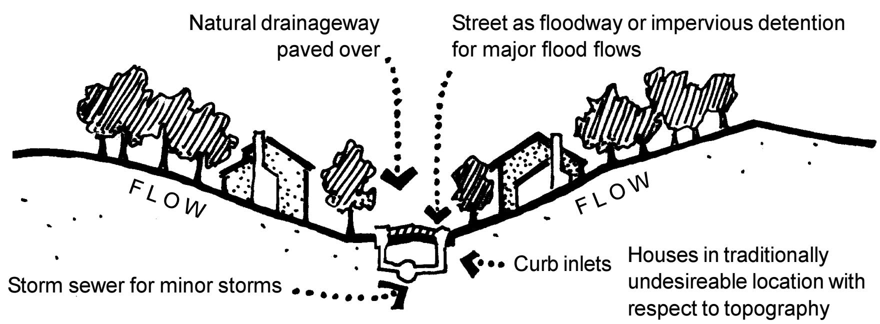


FIGURE 3-4: **Conventional curb-and-gutter streets with storm sewers tend to gravitate to low areas where the hydraulic efficiency of the storm sewer is maximized.**



Example Case

The modern classic example of a comprehensive approach to development incorporating all of these goals is Woodlands New Community located north of Houston, Texas. This 2,000 acre new town development was planned and designed by Wallace, McHarg, Roberts and Todd, Landscape Architects and Planners, Philadelphia, Pennsylvania. This new town was sited on heavily wooded flat land with extensive areas of poorly drained soils. By working closely with a multidisciplinary team of specialists, including ecologists, hydrologists, engineers and market specialists, a comprehensive plan was developed that preserved the natural drainage system, avoided critical areas, worked with existing topography and maintained pre-development hydrological conditions.

In the original planning, engineers compared the cost of the natural drainage system to that for a conventional approach and found that the natural drainage option saved over $14 million (Juneja and Veltman, 1980). Further, the conventional approach to stormwater management would have cleared thousands of trees, lowered water tables, increased runoff volume 180 percent, degraded downstream water quality and caused a 15 million gallons per day drawdown from the underlying aquifers. The plan avoided or sharply reduced the impact of all these problems.

The Woodlands general plan used the existing natural drainage system to provide the major storm subsystem of the stormwater management plan. This was accomplished by locating major roads and dense development on ridge lines and higher elevations, while preserving the floodplains in parks and open space and low density housing on intermediate areas. The minor stormwater management system focused on maintaining the absorptive capacity of the soil. This was accomplished by carefully designing roads, parks and golf courses to maximize infiltration, and by establishing home site development strategies which limited impermeable surfaces and included extensive overland drainage systems. Building construction and site grading were also tightly controlled and supervised to preserve the existing soil structure and minimize the area disturbed during construction. The final development increased the volume of runoff generated by only 55 percent (Juneja and Veltman, 1980).

The ultimate measure of the Woodlands approach occurred in April, 1979. At that time, a record storm hit the Houston area dropping nine inches of rainfall within five hours. No houses within the Woodlands sustained any flooding (Juneja and Veltman, 1980). Neighboring areas were awash and hard hit with flood damage.

B. Steps to Construction Site Erosion and Sediment Control Planning

Purpose

The purpose of an erosion, sediment and water quality control plan is to define and schedule the control measures that will be used to minimize erosion, detain excess stormwater runoff, prevent off-site sedimentation and the resulting water quality degradation. A detailed map displays the location of each practice.

The Plan

The plan should serve as a blueprint for location, installation and maintenance of practices to control all anticipated erosion and prevent sediment and increased runoff from leaving the site.

The Process

An erosion and sediment control plan should be prepared to document planning decisions and to explain this information to reviewing officials and the contractors. The following steps are recommended when preparing an erosion and sediment control plan.

1. Inventory the Resources.

The existing site conditions should be evaluated to gather information that will be needed for the erosion and sediment control plan. That information should be plotted on a site map and explained in the narrative portion of the plan. The following data should be collected and marked on a topographic map of the site.

a. Topography

Prepare a topographic map of the site to show the existing contour elevations at intervals of not more than two feet. The primary topographic considerations are slope steepness and slope length. The erosion potential increases with slope steepness and length. When the slope has been determined, areas of similar steepness should be outlined. Slope gradients can be grouped into three general ranges of soil erodibility:

0 - 6%	Low to moderate erosion hazard
6 - 12%	Moderate to high erosion hazard
> 12%	Severe erosion hazard

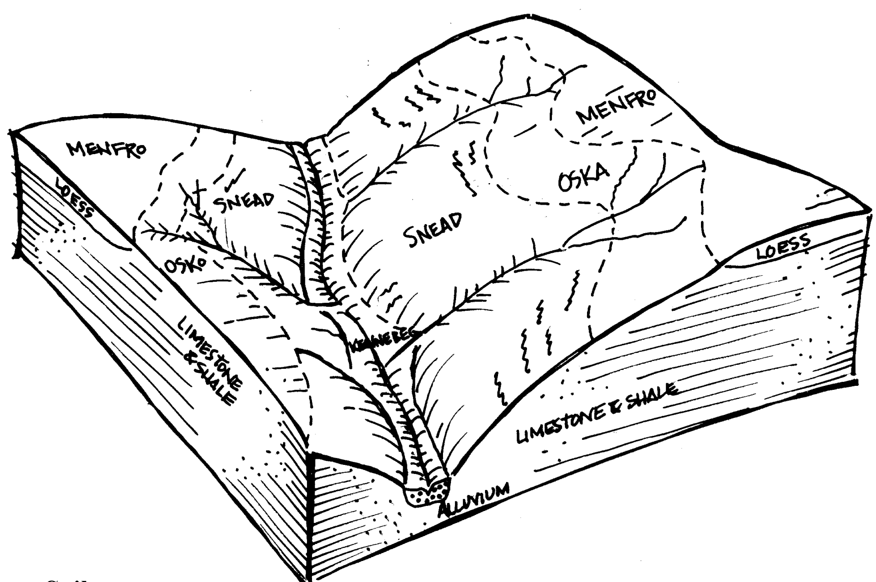
Within these slope gradient ranges, the greater the slope length, the greater the erosion hazard. Therefore, when determining potentially critical areas, the site planner should be aware of excessive long slopes. As a general rule, the erosion hazard will become critical if slope lengths exceed the following values:

0 - 6%	200 Feet
6 - 12%	100 Feet
> 12%	50 Feet

These are general guidelines. If soils encountered are highly erodible, the erosion potential may be much higher than indicated by these slopes and distances.

b. Drainage Patterns

Locate and clearly mark all existing drainage swales on the topographic map. Natural drainage patterns exist on the land. These patterns, which consist of overland flow through swales, depressions and natural watercourses, should be identified in order to plan around critical areas where water will concentrate. Where it is possible, natural drainageways should be used to convey runoff over and off the site to avoid the expense and problems of constructing an artificial drainage system. Manmade ditches and waterways will become part of the erosion problem if they are not properly stabilized. Care should also be taken to assure that increased runoff from the site will not cause instability or flooding downstream. Possible sites for stormwater detention should also be located at this point.



c. Soils

Determine and show major soil type(s) on the site topographic map. Soils information can be obtained from the Natural Resources Conservation Service office. Commercial soil evaluation firms are also available. Soils information should be plotted directly onto the map or an overlay at the same scale to make interpretation easier.

Soil properties such as flood hazard, natural drainage, depth to bedrock, depth to seasonal water table, permeability, shrink-swell potential, texture and erodibility will exert a strong influence on land development decisions; e.g., septic systems, roads and foundations.

d. Ground Cover

Show the existing vegetation on the site. Features such as tree clusters, grassy areas and unique vegetation should be shown on the map. In addition, existing denuded or exposed soil areas should be indicated.

Ground cover is the most important factor in terms of preventing erosion. Any existing vegetation which can be saved will help prevent erosion. Trees and other vegetation protect the soil as well as beautify the site after construction. If the existing vegetation cannot be saved, the planner should consider staging construction, temporary seeding or temporary mulching. Staging construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at once and the time that soil is exposed without ground cover is minimized. Temporary seeding and mulching involves seeding or mulching areas that would otherwise lie open for long periods of time. This limits time of exposure and reduces the erosion hazard from both wind and water. Soil erosion will occur wherever the soil surface is loose and dry, vegetation is sparse or absent, and/or wind is sufficiently strong. Furthermore, on-site erosion and off-site sediment deposition will occur with stormwater runoff.

e. Adjacent Areas

Delineate areas adjacent to the site on the topographic map. Features such as streams, roads, houses, other buildings, wooded areas, etc., should be shown. An analysis of adjacent properties should focus on areas upstream and downstream from the construction project.

Streams which will receive runoff from the site should be surveyed to determine their capacity and stability. Waters that will receive direct runoff from the site should be a major concern. The potential for sedimentation and pollution of these waters should be considered as well as the potential for downstream channel erosion due to the increased volume, velocity and peak flow rate of stormwater runoff from the site. The potential for sediment deposition on adjacent properties due to sheet and rill erosion should also be analyzed so that appropriate sediment-trapping measures can be planned.

The stormwater from drainage of adjacent upstream areas should be considered to assure that a stabilized conduit remains. Altering the outlet of drainage patterns has the potential for creating upstream flooding and excess erosion on site.

2. Identify Developmental Concerns.

Developmental concerns (DC) need to be identified to address the potential of adverse environmental impacts as a result of erosion, sedimentation and increased stormwater velocities. Erosion, sediment and water quality control planning should be an integral part of the site-planning process, not just an afterthought. The potential for soil erosion should be a significant consideration when deciding upon the layout of buildings, parking lots, roads and other facilities. Costly erosion and sediment control measures can be minimized if the site design can be adapted to existing site conditions and good conservation principles are used.

All developmental concerns may not be relevant to all sites. However, if the applicable concerns are addressed, effective erosion and sediment controls can be achieved.

For further information on the specific conservation measures identified to address developmental concerns, see the Protecting Water Quality field guide.

Costly erosion and sediment control measures can be minimized if the site design can be adapted to existing site conditions and good conservation principles are used.

Developmental Concerns:

DC-1	Stabilization of Denuded Areas and Soil Stockpiles
DC-2	Establishment of Permanent Vegetation
DC-3	Protection of Adjacent Properties
DC-4	Timing and Stabilization of Sediment-Trapping Measures
DC-5	Use of Sediment Basins and Detention Ponds
DC-6	Cut and Fill Slopes
DC-7	Storm Management Criterion for Controlling Off-Site Erosion
DC-8	Stabilization of Waterways and Outlets
DC-9	Storm Sewer Inlet Protection
DC-10	Working in or Crossing Waters
DC-11	Underground Utility Construction
DC-12	Construction of Access Routes
DC-13	Disposition of Temporary Measures
DC-14	Maintenance of Practices

The following flow charts of developmental concerns provide an orderly process to achieve construction site erosion and sediment control which in turn should protect water quality. These flow charts provide minimum recommendations for erosion and sediment control and apply to all projects where land is disturbed. These charts will refer the reader to sections in the Protecting Water Quality field guide.

These flow charts were adapted from the Minnesota Board of Water and Soil Resources Construction Site Erosion and Sediment Control Handbook.

Developmental Concerns 1 & 2:

DC-1 • Stabilization of denuded areas and soil stockpiles

A. Permanent or temporary soil stabilization should be applied to disturbed areas within two weeks after rough grading. Soil stabilization refers to measures which protect soil from erosive forces of raindrop impact and flowing water. Applicable practices include vegetative establishment, mulching and early application of gravel base on areas to be paved. Soil stabilization measures selected should be appropriate for the time of year, site conditions and estimated duration of use.

