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ABSTRACT

Guidelines and technical standards for development of local erosion and sediment control programs and conservation standards to meet the goals established by the Virginia Erosion and Sediment Control law are presented in this handbook. Part I defines natural and manmade erosion, sedimentation, and the hazards of uncontrolled wear and damage to the land. Part II provides guidelines for erosion and sediment control planning and plans, submission of plans to local and State authorities, and activities which require approved plans. Comprising most of the handbook, part III contains standards and specifications for a variety of erosion and sediment control practices for use on construction sites and similarly disturbed areas. Control practices generally fall into two categories, vegetative and mechanical. Mechanical control practices include structural and material specifications for dikes, drains, outlets, grading, and other control methods. Vegetative practices to stabilize disturbed areas include plantings, seeding, sod, and other protection methods. Parts IV and V contain the Virginia Soil and Water Conservation Commission's requirements for State agency projects and for local control programs. The handbook also lists references and a glossary of representative terms used in conservation activities. Numerous tables, drawings, photographs, and figures supplement the information in the handbook. (MF)

VIRGINIA
EROSION AND SEDIMENT
CONTROL HANDBOOK

STANDARDS, CRITERIA AND GUIDELINES

VIRGINIA SOIL AND WATER
CONSERVATION COMMISSION

APRIL 1974

COMMONWEALTH OF VIRGINIA

VIRGINIA SOIL AND WATER CONSERVATION COMMISSION

P. O. BOX 1163, RICHMOND, VIRGINIA 23209

April 18, 1974

To the Users of the handbook:

Ladies and Gentlemen:

As Chairman of the Virginia Soil and Water Conservation Commission, I am pleased to present the conservation standards, guidelines and criteria to minimize erosion and sedimentation contained in this Virginia Erosion and Sediment Control Handbook. The handbook contains the State erosion and sediment control program adopted by the Commission on April 18, 1974. When effective programs are implemented at the local level, significant benefits will accrue to the citizens of the Commonwealth through the use of these conservation measures.

The Commission expresses appreciation to the many agencies and individuals who contributed to the development of the handbook. Special thanks is extended to the Erosion and Sediment Control Advisory Board, the Technical Committee for Erosion and Sediment Control, and Glenn B. Anderson, Erosion and Sediment Control Specialist, who assisted the Commission in the basic research and development of this handbook. The Commission also acknowledges the assistance of the Office of the Attorney General, the State Water Control Board, USDA-Soil Conservation Service, and other agencies that furnished information which has been adapted for use in this handbook.

Respectfully,

R. DuVal Dickinson

R. DuVal Dickinson
Chairman

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PART I

INTRODUCTION

APRIL 1974

INTRODUCTION

The purpose of the Erosion and Sediment Control Law is to provide for the protection of the land and water resources of the state with minimum adverse affect upon economic activity. The rapid shift in land use from agricultural to nonagricultural has accelerated the processes of soil erosion and sedimentation with the result that waters are being polluted and spoiled to such a degree that fish, aquatic life, and recreation and other uses of lands and waters are being adversely affected.

As the population of our state grows, our natural resources become increasingly more important. Their preservation is easier and less expensive to accomplish than their restoration--a restoration that may never be physically possible or economically feasible. Virginia has taken a bold step in establishing a statewide coordinated program to conserve and protect the land, water, air and other natural resources of the Commonwealth for generations to come.

The Virginia General Assembly has seen fit to place this basic responsibility on those who know and understand best local conditions and who will benefit most directly from its provisions. The success of the program depends upon the conservation districts, counties, cities and towns and the public in general. Realizing the importance of economic benefits of prevention, it is envisioned that responsible officials and citizens will make enlightened use of the erosion and sediment control program to protect our natural resources while accommodating our needs that disturb the land and affect the waters.

This handbook provides the guidelines and technical standards for development of local erosion and sediment control programs and conservation standards to meet the goals established by law.

Natural Erosion

In preparing the program guidelines and technical standards it was recognized that erosion and sedimentation are also natural phenomena. These forces have been continuously active since the beginning of time and will continue in spite of man's efforts. Man has accelerated the process of erosion and sedimentation by altering the topography, soil conditions, natural cover, and drainage patterns to suit his immediate needs. The challenge now is to accommodate man's needs by recognizing these natural forces and working in harmony with nature. An understanding of the basic characteristics of erosion and sedimentation and the hazards they create is fundamental to this cooperation.

Erosion

Soil erosion is the disintegration or wearing away of the land surface by running water, wind, and other geological agents. In Virginia, most soil erosion is caused by the impact of falling and flowing water on exposed and unprotected soil material. The energy of falling and flowing water detaches, disperses, and transports soil particles. Raindrops strike the ground with a velocity of approximately 30 feet per second and with an impact that dislodges soil particles. Surface runoff then carries the particles downslope. The impact of rain falling on exposed soil also decreases infiltration by sealing the soil surface and thereby increasing surface water buildup and initiating sheet flow. When surface storm runoff begins to flow, it soon concentrates to form rills and gullies and gains increased energy to erode and transport soil particles. When available energy is greater than that demanded by the burden of the sediment load being transported, the moving water will erode and transport additional soil particles. If available energy of the flowing water is