B. Soil stockpiles must be vegetated or covered and protected with sediment-trapping measures to prevent soil loss.

C. Stockpiles should not be located in drainageways or near bodies of water.

DC-2 • Establishment of permanent vegetation

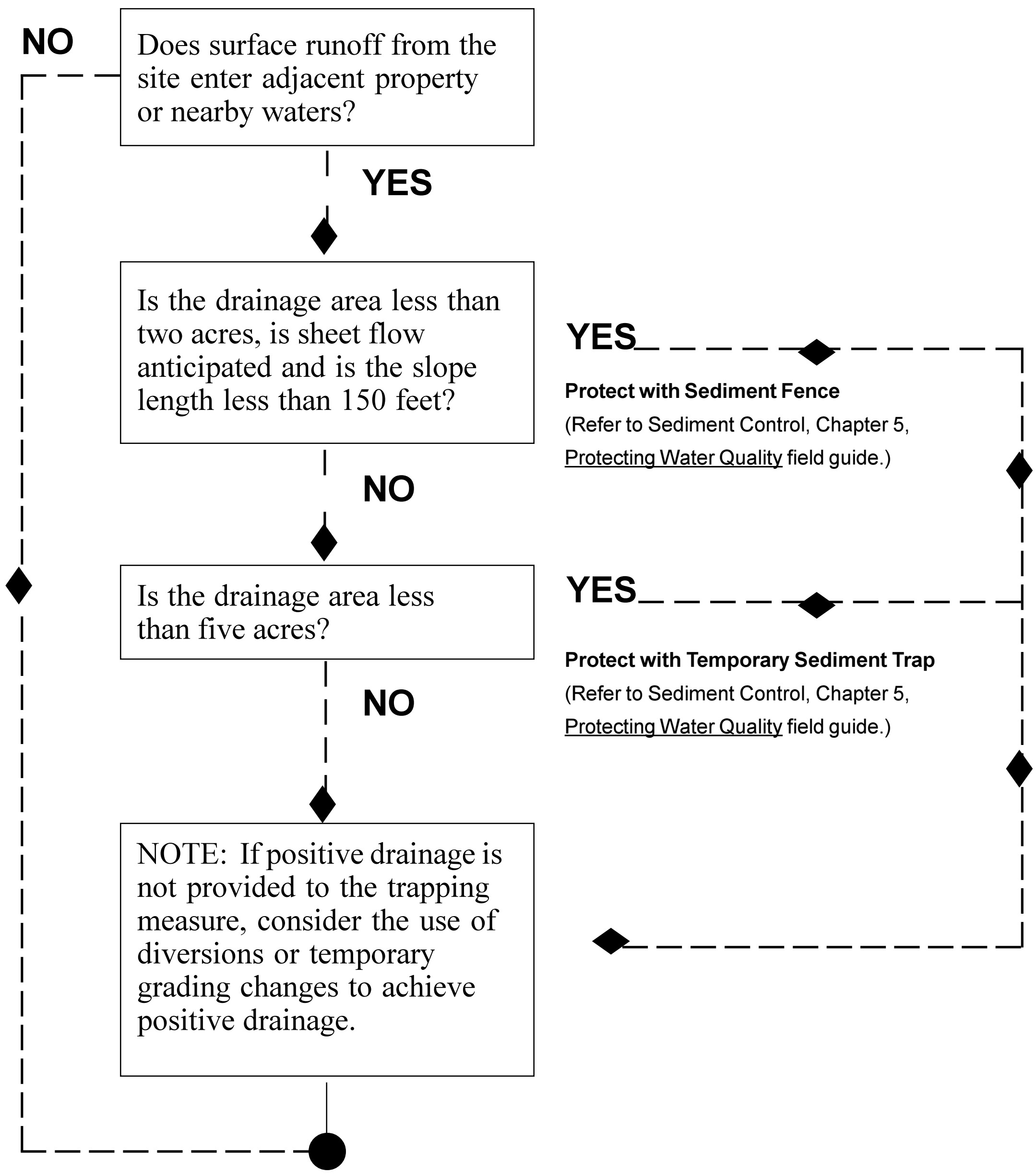
A permanent vegetative cover must be established on denuded areas not otherwise permanently stabilized. Permanent vegetation is not to be considered established until a ground cover is achieved which is mature enough to control satisfactorily.

- Will construction cease for two years or more?
  - **NO** → Protect with Temporary Seeding or Mulching Practices. (Refer to Chapter 5 of the Protecting Water Quality field guide.)
  - **YES** ↓
- See Permanent Seeding.
- Is a seed mix available for the time of year seeding will take place?
  - **NO** → Protect with Mulching or Temporary Seeding practices until permanent seeding date. (Refer to Chapter 5 of the Protecting Water Quality field guide.)
  - **YES** ↓
- Seed according to Permanent Seeding.
- Are slopes 3:1 or greater?
  - **YES** → Consider use of blanket mulch in, Mulching for critical areas. (Refer to Chapter 5 of the Protecting Water Quality field guide.)
  - **NO** ↓
- Mulch according to Mulching Practice.

Developmental Concern 3:

DC-3 • Protection of adjacent properties

Properties adjacent to the site of land disturbance must be protected from sediment deposition. This may be accomplished by preserving a well vegetated buffer strip around the lower perimeter of the land disturbance, by installing perimeter controls such as silt fences, diversions or sediment basins, by stockpiling soil in appropriate locations or by a combination of such measures.



Developmental Concern 4:

DC-4 • Timing and stabilization of sediment-trapping measures

Detailed construction schedules must be submitted as part of the erosion and sediment control plan. Construction schedules include:

- When the construction of sediment-trapping measures will occur;
- Stabilization of the earthen structures; and
- The timing of construction phases and grading phases.

NOTE: The plan should indicate that sediment basins and traps, perimeter dikes, sediment barriers and other measures intended to trap sediment on-site will be constructed as a first step in grading and will be made functional before land disturbance takes place upslope.

(Refer to Sediment Control, Chapter 5, Protecting Water Quality field guide.)

NOTE: The earthen structures such as dams, dikes and diversions should be seeded and mulched within 15 days of installation.

(Refer to Surface Stabilization, Chapter 5, Protecting Water Quality field guide.)

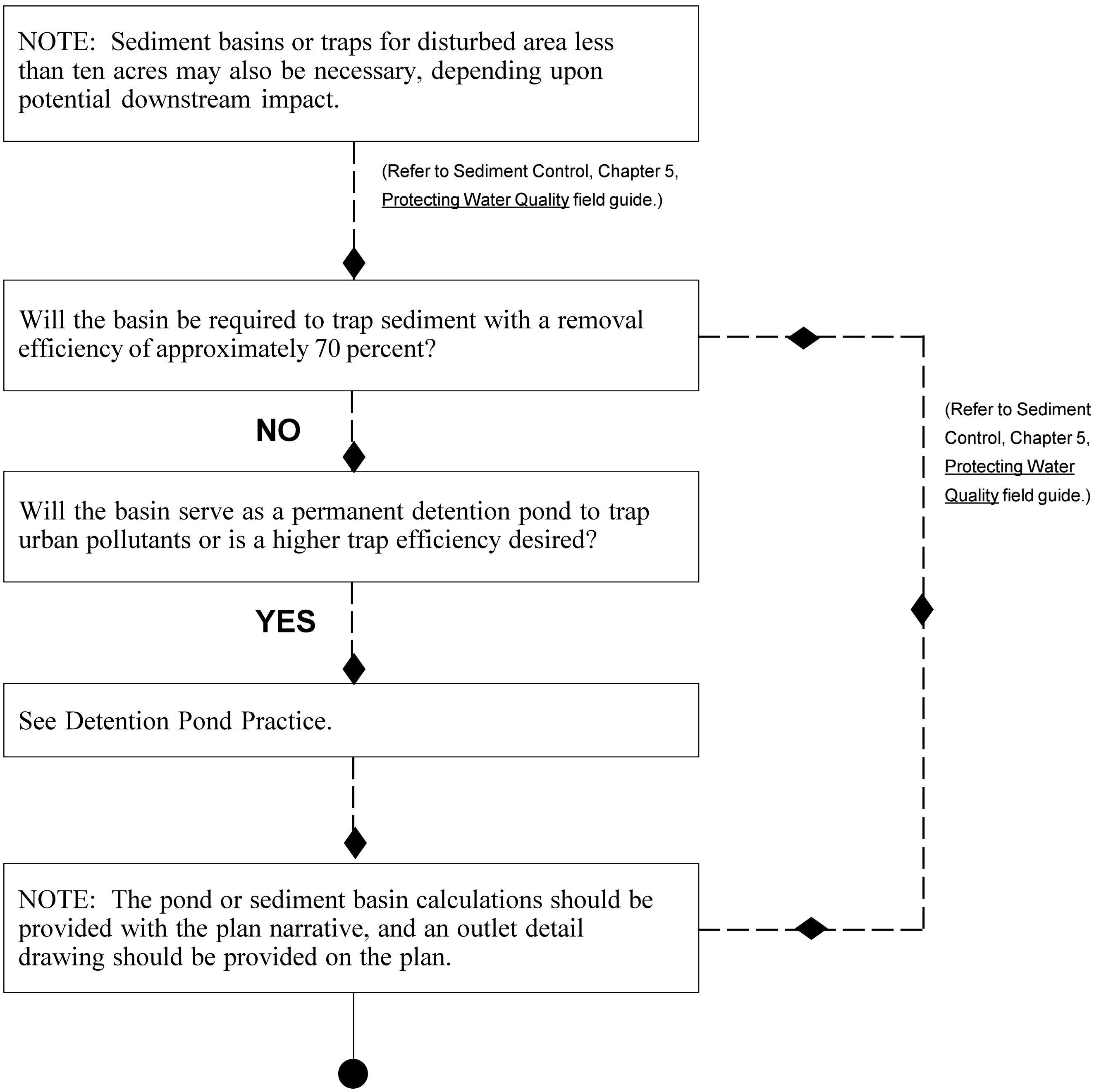
NOTE: If utility construction or the grading operation can be phased, the plan should indicate the anticipated schedule.

Developmental Concern 5:

DC-5 • Use of sediment basins and detention ponds

Stormwater runoff from drainage areas with ten acres or greater area must pass through a sediment basin or other suitable sediment-trapping facility with equivalent or greater storage capacity. There are several options available for basin design. The chart below gives three possible options.

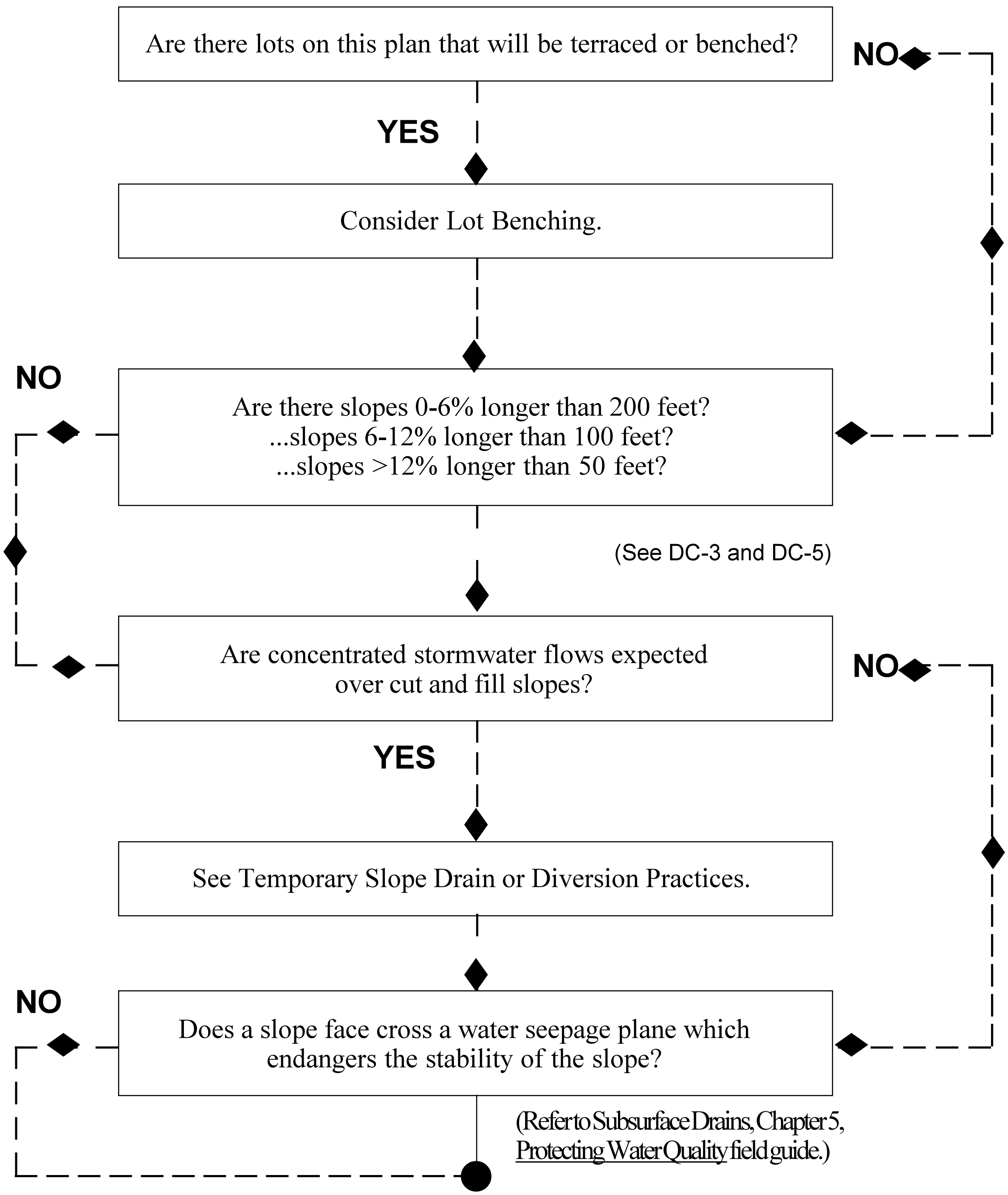
All areas disturbed by utility construction must be restabilized; and if dewatering services are used, adjacent properties must be protected.



Developmental Concern 6:

DC-6 • Cut and fill slopes

Cut and fill slopes must be designed and constructed in a manner that will minimize erosion. Consideration must be given to the length and steepness of the slope, the slope type, upslope drainage area, groundwater conditions and other applicable factors. The following guidelines are provided to aid in the development of an adequate design.



Developmental Concerns 7 & 8:

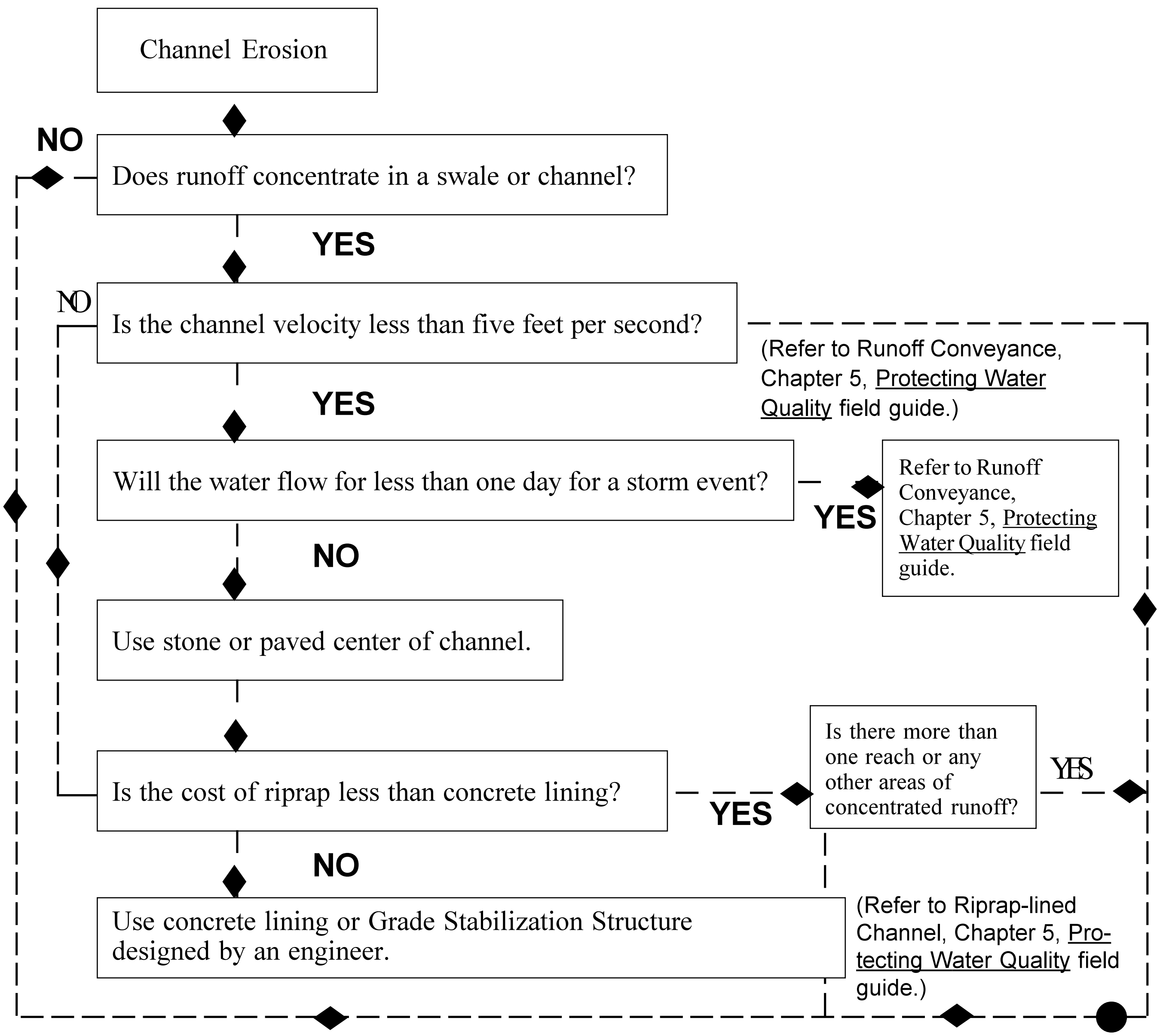
DC-7 • Storm management criterion for controlling off-site erosion

Properties and waterways downstream from development sites must be protected from erosion due to increases in the volume, velocity and peak water flow of stormwater runoff.

Concentrated storm runoff water leaving a development site must be discharged directly into a well-drained natural or manmade off-site receiving channel or pipe. If there is no well-defined off-site receiving channel or pipe, one must be constructed to convey stormwater to the nearest adequate channel. Newly constructed channels must be designed as stable channels.

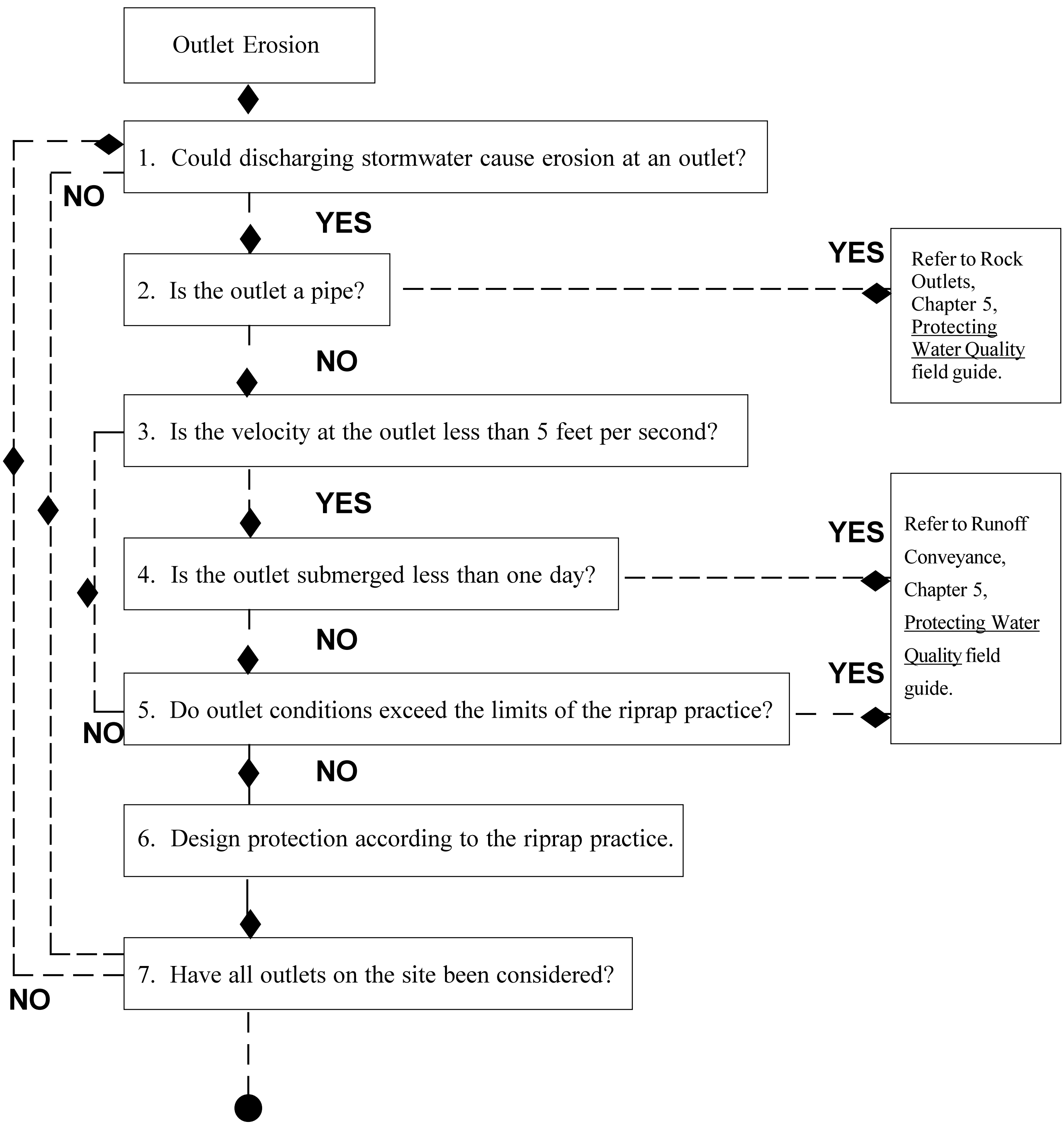
DC-8 • Stabilization of waterways and outlets

All on-site water conveyance channels must be designed and constructed to carry and withstand the expected velocity of flow from at least a 10-year frequency, 24-hour duration storm without erosion. Stabilization adequate to prevent erosion must also be provided at the outlets of all storm sewer pipes.



Developmental Concerns 7 & 8:

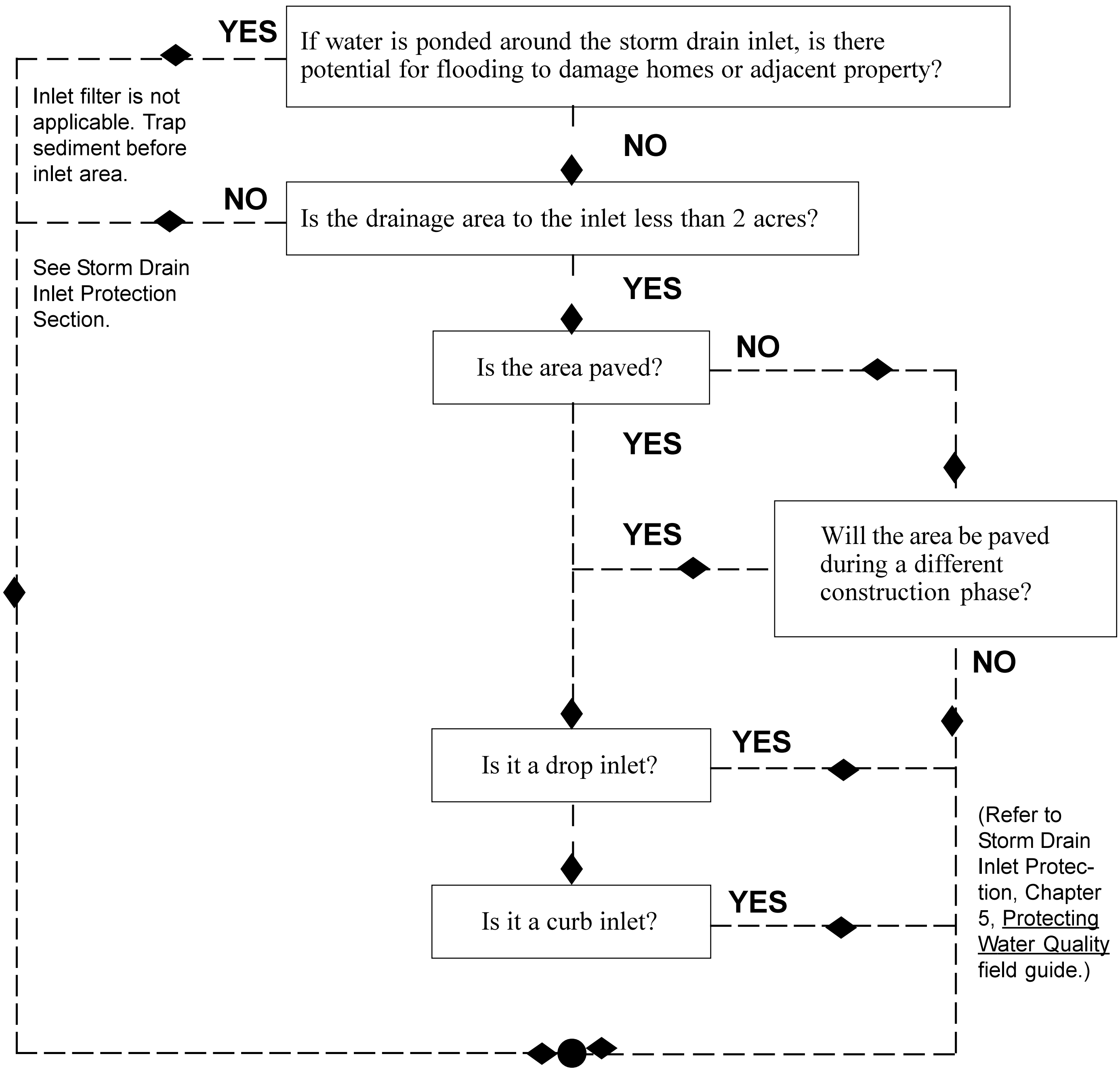
(continued)



Developmental Concern 9:

DC-9 • Storm sewer inlet protection

All storm drain inlets which are functioning during construction must be protected so that sediment-laden water will not enter the conveyance system without first being filtered or otherwise treated to remove sediment. The use of storm drain inlet protection can usually be avoided if other strategies are implemented that keep sediment from entering streets. If a site is properly seeded and slope lengths are short, then the sediment in runoff will be substantially reduced. If a site will require storm drain inlet protection, the proper detail should be shown on the plan.



Developmental Concern 10:

DC-10 • Working in or crossing waters

Where work is necessary adjacent to waters, precautions must be taken to contain sediment and stabilize the work area during construction to minimize erosion and restabilize the work area within one week.

Will construction traffic cross a live (wet) watercourse during construction?

NO

YES (Refer to Temporary Stream Crossing, Chapter 5, Protecting Water Quality field guide.)

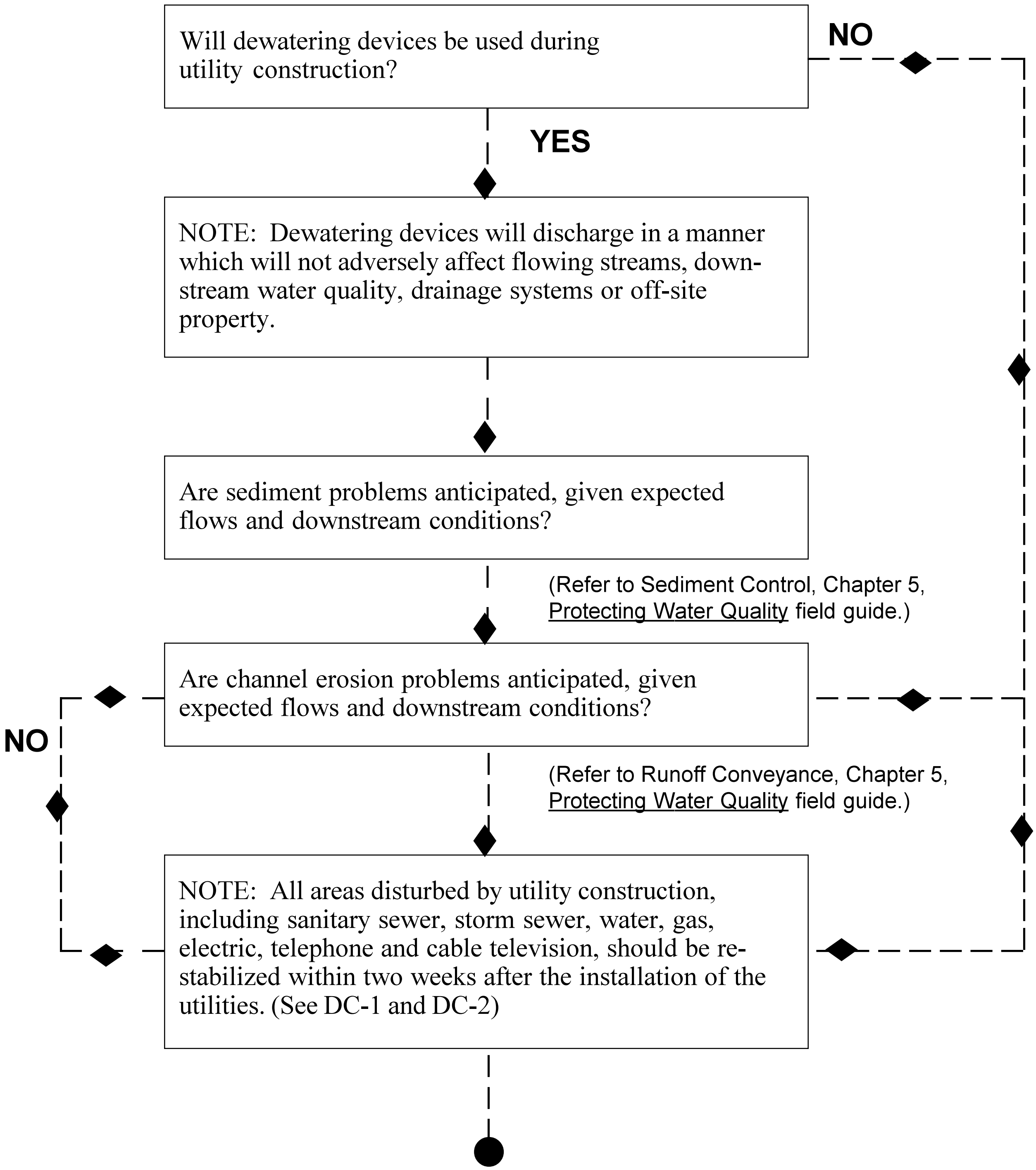
NOTE: Disturbed areas need to be seeded and mulched within one week after completion or work.

(Refer to Seeding Recommendations, Chapter 5, Protecting Water Quality field guide.)

Developmental Concern 11:

DC-11 • Underground utility construction

All areas disturbed by utility construction will be restabilized; and if dewatering services are used, adjacent properties will be protected.



Developmental Concern 12:

DC-12 • Construction of access routes

Whenever construction vehicle access routes intersect paved public roads, provisions must be made to minimize the transport of sediment (mud) by runoff or vehicle tracking onto the paved surface. Where sediment is transported onto a public road surface, the roads 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 entrance point(s) will be located.

Developmental Concern 13:

DC-13 • Disposition of temporary measures

All temporary erosion and sediment control measures can be disposed of within 30 days after final site stabilization is achieved or after the temporary measures are no longer needed. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures should be permanently stabilized to prevent furthur erosion and sedimentation.

Developmental Concern 14:

DC-14 • Maintenance of practices

All temporary and permanent erosion and sediment control practices must be maintained and repaired as needed to assure the continued performance of their intended function.

A contact person, to handle maintenance questions during the various phases of construction, should be specified in the plan.

These concerns were adapted from the Minnesota Board of Water and Soil Resources Construction Site Erosion and Sediment Control Handbook.

3. Determine Course of Action.

When the layout of the site has been decided upon, a plan to control erosion and sedimentation from the disturbed areas must be formulated.

The site planner should be guided primarily by developmental concerns, which establish a minimum level of control for all projects. The site planner should determine which of the developmental concerns are applicable to the site and select conservation practices that can be used to satisfy the concern.

The following general procedure is recommended for erosion and sediment control planning:

a. Determine Limits of Clearing and Grading
Decide exactly which areas must be disturbed in order to accommodate the proposed construction. Pay special attention to critical areas, if any, that must be disturbed.

b. Divide the Site Into Drainage Areas
Determine how runoff will travel over the site. Consider how erosion and sedimentation can be controlled in each small drainage area before looking at the entire site. Remember, it is easier to control erosion than to contend with sediment after it has been carried downstream.

c. Select Erosion and Sediment Control Practices
Erosion and sediment control practices can be divided into three broad categories: **vegetative controls, structural controls** and **management measures.**

- ***Vegetative controls*** are the first line of defense to prevent erosion. The best way to protect the soil surface is to preserve the existing ground cover. If land disturbance is necessary, seeding and mulching can be used on areas that will be inactive for long periods of time.

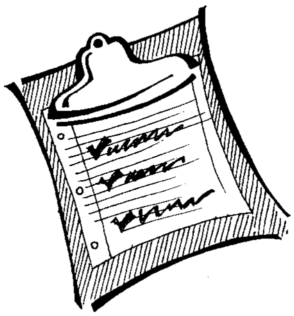
- ***Structural controls*** are generally more costly and less efficient than vegetative controls. Structural controls are usually necessary since not all disturbed areas can be protected with vegetation. They are usually the next line of defense used to capture sediment before it leaves the site.

- ***Management measures include:***
  Staging the construction on large projects so that one area can be stabilized before another is disturbed.

  - Developing and carrying out a regular maintenance schedule for erosion and sediment control practices. See Appendix B for Inspection Log.

  - Physically marking limits of land disturbance on the site with tape, signs or other methods so workers can identify and avoid areas to be protected.

  - Delegating responsibility for implementing the erosion and sediment control to one individual (preferably the job superintendent or foreman).



d. Plan For Stormwater Management

Where increased runoff will cause the capacity of a receiving channel to be exceeded, the site planner will need to select appropriate stormwater management measures. Any changes to discharges from a site must be in compliance with regulations of the local watershed district or water management organization.

The final step is consolidating the pertinent information and developing it into a specific erosion and sediment control plan for the project. The flow charts that outline developmental concerns can help the planner identify needs and select appropriate practices.

The plan consists of two parts: a narrative and a site plan. The narrative explains site problems and their solutions with all necessary documentation. The site plan is one or a series of maps or drawings that contain information explained in the narrative.

Checklists of items that should be included in a narrative site plan and site plan maps are shown in Appendix A. These checklists can be used by a site planner as a quick reference to determine if all the major items are included in the erosion and sediment control plan.

4. Implement, Maintain & Inspect.

Regular on-site inspections ensure that the approved plan is implemented, provides the land developer with technical assistance as needed, provides a means to determine if changes to the plan are necessary and to note deviations from the plan when they first occur.

A pre-construction conference with the developer is recommended for large projects or difficult sites. During this meeting the plan can be jointly reviewed, any problems or misconceptions can be resolved and a basis for clear communication and good working relations can be established.

Essential elements of an inspection program include:

- Inspection during or immediately following initial installation of sediment control practices; in particular, sediment basins, sediment traps, diversions and other structural measures.
- Inspection following severe rainstorms to check for damage to sediment control practices.
- Inspection prior to seeding deadlines, particularly in the fall.
- Final inspection of projects nearing completion to ensure that temporary control practices have been removed, stabilization is complete, drainageways are in proper condition and that the final contours agree with the proposed contours on the approved plan. This inspection should be made prior to the release of any performance guarantees.

In addition, interim inspections should be made giving particular attention to the maintenance of installed control practices. Maintenance is crucial for the proper functioning of conservation measures. A written scheduled maintenance program for all temporary and permanent erosion, sediment and stormwater control measures should be provided. For maintenance detail refer to specific practice guides in the Protecting Water Quality field guide.

All inspections should be documented by a written report or log. These reports should contain the date and time of inspections, dates when land-disturbing activities begin, comments concerning compliance or noncompliance and notes on any verbal communications concerning the project. A sample inspection log is shown in Appendix B.

Maintenance is crucial for the proper functioning of conservation measures.

Checklist For Narrative Site Plan

PROJECT NAME ____________________

PROJECT LOCATION ____________________

PLAN DEVELOPED BY ____________________

DATE ____________________

1. Project Description	Description of the nature and purpose of the land-disturbing activity and the amount of grading involved.
2. Phasing of Construction	Description of proposed time frame for the project.
3. Existing Site Conditions	Description of proposed stages of grading, utilities and building construction.
4. Adjacent Areas	Description of neighboring areas such as streams, lakes, foreign drainage patterns, residential areas, roads, etc., which might be affected by the land disturbance.
5. Soils	Description of the soils on the site giving such information as soil names, mapping unit, erodibility, permeability, limitations, depth, texture and soil structure.
6. Critical Areas	Description of areas on the site which have potential for serious erosion problems such as steep slopes, long slope lengths and swells. Also include special areas such as wetlands, cultural resource areas, endangered species, dense vegetated areas, wooded and riparian areas.
7. Erosion and Sediment Control Measures	Description of the methods which will be used to control erosion and sedimentation on the site.
8. Permanent Stabilization	Brief description, including specifications, of how the site will be stabilized after construction is completed.
9. Stormwater Management Consideration	Will the development of the site result in increased peak rates of runoff? Will this result in flooding or channel degradation downstream? If so, considerations should be given to stormwater control structures on the site.
10. Maintenance	A schedule of regular inspections and repair of erosion and sediment control structure.
11. Calculations	Any calculations made for the design of such items as sediment basins, diversions, waterways and calculations for runoff and stormwater detention basin design (if applicable).

Checklist For Site Plan Map Preparation

☐ **1. LOCATION MAP**
A small map locating the site in relation to the surrounding areas, road system and receiving streams. Define the watershed boundary.

☐ **2. INDICATE NORTH**
Show the direction of north in relation to the site.

☐ **3. SCALE**
Indicate scale, using a graduated line, which represents the drawn dimensions in relation to actual size of the project site, usually in number of feet per inch.

☐ **4. BENCHMARK**
An established elevation affixed to a permanent object which can be used to check grade.

☐ **5. PLAN DRAWING**
A drawing of project site which includes:

- ☐ **a. Existing Contours**
  Existing two-foot contours of the site including (at least 200 feet beyond property boundary.)
- ☐ **b. Final Contours**
  Proposed changes to the existing contours.
- ☐ **c. Existing Vegetation**
  Existing tree lines, grassy areas or unique vegetation.
- ☐ **d. Soils**
  Boundaries of different soil types.
- ☐ **e. Property Boundaries and Lot Lines**
  Boundaries of the property, lot lines, section lines and adjacent plats.
- ☐ **f. Elevation and Grade**
  Elevation of lot corners, grade of streets, parking lots, water levels of ponds, wetlands and lakes, elevation of storm sewer inlets and outlets and elevations of first floor of proposed structures.
- ☐ **g. Drainage**
  The dividing lines and the direction of flow for the different drainage areas.
- ☐ **h. Critical Erosion Areas**
  Areas with potentially serious erosion problems.

Checklist For Site Plan Map Preparation - continued

☐ **i. Limit of Clearing and Grading**
Indicate all areas which are to be cleared and graded.

☐ **j. Utility**
Locations of utilities in the area of the proposed development.

☐ **k. Location of Erosion and Sediment Control Practices**
Location of the erosion and sediment control and stormwater management practices used on the site. Illustrate with detailed drawing.

☐ **l. Structural Practices**
Any structural practices used that are not referenced in this handbook or other local handbooks. Explain and illustrate with detailed drawings.

☐ **6. PLAN PREPARER**
Include the signature of the individual or agency responsible for implementation and maintenance of erosion, sediment and stormwater control measures.

☐ **7. RESPONSIBLE INDIVIDUAL**
Include the signature of the individual or agency responsible for implementation and maintenance of erosion, sediment and stormwater control measures.

Inspection Log

PROJECT NAME ____________________

FILE NUMBER ____________________

INSPECTION DATE ____________________ **TIME** ____________________

INSPECTED BY ____________________

STAGE OF ACTIVITY ____________________

☐ Are there any denuded areas which require temporary or permanent stabilization?
DC-1

PROBLEM:

CORRECTIVE ACTION:

☐ Do any seeded areas require maintenance fertilization, seeding or mulching?
DC-2

PROBLEM:

CORRECTIVE ACTION:

☐ Is there any evidence that sediment is leaving the site and damaging adjacent property?
DC-3

PROBLEM:

CORRECTIVE ACTION:

☐ Are there perimeter sediment-trapping measures in place and earthen structures seeded and mulched?
DC-4

PROBLEM:

CORRECTIVE ACTION:

☐ Are all sediment-trapping practices called for on the plan installed in the proper location and in accordance with minimum standards?
DC-5

PROBLEM:

CORRECTIVE ACTION:

☐ Are all cut and fill slopes adequately stabilized?
DC-6

PROBLEM:

CORRECTIVE ACTION:

Inspection Log - continued

☐ Is there evidence of increased off-site erosion since the project began? DC-7

PROBLEM:

CORRECTIVE ACTION:

☐ Are all on-site drainage channels and outlets adequately stabilized? DC-8

PROBLEM:

CORRECTIVE ACTION:

☐ Are all operational storm drain inlets protected so that sediment will not enter the system? DC-9

PROBLEM:

CORRECTIVE ACTION:

☐ Is there any work going on in streams that may require stabilization or temporary stream crossing? DC-10

PROBLEM:

CORRECTIVE ACTION:

☐ Are utility trenches being backfilled, seeded and dewatered properly? DC-11

PROBLEM:

CORRECTIVE ACTION:

☐ Is there any evidence of mud on public roads? DC-12

PROBLEM:

CORRECTIVE ACTION:

☐ Are there any structural practices that should be removed because they are no longer needed? DC-13

PROBLEM:

CORRECTIVE ACTION:

☐ Do any structural practices require repair or clean-out to maintain adequate function? DC-14

PROBLEM:

CORRECTIVE ACTION:

Inspection Log - continued

OTHER OBSERVATIONS OR DECISIONS MADE

ORAL/WRITTEN NOTIFICATION GIVEN TO

COMPLETION DATE

DEVELOPMENTAL CONCERNS:

Missouri NPDES Permit Requirements

(in part)

Applicability to Valuable Resource Waters

1. **Stormwater discharges to streams or stream segments defined as Valuable Resource Waters must be identified under the following conditions:**

   a. Stormwater discharges within 1000 feet of:
      i. Streams identified as a losing stream;
      ii. Streams or lakes listed as an outstanding national or state resource water;
      iii. Reservoirs or lakes used for public drinking water supplies (class L1); or
      iv. Streams, lakes or reservoirs identified as critical habitat for endangered species.

   b. Stormwater discharges:
      i. Within 100 feet of a permanent stream (class P) or major reservoir (class L2); or
      ii. Within two stream miles upstream of biocriteria reference locations.

   c. Stormwater discharges where:
      i. Any of the disturbed area is defined as a wetland (Class W); or
      ii. The stormwater discharges to a sinkhole or other direct conduit to groundwater.

2. **This permit applies to discharges to Valuable Resource Waters provided that the particular sections that are identified as pertaining to these water are adhered to.**

3. **Streams and stream segments that meet these criterion are identified and/ or defined in 10 CSR 20, Chapter 7 (Water Quality).**

Exemptions from Permit Requirements

1. **Facilities that discharge all stormwater runoff directly to a combined sewer system are exempt from stormwater permit requirements.**

2. **Linear, strip or ribbon construction or maintenance operations as defined in 10 CSR 20-6.200 (l)(B).**

3. **Sites that disturb less than five acres of total land area that are not part of a common plan or sale and that do not cause any violations of water quality standards and are not otherwise designated by the department as requiring a permit.**

4. **Agricultural stormwater discharges and irrigation return flows. For purposes of this permit, land disturbance activities from Class I Concen trated Animal Feeding Operations (CAFO) are not considered an agricul tural activity and therefore not exempted.**

Clarification Exemption of Agricultural Activities

Missouri Storm Water Regulations

May 1994

Missouri regulations governing stormwater discharges (IO CSR 6.200) exempt "agricultural stormwater discharges." The following information clarifies what is meant by "agricultural stormwater discharges," and when activities on agricultural land are exempt and when they are not.

Exempt

For purposes of stormwater regulations, agricultural activities are silviculture; pasturing of animals; growing crops; conservation practices; and the use and construction of outbuildings that house equipment and machinery, farm animals and feed. These activities, unless regulated by 40 CFR Subchapter N, are exempt from stormwater regulations, including the requirement for a permit for the disturbance of five acres or more of land. See the section on Concentrated Animal Feeding Operations for an explanation of 40 CFR, Subchapter N, facilities.

Not Exempt

The exemption only applies if the activity or the clearing of land is solely for agricultural purposes as defined above. The following activities are NOT exempt from either industrial stormwater requirements or land disturbance requirements.

Land Clearing

Any clearing for industrial or commercial purposes is not exempt. For example, clearing of land for residential commercial development such as housing, office buildings or a golf course would not be exempt from land disturbance requirements.

As stated, strictly silviculture activities where trees are grown and harvested as logs with no roughing, hewing or other treatment are exempt from stormwater regulations. However, if the trees are being bulldozed and more than five acres are disturbed, then the land disturbance permit would be required and could be used for the purpose of controlling erosion. In addition, other logging activities would be covered by the requirements for the lumber and wood products industry.

If agricultural land is cleared, is not used for a defined agricultural activity within a year of the start of clearing activities and is used or sold and used for an activity that is not exempt, then that activity would be viewed as speculative land clearing and would require a stormwater permit. If stormwater requirements had not been met, the department would have reason to pursue an enforcement case against the person who owned the land when it was cleared.

Industrial Activity
Industrial activity that occurs on agricultural land is not exempt. For example, if gravel was extracted on land leased from a farm, the activity would be c1assified as mining under SIC code 1442 or 1446. Therefore, the activity would be considered a stormwater discharge associated with industrial activity and would require a permit.

Waste Disposal, Storage or Land Application
Open dumps, waste disposal areas and land application sites are not exempt. For example, it sawdust were disposed of on agricultural land and created a total pile area greater than 1/4 acre in size, the disposal area would need a stormwater permit.

Storage of a waste product to facilitate its beneficial use for a two-week period is exempt from requirements. Longer storage periods on agricultural land would require prior approval.

Land application of industrial wastes, by-products, sludges or biosolids onto agricultural land would require a permit. For example, land application of wastewater or sludges from meat processing plants and other food processing facilities would require a permit.

Concentrated Animal Feeding Operations (CAFOs)
Concentrated Animal Feeding Operations that are identified in 40 CFR, Sub Chapter N. and require a permit under 122 are not exempt from stormwater permitting requirements. The requirements extend to land application sites of wastes from these facilities and land disturbance activities of five acres or more from construction of these facilities.

CAFOs are defined as a lot or facility where animals (other than aquatic animals) have been, are or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period, where crops and forage are not sustained in the lot and that meet the criteria in Appendix B. In Appendix B, (a), Criteria for Determining a Concentrated Animal Feeding Operation, the following operations are defined and these operations are subject to stormwater requirements:

More than the numbers of animals specified in any of the following categories are confined:

1. 1,000 slaughter and feeder cattle;
2. 700 mature dairy cattle (whether milked or dry cows);
3. 2,500 swine each weighing over 25 kilograms (approximately 55 pounds);
4. 500 horses;
5. 10,000 sheep or lambs;
6. 55,000 turkeys;
7. 100,000 laying hens or broilers (if the facility has continuous overflow watering);
8. 30,000 laying hens or broilers (if the facility has a liquid manure system);
9. 5,000 ducks; or
10. 1,000 animal units.

Glossary

A

Accelerated Erosion See Erosion.

Acidic A material with a pH of less than 7.0. Soil nutrients are generally less soluble and less available to plants in moderately or strongly acid soils. Agricultural lime is commonly applied to acidic soils to increase the pH.

Acre An area of measurement equal to 43,560 square feet.

Aeolian Wind deposited material such as loess or dune sands.

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.

Agronomy The theory, study and practice of field crop production and soil management.

Alkaline A material with 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 material; e.g., silt fence, erosion control blanket or geotextile, etc., are buried to hold it in place.

Angle of Repose The maximum angle of slope (measured from a horizontal plane) at which loose, cohesionless material will come to rest. The angle of repose for unconsolidated soil varies with the soil grain size, grain shape and moisture content. To maintain stability, cut or fill slopes should not exceed the angle of repose or slippage may occur.

Anti-Seep Collar A plate of metal, high-density plastic or butyl rubber attached perpendicularly to the outside of a pipe placed through an embankment. Used to prevent water from flowing unabated along the outside of the pipe causing soil piping and structure failure.

Application Rate The quantity (mass, volume or thickness) of material applied per unit area.

Apron Protective material laid on a streambed or ground surface to prevent scour at a culvert outlet, abutment, toe of a structure or slope or similar location.

Aquifer An underground, porous, water-bearing geological formation composed of a layer of permeable rock, sand or gravel that provides a groundwater reservoir.

Armor A protective coat or artificial surface on streambeds, banks, shores or embankments used to resist erosion or scour. Examples of hard armor include concrete and riprap. Soft armor includes flexible geosynthetic support systems used with vegetation.

Articulated Block Systems Concrete blocks linked by cables or interlocking pieces that are flexible, porous and can accommodate growth of herbaceous and woody vegetation while offering the strength and durability of a hard armor.

B

BMP (Best Management Practice) The preferred methods and/or products that will correct or control erosion, sedimentation or water quality degredation on a specific site for particular site conditions.

Backfill Earth or other material used to replace material removed during construction, such as in culvert, sewer and pipeline installations.

Base Course (Base) A layer of material of specified thickness placed on the subgrade to distribute load, provide drainage and minimize frost action.

Bedding The soil or other material on which a pipe or conduit is supported.

Bench A step in a slope. Formed by a horizontal surface and a surface inclined at a steeper angle than that of the entire slope.

Bentonite (Sodium Bentonite) A highly plastic clay that swells extensively when wet. Used to seal soil to reduce seepage losses from ponds and lagoons.

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 break down 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, control sedimentation, protect water quality and/or provide wildlife habitat.

Biological Stability Ability to resist degradation from exposure to microorganisms.

Blanket Rolled materials consisting of coir (coconut fiber), 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.

Blinding (Clogging) The condition whereby soil particles block the voids at the surface of a geotextile, thereby reducing the rate of water flow through the geotextile.

Bridging (Soil) The formation of large voids due to inadequate compaction of earth material or the inclusion of improper fill inclusions.

Broadcast The application of material scattered or sprayed on the soil surface. Broadcast seeding is a uniform distribution of seeds over the entire planted area.

C

CPESC A Certified Professional Soil Erosion and Sediment Control Specialist as designated by the Soil & Water Conservation Society.

Canopy (Plant) The foliage of a tree, shrub or herbaceous plant. The area covered by the plant canopy is protected from splash erosion.

Canopy (Inlet) A principle spillway pipe with the inlet cut at an angle of 33, 45 or 56 degrees designed as an anti-vortex device which maximizes water flow through the pipe.

Carbon Black Material consisting primarily of elemental carbon used as an additive for plastic geosynthetic production. It imparts a black color to the compound which retards aging by ultraviolet light from the sun.

Catch Basin A receptacle for diverting surface water to a sewer or subdrain, having at its base a sediment bowl to prevent the admission of coarse material into a sewer or stream.

Cellular Confinement System A synthetic grid with open spaces filled with soil, sand, gravel or concrete. The matrix mechanically stabilizes these materials and is used for erosion control and/or load support applications.

Certified Seed Seed which has been analyzed by a state association test laboratory for percent germination, weed seed content and purity.

Channel A natural stream or excavated ditch that conveys water.

Channel Erosion See Erosion.

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, riprap, concrete or other material.

Check Dam (Rock Check Structures) Temporary barriers of 3-6 inch rock constructed across a swale or drainage ditch. Used to reduce the velocity of concentrated stormwater flows, reduce degradation and to trap sediment.

Chemical Stability The ability to resist chemicals; e.g., acids, bases, solvents, oils and oxidation agents and chemical reactions, including those catalyzed by light.

Chute A steeply inclined channel, usually lined with rock or concrete, for conveying water from a higher to a lower level.

Clay (1) Mineral particles less than .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.

Clogging See Blinding.

Coefficient of Permeability (k) The rate of discharge of a fluid per unit cross sectional area of a geotextile under a hydraulic gradient.

Cohesive Soil An unconfined soil that has considerable strength when air dried and that 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 coir tubes for scour protection and planting in bioengineering applications.

Compaction The application of mechanical forces to the soil to make it more dense and less porous.

Concrete A hard, strong building material composed of water, a cementing material such as portland cement and a mineral aggregrate such as sand or gravel.

Concrete Armor Blocks Interlocking blocks of precast concrete used for channel linings and streambank stabilization.

Conduit Any channel or pipe for transporting water.

Conservation District A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water and related resource conservation, use and development within its boundaries. Often called a soil conservation district or soil and water conservation district, it is usually a subdivision of state government with a local governing body, but with limited authorities.

Consistency The relative ease with which a soil can be deformed. Soil moisture content directly influences how a soil behaves when subjected to compression.

Contaminant A secondary material added by human or natural activities which may, in sufficient concentrations, render the primary material or atmosphere unacceptable.

Contour An imaginary line on the surface of the earth connecting points of the same elevation.

Coverage The surface area to be covered by a specified material. For roll goods, allowance is made for a defined overlap of the edges of the material.

Creep (1) Slow mass movement of rock or soil material down slopes primarily driven by gravity which is not usually perceptible except to observations of long duration. (2) The slow change in length or thickness of a material under prolonged stress.

Crest Elevation (1) The maximum elevation of surface water under consideration. (2) The highest elevation of a structure or component.

Critical Areas Regions highly susceptible to erosion such as an area subjected to concentrated water flow.

Critical Depth Water depth in a conduit at which certain conditions of maximum flow will occur.

Critical Slope (1) The slope at which a maximum flow will occur at minimum velocity. (2) The maximum angle with the horizontal axis at which a sloped bank of soil or rock of a given height will stand unsupported. See Angle of Repose.

Critical Velocity The average velocity of flow when flow is at critical depth.

Culvert A conduit for conveying surface water through an embankment.

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

D50 The sieve opening size which allows 50% of a given sample to pass through.

Dam An embankment constructed of compacted soil materials usually across a stream or area of concentrated water flow.

Darcy's Law A law describing the rate of flow of water through saturated porous media.

Deformation A change in the shape of a specimen; e.g., an increase in length produced as a result of the application of a tensile force.

Degradable The ability of a material to break down or decompose into lesser components.

Degradation (1) The loss of desirable properties by a material as a result of some process or physical/chemical phenomenon. (2) The progressive general lowering of a stream channel by erosion.

Density The mass of a substance per unit volume.

Department of Natural Resources (DNR) The state agency in Missouri responsible for preserving and protecting the state's natural and cultural resources. DNR is responsible for regulating the NPDES program which includes stormwater permitting. DNR also provides grants and low-interest loans to public entities for sediment control, water pollution control and related information/education projects.

Design Discharge A quantity of flow that is expected at a certain point as a result of a design storm or flood frequency. Usually expressed as a rate of flow in cubic feet per second.

Design Frequency The recurrence interval for hydrologic events used for design purposes. As an example, a design frequency of 50 years means a storm of a magnitude that would be expected to occur on the average of once in every 50 years.

Design Life The length of time for which it is economically sound to require a structure to serve without major repairs or replacement.

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 amount, duration, intensity and frequency that is used to calculate the volume of water runoff and peak discharge rate.

Dewatering The removal of surface or subsurface water as in removing water temporarily impounded in a holding basin or pond.

Dew Point The temperature at which water vapor starts to condense in cooling air at the existing atmospheric pressure and vapor content.

Dike An embankment or wall constructed to prevent flooding.

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 ridge of earth constructed to divert surface runoff water from one area to another for disposal at a non-erosive velocity.

Drainage Interception and removal of groundwater or surface water by artificial or natural means.

Drainage Area A geographical area that contributes runoff water to a common point.

Drainage Soil The frequency and duration of periods when the soil is not saturated.

Dredging The process of removing sediment from a watercourse such as a river or reservoir.

Drop Inlet A structure in which the water drops (1) through a vertical riser connected to a discharge conduit or (2) over the crest of a vertical wall to a lower elevation.

Drop Structure A structure in a channel or conduit which permits water to drop to a lower level.

Dry Well A steel catch basin with open bottom and perforated walls. Used to store surface runoff for infiltration or recharge into the ground.

E

ECC (Effective Calcium Carbonate) A measure of the ability of a liming material to neutralize soil acidity, expressed as a percentage. Agricultural lime is approximately 50% ECC.

Ecosystem The interaction between living organisms and their non-living environment.

Effluent A material which flows out from the point of concern. For example, sewage water or other waste liquids flowing out of a reservoir basin or treatment plant.

Embankment A mound of earth or stone built to hold back water or to support a roadway.

Emergence The process of a plant seedling rising above the soil surface.

Emulsion See Binder.

Environmental Protection Agency (EPA) The federal agency responsible for the implementation of the Clean Water Act. See Resource Inventory List for more information.

Energy Dissipator A structure installed at the outlet of a channel, drop structure or conduit to absorb the force of high-velocity flow. It may consist of riprap, linings, baffles, staggered blocks, etc.

Equivalent Opening Size (EOS) Number of the U.S. Bureau of Standards sieve (in mm or inches) having openings closest in size to the diameter of uniform particles which will allow 5% by weight to pass through the material. Used to select filter fabric for use in filtration and separation.

Equivalent Neutralizing Material (ENM) See ECC.

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:

Accelerated erosion: Erosion much more rapid than natural or geologic erosion, primarily as a result of human activities.

Channel erosion: The widening, deepening and headward cutting of small channels and waterways, due to erosion caused by moderate to large floods.

Gully erosion: The erosion process, whereby runoff water accumulates in narrow channels and over relatively short time periods, removes the soil to considerable depths. When surface channels cannot be smoothed out by normal agricultural tillage operations, they are called gullies.

Sheet erosion: The gradual removal of a fairly uniform layer of soil from the land surface by runoff water.

Shoreline erosion: The loss of soil materials due to the wave action of a permanent waterbody such as a pond, lake or ocean.

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.

Rill erosion: The erosion process whereby numerous small channels only several inches deep are formed. Commonly occurs on recently disturbed and exposed soils.

Saltation: The movement of soil particles by rolling or a series of short bounces along the ground surface due to the wind.

Suspension: The transport of soil particles by the wind for relatively long distances.

Erosion Control The prevention and/or reduction of soil particle movement. Erosion control reduces soil detachment, transport and deposition.

Erosion Control Blanket Temporary or permanent fabricated materials that protect the soil and enhance the establishment of vegetation.

Erosion Control Revegetation Mat (ECRM) A permanent blanket made of synthetic material used for long term protection against soil movement.

Erosion Control Technology Council (ECTC) A division of the International Erosion Control Association which develops standards and guidelines for products and testing of materials.

Evaporation The conversion of water from a liquid to a vapor form.

F

Fabric See Geotextile.

Fabric Formed Concrete Systems Geotextile tubes and mattresses that are filled with concrete to provide a hard armor protection system.

Fabric Wrapped Drain An inner core of a porous medium such as sand, gravel or a corrugated pipe, with an outer geotextile wrap or sheath used to collect and remove excess water.

Fascine (Wattle) Bundles of tree or shrub branch cuttings which are tied together and anchored in trenches with wooden stakes. Used for a variety of slope stabilization projects.

Fertilization The process of adding soil nutrients to the soil to stimulate plant growth. The percentage of available nutrients in bulk fertilizer is labeled as % nitrogen, % phosphorus and % potassium. A 100 pound bag of 12-12-12 is 12% nitrogen, 12% phosphorus and 12% phosphate. The bag contains 12 pounds of each nutrient along with 64 pounds of inert ingredients.

Fill (Embankment) A bank of soil, rock or other material constructed above the natural ground surface.

Filter Cloth See Geotextile.

Filter Strip A wide belt of vegetation designed to provide infiltration, intercept sediment and other pollutants and reduce stormwater flow and velocity. Designed to accept an even distribution of surface runoff; its effectiveness is reduced if a channel forms or if high velocity flows occur.

Filtration The process of retaining soils or other materials while allowing the passage of water or fluids.

Finished Grade The final elevation of the ground surface conforming to the approved construction plan.

Flood An overwhelming quantity of water. Measured in terms of either water level or discharge rate.

Floodplain A relatively level surface of stratified alluvium which adjoins a water course and is subject to periodic flooding, unless protected artificially by a dike or similar structure.

Footing The supporting base or ground work of a structure.

Freeboard The vertical distance between the elevation of the design high-water level and the top of a dam, diversion ridge or other water control device.

Freeze-Thaw Resistance Ability to resist movement and/or degradation caused by cycles of extreme temperature fluctuations above and below the freezing point.

Friction Angle An angle, the tangent of which is equal to the ratio of the friction force per unit area to the normal stress between two materials.

Frost Heave The raising of a surface or object due to the accumulation of ice in the underlying soil.

G

Gabion A galvanized or polyvinylchloride coated steel wire mesh basket filled with stones, broken concrete or other dense, erosion resistant material. Baskets usually form part of a larger unit of several such baskets. Used to protect channel banks, shorelines or steep slopes from erosion.

Gauge Standard measurement of the thickness of metal sheets or wire (and bearing a relation to the weight of the metal).

Geocomposite A manufactured material using geotextiles, geogrids and/or geomembranes in laminated or composite form.

Geogrid A net-like polymeric material used to reinforce, stabilize and/or contain soil, rock, earth or other material in a wide variety of applications including internally reinforced soil walls, segmental retaining walls, steep slopes, etc.

Geomembrane A synthetic impermeable membrane used to contain liquids and/or sediment.

Geosynthetics Any synthetic material, including geotextiles and geomembranes, or any combination thereof, used with foundation, soil, rock, earth or any other geotechnical engineering related material, as an integral part of a structure or system.

Geotechnical Engineering The application of the laws and principles of science and mathematics to solve problems related to the materials of the earth's crust. It includes the fields of soil mechanics, rock mechanics, and many of the engineering aspects of geology, geophysics, hydrology and related sciences.

Geotextile (Fabric, Filter Cloth) A woven or nonwoven water permeable material either natural or synthetic used to filter liquids and to prevent the movement of sediment, to separate different materials or to reinforce and strengthen them.

Germination The beginning of plant growth. The sprouting of roots, stems and leaves from seed.

Glacial Till Material deposited by glaciation, usually composed of a wide range of particle sizes, which has not been subjected to the sorting action of water.

Gradation The distribution of particle sizes in a material.

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.

Grade Stabilization Structure A structure, usually a combination of an earth embankment and mechanical spillway installed to discharge water from a higher to a lower elevation in order to control erosion and head-cutting or to reduce channel grade.

Gradient See Slope.

GRAND Great Rivers Alliance of Natural Resources Districts. Regional association of conservation districts serving the urban conservation needs of eight Missouri and Illinois counties in the St. Louis metropolitan area.

Granular A description of the uniformity of grain size of gravel, sand or crushed stone.

Gravel (1) Soil particles with diameters between 2 mm and 3 inches. (2) Loose, rounded fragments of rock commonly used to surface roads.

Ground Cover Any vegetation producing a protective mat on or just above the soil surface. Usually refers to low-growing herbaceous plants.

Ground Water Level See Water Table.

Grout A fluid mixture of cement, water and sand or other fillers that can be poured or pumped easily. Used to fill the voids between riprap, culverts or other structures in channels or slopes to prevent or reduce erosion or inadvertant water flow.

Gully Erosion See Erosion.

H

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 overfalls to a lower level and active erosion occurs.

Herbaceous A non-woody plant.

High-Density Polyethylene (HDPE) A synthetic polymer used for geomembranes and pond liners.

Horizon A layer of soil that is distinguishable from adjacent layers by characteristic physical and chemical composition. Soil horizons are commonly referred to as topsoil, subsoil and parent material. “A” horizon: the uppermost layer usually contains organic matter. “B” horizon: the layer which accumulates material leached from the “A” horizon. “C” horizon: undisturbed parent material from which the overlaying layers have developed.

Humus See Organic Matter.

Hydraulic Gradient A line which represents the relative force available due to the potential energy available. This is a combination of energy due to the height of the water and internal pressure. In an open channel the line corresponds to the water surface. In a closed conduit, if several openings are placed along the top of the pipe and open end tubes inserted, a line connecting the water levels in the tubes represents the hydraulic energy.

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 which is sprayed on the soil surface.

Hydraulic Radius The cross-sectional area of a stream of water divided by the length of that part of its periphery in contact with its containing conduit. The ratio of area to wetted perimeter.

Hydraulics The science and technology of the mechanics of fluids.

Hydric Soil Soils that are wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.

Hydrograph A chart showing for a given point on a stream the runoff rate, depth, velocity or other property with respect to time.

Hydrologic Soil Groups Categories of soil based upon their runoff producing characteristics. Group A soils have low runoff potential. Group D soils, the other extreme, have high runoff potential. Hydrologic soil groups are listed in NRCS soil surveys, a publication available at NRCS/Conservation District offices.

Hydrology Science dealing with the distribution and movement of water.

Hydrophilic Molecules and surfaces that have a strong affinity for water molecules.

Hydrophobic Molecules and surfaces that have little or no affinity for water molecules.

Hydrophytic A plant adapted to growth in water or saturated soil.

Hydroseeding Spreading of seed hydraulically in a water medium. Mulch, lime and fertilizer can also be incorporated into the sprayed mixture.

Hydrostatic Pressure A state of stress in which all the principle stresses are equal (and there is no shear stress), as in a liquid at rest; the pressure in a liquid under static conditions; the product of the unit weight of the liquid and the difference in elevation between the given point and the free water elevation. Measured in pounds per square inch.

Hygroscopic A material that attracts, absorbs and retains atmospheric moisture.

I

IECA The International Erosion Control Association
P.O. Box 774904, Steamboat Springs, Colorado 80477-4904
Phone (800) 455-4322

Serving as a global resource for people who share a common responsibility for the prevention and control of erosion. The Great Rivers Chapter serves Iowa, Kansas, Missouri and Nebraska.

Contact Great River Chapter of IECA at:
600 Broadway, Suite 300, Kansas City, Missouri 64105
Phone (816) 474-4240

Impermeable Does not permit passage of a fluid or a gas.

Impervious Impenetrable. Surfaces such as compacted soil, rooftops, sidewalks or pavement which are resistant to the entrance of water, air or plant roots.

Incorporate To mix materials such as fertilizer or lime into the soil with tillage operations.

Infiltration The downward entry of water into the surface of soil.

Inflow The water discharged into a point of concern.

Inoculation (of seeds) The addition of nitrogen-fixing bacteria (inoculant) to legume seeds or to the soil in which the seeds are to be planted. The bacteria convert atmospheric nitrogen into a form available for plant growth.

Inorganic Composed of matter that is not of plant or animal origin.

Inorganic Soil See Mineral Soil.

Intermittent Stream A stream, or reach of a stream, that does not flow year round.

K

Kansas Department of Health and Environment (KDHE) The state agency in Kansas which regulates the NPDES Program including stormwater runoff permitting. See Resource Inventory List for more information.

L

Landscaping The placement of sod, seed, trees and other vegetation after final grading is completed.

Lapped Joint A joint made by placing one surface to be joined partly over another surface and bonding or fastening them together.

Leachate Liquid that has percolated through a material and contains soluble components removed from that material.

Leaching The removal in solution of soluble materials by percolating water. Generally refers to the movement of soil nutrients to a deeper soil horizon, making them unavailable for plant growth. It can also refer to the movement of contaminants through the soil and into the groundwater.

Legume Any member of the pea or bean family which includes peas, beans, clovers, alfalfas, lespedezas and vetches. Most are nitrogen-fixing plants.

Lift An applied and/or compacted layer of soil, asphalt or waste. Also referred to as a course.

Lime, Agricultural A soil amendment containing calcium carbonate and other materials used to neutralize soil acidity and furnish calcium for plant growth.

Liner A layer of emplaced materials which serves to restrict the escape of liquids or solids placed within the impoundment. This includes reworked or compacted soil and clay, asphaltic and concrete materials, spray-on membranes, polymeric membranes or any substance that serves the above stated purpose. The portion of a reservoir responsible for the first line of defense against seepage; that is, the part immediately adjacent to the liquid being held.

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.

Loess Material transported and deposited by wind and consisting of predominantly silt-sized particles. Loess has an open structure and relatively high cohesion due to cementation of clay or calcareous material at grain contacts. A characteristic of loess deposits is that they can stand with nearly vertical slopes.

M

MAACD Mid-America Association of Conservation Districts. A regional association of conservation districts serving the urban conservation needs of ten Kansas and Missouri counties in the Kansas City metropolitan area.

Mannings Equation An equation for determining the flow rate of water in a uniform, steady state condition.

Mass The quantity of matter in a body.

Mass Per Unit Area The amount of material per unit area. Units can be ounces per square yard or grams per square meter.

Mean The average value of a group of numbers.

Mil Abbreviation for one-thousandth.

Mineral Soil (Inorganic Soil) A soil with less than 20% organic matter.

Mitigation The process of reducing the negative impacts of a project.

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 solid material.

Monomer A relatively simple compound which can react to form a polymer.

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.

N

Natural Erosion The natural influence of climatic forces on the surface of the earth.

National Pollution Discharge Elimination System (NPDES) Federal legislation that requires cities with populations over 100,000 to establish a permit process to control sediment pollution. A permit is also required for development sites five acres or greater in size. Permits are authorized and enforced by the Environmental Protection Agency or a designated state agency as directed by the Clean Water Act.

Natural Resources Conservation Services (NRCS) A federal agency, formally known as the Soil Conservation Service, that provides technical assistance on natural resource management issues. NCRS is a subsidiary of the United States Department of Agriculture (USDA). See the Resource Inventory List for more information.

Nonpoint Source Pollution (NPS) Pollution that enters a waterbody from sources that are diffuse. A point source, by contrast, can be easily identified as distinct such as an industrial or sanitary sewer pipe.

Normal Water Level The average summer water level. The free surface associated with flow in natural streams.

O

Observation Well A vertical pipe placed in the ground to observe groundwater levels.

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. In many cases where dikes are constructed to increase channel capacity, entrance of surface waters is necessarily controlled.

Ordinance A law set forth by a governmental authority.

Organic Matter (Humus) The portion of soil, usually dark in color, 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.

Overburden (1) The loose soil, sand, silt or clay that overlies bedrock. (2) All material overlying an underground excavation.

Overfall A sudden drop in grade, usually associated with a gully.

Overlap That section of adjacent geosynthetic materials that are in contact; one under the other forming a seamed or unseamed joint.

P

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 (including the germination of hard seed) divided by 100.

Particle Size The effective diameter of a particle measured by sedimentation, sieving or micrometric methods.

Peak Discharge The maximum instantaneous flow from a given storm condition at a specific location.

Percent Open Area The net area of a fabric that is not occupied by fabric filaments, normally determinable only for geotextiles having distinct visible and measurable openings that continue directly through the fabric.

Percolation The downward movement of water through the soil horizons. The percolation rate of soil is usually expressed as inches per hour.

Permanent Seeding The establishment of perennial vegetation on disturbed areas for periods longer than 12 months.

Permeability (Soil) The property of the soil that expresses the ease with which water moves downward through the profile. The rate (inches per hour) at which a saturated soil transmits water.

Permittivity The flow rate of water through a geotextile.

Pervious A property of a material through which water passes relatively freely; i.e., sands and gravels.

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.

Photodegradable The ability of a material to breakdown due to exposure to sunlight.

Pipe A culvert having a non-rectangular cross-section, often assumed to be circular unless specified otherwise, which carries a liquid or gas.

Piping (Tunneling) The movement of soil particles by seepage leading to the development of subsurface voids, tunnels or pipelike cavities.

Plastic A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

Plasticity The capacity of a soil or rock to be deformed continuously and permanently by relatively moderate pressure without cracking or appreciable volume change.

Polymer A macromolecular material formed by the chemical combination of monomers. Plastics, rubbers and textile fibers are all high molecular weight polymers. Only synthetic polymers are used to make synthetics.

Polyvinylchloride (PVC) A synthetic thermoplastic polymer prepared from vinyl choride. PVC can be compounded into rigid forms used in pipes or into flexible forms used in the manufacture of geotextiles.

Ponding Water backed up in a channel, depression or ditch as the result of a constriction, obstruction or lack of outlet.

Porosity (D) The percentage by volume of voids of a given material with respect to the total volume of the material.

Porous Pavement A permeable surface material which provides support for traffic without deformation and allows for stormwater and surface runoff to gradually infiltrate into the subsoil.

Potable Water Water suitable for human consumption.

Precipitation Process by which water in liquid or solid state (rain, sleet, snow) is discharged out of the atmosphere upon a land or water surface.

Q

Qualified Design Professional Someone who is trained and highly qualified in their field such as horticulturists, landscapers, various design specialists and technicians.

R

RUSLE (Revised Universal Soil Loss Equation) An updated, computerized method of estimating soil movement due to water erosion. RUSLE incorporates the updated climate, soil erodibility and vegetative cover factors of the Universal Soil Loss Equation.

Registered Design Professional A qualified design professional who is normally certified and/or degreed as an engineer, landscape architect, arborist, forester, biologist, erosion and sediment control specialist, etc.

Reinforcement To strengthen by the addition of materials or support. For example, the strengthening of a soil-geosynthetic system by contributions of the geosynthetic inclusion.

Residual Soil Soil derived in place by the effects of weathering.

Retaining Wall A constructed wall used to eliminate steep slopes while providing stability.

Revetment A lining of stone, concrete, geosynthetics or organic materials used to stabilize a streambank, riverbank or channel.

Rill Erosion See Erosion.

Riparian Area Land adjacent to a body of water that is at least periodically influenced by concentrated water flows or by flooding.

Riprap Dense stone of various size, resistant to weathering, that is placed on earth surfaces, such as the face of a dam or the bank of a stream, to prevent scour erosion.

Riser A vertical pipe connected to an underground pipe used to control the discharge rate from a pond or basin.

Rock Natural, solid, mineral matter occurring in large masses or fragments.

Rock Check Structures See Check Dam.

Roll Goods A general term applied to manufactured materials such as erosion control blankets, turf reinforcement mats (TRM's), netting, geotextiles and other geosynthetics which are furnished in rolls.

Roughness Coefficient A factor in flow formulas representing the effect of channel or conduit roughness on the velocity of flowing water.

Runoff That portion of precipitation not absorbed or retained on the land surface, but that which collects and flows from a drainage area. Water which is lost without entering the soil is called surface runoff. Water which enters the soil before reaching a stream channel is called groundwater runoff. The rate of surface water runoff in open channels or in stormwater conveyance systems is measured in cubic feet per second.

S

Sand (1) Mineral particles that range in size from 2 mm to .05 mm in equivalent diameter. (2) A loose, granular material that results from the disintegration of rocks, consisting of particles smaller than gravel but coarser than silt. (3) A soil containing 85% or more of sand and 10% or less of clay.

Sand Diaphragm A verticle wall of sand around a pipe placed through an embankment. Used instead of anti-seep collars. Drainage from the wall is outletted at the downstream toe of the embankment.

Saltation See Erosion.

Saturation (Soil) The point at which all the voids between soil particles are filled with water.

Scarify (1) Roughening the land surface. (2) To abrade the seed coat to improve seed germination.

Scour The clearing and digging action of flowing water, especially the erosion caused by stream water in sweeping away sediment from the streambed and outside bank of a curved channel.

Sediment Mineral or organic material which, after being in suspension and transported from its original location by wind, water, gravity or ice, has come to rest in a new location.

Seed Bed Soil that has been prepared to promote the germination of seed and the growth of seedlings.

Seed Purity The percentage of the desired species, in relation to the total quantity of bulk material which may include other species, weed seeds or inert matter such as leaves, stems, soil, etc.

Seepage The slow movement of gravitational water through soil, rock, embankments or structures.

Separation The function of a geotextile or other product as a partition between two adjacent dissimilar materials to prevent mixing of the two materials.

Shear Stress (Tangential Stress) The stress component tangential to a given plane. Basic formula to determine the Shear Stress of a Channel (unit wt. of water [62.4 lbs./cu.ft.] X Slope [ft./ft.] X Depth [ft.] = Shear Stress [lbs./sq. ft.]).

Sheet Erosion See Erosion.

Sheet Flow Water flowing across a wide, uniform area such as a highway, parking lot or field.

Shoreline Erosion See Erosion.

Shotcrete Mortar or concrete conveyed through a hose and pneumatically projected at high velocity onto a surface. Used to stabilize the surface. Can be applied by a “wet” or “dry” mix method.

Shrink-Swell The volume change of soil based on moisture capacity. Soils that shrink when dry and swell when wet can damage plant roots, roads, dams and building foundations.

Silt (1) Mineral particles that range in size from .005 mm to .002 mm in equivalent diameter. (2) A soil containing 80% or more of silt and less than 12% clay. (3) A deposition of sediment.

Silt Fence A temporary barrier consisting of a geotextile which is attached to supporting posts and trenched into the ground at the base. As the runoff water slowly filters through the geotextile, the sediment settles out on the uphill side of the silt fence.

Sink Hole A depression in the substrate, usually deep in comparison to its diameter. Caused by the settlement or substrate particle removal by migrating water.

Site Synonymous with job site.

Slag Rough, cindery lava from a volcano.

Slide Movement of a part of the earth under force of gravity, usually due to saturated conditions, or an earthquake.

Slope Degree of deviation from horizontal; expressed as a percentage, as a numerical ratio or in degrees. As a percentage, slope is the number of feet of rise or fall in 100 feet of horizontal distance. As a ratio, it is the number of feet of horizontal to the number of feet vertical. For example, a 25 percent slope is equal to a 4:1 slope and is equal to a slope of approximately 14 degrees.

Slumping The movement of a mass of rock or earth descending to a lower level.

Slurry A watery mixture of suspended matter.

Soil (Earth) Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks or organic materials.

Soil Liquefaction Loss of strength of a saturated soil resulting from the combined effects of vibrations and hydraulic forces, thereby causing the material to flow.

Soil Mechanics The application of the laws and principles of mechanics and hydraulics to engineering problems dealing with soil as an engineering material.

Soil Profile Vertical section of the soil from the surface through all horizons.

Soil Stabilization Chemical or mechanical treatment designed to increase or maintain the stability of a mass of soil or otherwise to improve its engineering properties.

Soil Test The process to determine the soil pH and the nutrient-supplying capability of a specific soil for a specific crop or plant species. Used to determine recommended liming and fertilization rates. Available through University Extension offices and private laboratories.

Soil and Water Conservation Society (SWCS) A multidisciplinary membership organization advocating the protection, enhancement and wise use of soil, water and related natural resources.

7515 Northeast Ankeny Road
Ankeny, Iowa 50021-9764
Phone: (515) 289-2331.

Sloughing The separation and downhill movement of a small portion of the slope from surrounding material.

Species The basic biological classification of organisms. For example, species of grass include Tall Fescue, Smooth Bromegrass and Timothy.

Specific Gravity The ratio of the density of a material to the density of water when both densities are obtained by weighing in air. A specific gravity less than one implies that the material will float.

Spillway (Principle) An open or closed channel or conduit used to convey excess water from a pond, reservoir or basin.

Spillway (Emergency) A designed depression at one side of the embankment of a pond or basin that will pass peak discharges greater than the maximum design storm controlled by the principle spillway and detention storage.

Splash Erosion See Erosion.

Splash Pad A nonporous material placed at the outfall of a conduit, channel or grade stabilization structure, to decrease energy of water flow to a non-erosive velocity.

Spoil Excess rock or soil material not needed after a practice is constructed.

Sprig A portion of the stem and/or roots of a plant used for propagation. For example, Bermuda grass is commonly established with sprigs rather than seed.

Stable Non-eroding.

Stable Outlet An outlet, either natural or constructed, which will dispose of water at non-erosive velocities and without flooding.

Stabilize (1) To establish a non-erosive condition so that stormwater runoff from a design storm will not cause erosion of soil. Usually achieved by protecting erodible areas with structures or vegetation. (2) To establish a soil condition that will not slide or slump, usually by removing saturated conditions or by flattening slopes.

Stage The height of the surface of a river above an arbitrary zero point.

Staple A fastening device typically manufactured of 8-11 gauge wire, “U” shaped with 4-10" legs and a 1-2" crown. Used to secure erosion control blankets, geotextiles and related materials to the ground.

Steady Flow A flow in which the volume passing a given point per unit of time remains constant.

Storage Basin Space for detention or retention of stormwater runoff for controlled release during or following the design storm. Storage may be upstream, downstream, offstream, onstream and/or underground.

Stone Crushed or naturally angular particles of rock between the size of 4.75 and 75 millimeters.

Storm Sewer A conduit that carries stormwater, surface drainage, street wash and other washwaters but usually excludes sewage and industrial wastes. Also called a storm drain.

Stormwater Management A master plan or systems approach to the planning of facilities, programs and managemant organizations for comprehensive control and use of stormwater within a defined geographical area.

Stream Hydraulics The science and technology of water behavior in streams.

Structure (1) The relation of particles or groups of particles which impart to the whole soil a characteristic manner of breaking: some types are crumb, block, platy and columnar. (2) A constructed practice designed to control erosion, sedimentation, stormwater runoff or an overfall.

Subgrade The soil prepared and compacted to support a structure or a pavement system.

Subsoil (1) Soil below a subgrade or fill. (2) That part of the soil profile occuring below the "A" horizon.

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.

Suspension The state of a substance when its particles are kept from falling or sinking. See Erosion.

Swale A low-lying, often wet, area of land.

Synthetic Any material created by artificial means.

T

Tackifier See Binder.

Tangential Stress See Shear Stress.

Temporary Seeding The establishment of fast-growing annual vegetation to provide economical erosion control for up to 12 months and to reduce the amount of sediment moving off the site.

Tensile Strength The maximum force a material can bear without tearing apart. Units are reported as maximum stress (e.g., pounds per square inch) or force per unit thickness (e.g., pounds per inch width).

Tenting Separation of installed manufactured blankets from contact with the ground surface.

Texture The percent of sand, silt and clay in a soil.

Tillage (1) The mechanical manipulation of soil with equipment such as plows, discs, cultivators or harrow. (2) Tilled land.

Toe Drain A subdrain installed near the downstream toe of a dam or levee to intercept seepage and to outlet it away from the structure.

Toe of Slope The junction of a slope and the bottom of the slope.

Top of Slope The junction of a slope and the top of the berm, channel or embankment.

Topographic Map A map of contour lines.

Topsoil Surface soil, usually containing organic matter. The fertile soil most capable of growing vegetation and crops.

Toxic The characteristic of being poisonous or harmful to plant or animal life.

Trash Rack A structural device used to prevent debris from entering a pipe, spillway or other water structure.

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 (TRM) Permanent synthetic erosion control blankets which resist erosion and reinforce the root zone of vegetation to allow heavier flows without losing the vegetation or underlying soil. Increases the ablity of vegetation to resist the erosive force of flowing water.

U

Underdrain See Subsurface Drain.

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.

Ultraviolet Degradation Breakdown of polymeric structures when exposed to light.

Ultraviolet (UV) Radiation Stability The ability of a material to resist deterioration from exposure to sunlight.

Uniform Flow Flow in which the velocities are the same in both magnitude and direction from point to point along the stream or conduit.

Unsheltered Distance The distance from the downwind edge of an area and a stable point in the direction of the prevailing wind. Used as a factor in estimating wind erosion.

Unsteady Flow A flow in which the velocity changes with respect to both space and time.

Upland The region of higher elevations above a floodplain.

Uplift The hydrostatic force of water exerted on or underneath a structure, causing a displacement of the structure.

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 and/or management practices.

V

Vegetation Plant life or total plant cover of an area.

Void (1) Space in a soil or rock mass not occupied by solid mineral matter. This space is generally occupied by air or water. (2) The open spaces in a geosynthetic material through which flow can occur.

W

Washout The failure of a culvert, bridge, embankment or other structure resulting from the action of flowing water.

Water Course A natural or artificial channel in which a flow of water occurs, either continuously or intermittently. Water courses may be either on the surface or underground.

Water Quality The chemical, physical and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Water Table (Ground Water Level) The upper surface of the zone of saturation in permeable rock or soil.

Watershed The region drained by, or contributing water to a stream, lake or other body of water.

Wattle See Fascine.

Weathering The process of disintegration and decomposition as a consequence of exposure to the atmosphere, to chemical action and to the action of frost, water and heat.

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.

Well Graded An equal distribution of particle sizes. Usually refers to gravel.

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.

Wetted Perimeter The length of wetted contact between a stream of water and its containing channel measured at right angles to the direction of flow.

Wind Erosion Equation An estimate of the amount of soil that moves due to wind erosion based upon five factors: soil erodibility, ridge roughness, climate, unsheltered distance and vegetative cover.

GEOTEXTILE TERMINOLOGY
Compiled and edited by Ronald Frobel, 1987

FOR ADDITIONAL INFORMATION:

For more information, use the resource inventory list to identify the major responsibilities of each organization. You will want to develop a list of contacts for your local community.

JURISDICTION	Clean Water Act	Conservation District Law	Historic Sites	Information/ Education	Land Management	Erosion Control	Nonpoint Source Pollution	Riparian Areas	Streambank Erosion	Stream Obstructions	Soils Information	Trees/ Woodlands	Threatened/ Endangered Species	Urban Conservation	Wetlands	Wildlife Habitat
FEDERAL AGENCY CONTACTS:																
U.S. Environmental Protection Agency Region 7														X		
U.S. Army Corps of Engineers: Chief Regulatory Branch • Kansas City District	X							X	X					X		
U.S. Department of Agriculture (USDA) Natural Resources Conservation Service, Kansas				X	X	X		X			X	X		X	X	X
U.S. Fish and Wildlife Service: Region 6 (includes Kansas)													X			X
U.S. Fish Wildlife Service: Region 3 (includes Missouri) Ecological Services Office													X			X
USDA - Natural Resources Conservation Service, Missouri				X	X	X		X	X		X	X		X		
STATE/AREA CONTACTS:																
Mid-America Association of Conservation Districts				X										X		
International Erosion Control Association			X		X											
Soil & Water Conservation Society			X		X											
KANSAS																
State Conservation Commission		X		X			X	X							X	
Kansas Department of Agriculture Division of Water Resources										X						

JURISDICTION	Clean Water Act	Conservation District Law	Historic Sites	Information/ Education	Land Management	Erosion Control	Nonpoint Source Pollution	Riparian Areas	Streambank Erosion	Stream Obstructions	Soils Information	Trees/ Woodlands	Threatened/ Endangered Species	Urban Conservation	Wetlands	Wildlife Habitat
Kansas Department of Agriculture Kansas Water Office				X												
Kansas State Historical Society Center of Historical Research			X													
Kansas Department of Health & Environment Northeast Kansas District Office				X		X								X		
Kansas Department of Health & Environment • Bureau of Water	X			X		X	X									
Kansas Department of Wildlife & Parks							X					X			X	
Kansas State University Cooperative Extension Service				X								X				
Kansas Forest Service				X								X				X
MISSOURI																
Missouri Department of Agriculture			X													
Missouri Department of Natural Resources (MDNR), Division of Environmental Quality, Water Pollution Control Program								X	X	X				X	X	
MDNR, Division of State Parks, Historic Preservation Programs			X	X												
MDNR, Division of Environmental Qualtiy, Kansas City Regional Office	X		X		X	X										
Missouri Department of Conservation			X	X			X	X			X	X	X	X	X	
University of Missouri Cooperative Extension Service				X			X	X	X			X				
MDNR, Soil & Water Districts Commission		X				X					X					

COMMUNITY CONTACTS: (To be developed locally)

For More Information

FEDERAL AGENCY CONTACTS

USDA Natural Resources Conservation Service - Kansas
730 South Broadway
Salina, Kansas 67401
Phone (785) 823-4547

USDA Natural Resources Conservation Service - Missouri
Parkade Plaza Suite 250
601 Business Loop 70 West
Columbia, Missouri 65203
Phone (573) 876-0900

U.S. Environmental Protection Agency - Region 7
726 Minnesota Avenue
Kansas City, Kansas 66101
Phone (913) 551-7034

U.S. Army Corps of Engineers
Chief Regulatory Branch - Kansas City District
700 Federal Building
601 E. 12th Street
Kansas City, Missouri 64106-2896
Phone (816) 426-3967

U.S. Fish and Wildlife Service - Region 6 (Kansas)
315 Houston Suite E
Manhattan, Kansas 66502
Phone (785) 539-3474

U.S. Fish and Wildlife Service - Region 3 (Missouri)
Ecological Services Office - Columbia Field Office
608 E. Cheny St.
Columbia, Missouri 65201
Phone (573) 875-5374

STATE AGENCY CONTACTS (Kansas)

State Conservation Commission
109 SW 9th, Suite 500
Topeka, Kansas 66612-1299
Phone (785) 296-3600

Kansas Department of Agriculture
Division of Water Resources
901 S. Kansas Avenue, Suite 200
Topeka, Kansas 66612-1283
Phone (785) 296-3717

Kansas Department of Agriculture
Kansas Water Office
109 S.W. 9th
Topeka, Kansas 66612-1249
Phone (785) 296-3185

Kansas State Historical Society
Center for Historical Research
120 W. Tenth St.
Topeka, Kansas 66612-1291
Phone (785) 296-3251

Kansas Department of Health and Environment
Bureau of Water
Forbes Field - Building 283
Topeka, Kansas 66620-0001
Phone (785) 296-5557

Kansas Department of Health and Environment
Northeast Kansas District Office
800 W. 24th St.
Lawrence, Kansas 66046-4417
Phone (785) 842-4600

Kansas Department of Wildlife and Parks
3300 SW 29th St.
Topeka, Kansas 66614
Phone (785) 273-6740

STATE AGENCY CONTACTS (Missouri)

Missouri Department of Natural Resources
Division of Environmental Quality
Water Pollution Control Program
Permits Section
P.O. Box 176
Jefferson City, Missouri 65102-0176
Phone (800) 334-6946 or (573) 751-6825

Missouri Department of Natural Resources
Division of State Parks
Historic Preservation Program
P.O. Box 176
Jefferson City, Missouri 65102-0176
Phone (573) 751-7858

Missouri Department of Natural Resources
Division of Environmental Quality
Kansas City Regional Office
500 NE Colbern Road
Lee's Summit, Missouri 64086-4710
Phone (816) 554-4100

Missouri Department of Conservation
P.O. Box 180
Jefferson City, Missouri 65102
Phone (573) 751-4115

University of Missouri
Cooperative Extension Service
309 University Hall
Columbia, Missouri 65211
Phone (573) 882-7754

Missouri Department of Natural Resources,
Soil and Water Districts Commission
P.O. Box 176
Jefferson City, Missouri 65102-0176
Phone (573) 751-4932

Missouri Department of Agriculture
P.O. Box 630
Jefferson City, Missouri 65102-0630
Phone (573) 751-2672

OTHER AGENCY CONTACTS

City of Lawrence, Kansas
c/o George Williams, Public Works Director
6 East 6th
Lawrence, Kansas 66044

Department of Natural Resources and Environmental Control
Division of Soil and Water Conservation
89 Kings Highway
P.O. Box 1401
Dover, Delaware 19903
Phone (302) 739-4411

International Erosion Control Association
P.O. Box 774904
Steamboat Springs, Colorado 80477-4904
Phone (800) 455-4322

Iowa Department of Natural Resources
Environmental Protection Division
900 E. Grand Avenue
Des Moines, Iowa 50319-0034
Phone (515) 281-8941

Johnson County Extension Center
135 W. Market
Warrensburg, Missouri 64093
Phone (660) 747-3193

Johnson County Extension Office
13480 S. Arapaho
Olathe, Kansas 66062
Phone (913) 764-6300

Kansas Forest Service
2610 Claflin Road
Manhattan, Kansas 66502
Phone (785) 532-3300

Kansas State University Cooperative Extension Service
123 Umberger Hall
Manhattan, Kansas 66506
Phone (785) 532-5820

Maryland Department of the Environment
Water Management Administration
2500 Broening Highway
Baltimore, Maryland 21224
Phone (410) 631-3563

Metropolitan Lakes Association
c/o Rick Noble
P.O. Box 26530
Kansas City, Missouri 64196
Phone (816) 471-6900
Fax. (816) 741-2081

Mid-America Association of Conservation Districts
600 Broadway, Suite 300
Kansas City, Missouri 64105-1554
Phone (816) 474-4240 Ext. 249
Fax (816) 421-7758

Minnesota Pollution Control Agency
Division of Water Quality
520 Lafayette Road North
St. Paul, Minnesota 55155
Phone (612) 296-6300

North Carolina Sedimentation Control Commission
Department of Natural Resources and Community Development
P.O. Box 27687
Raleigh, North Carolina 27611-7687
Phone (919) 733-3833

Sedgwick County Conservation District
7130 West Maple, Suite 100
Wichita, Kansas 67209-2101
Phone (316) 942-8422
Fax (316) 945-4368

Soil and Water Conservation Society
7515 NE Ankeny Rd.
Ankeny, Iowa 50021-2331
Phone (515) 289-2331

St. Charles County Soil and Water Conservation District
1 Westbury Square, Bldg. D
St. Charles, Missouri 63301
Phone (314) 724-2237
Fax (314) 724-0839

Virginia Department of Conservation and Recreation
Division of Soil and Water Conservation
203 Governor St., Suite 206
Richmond, Virginia 23219-2094
Phone (804) 786-2064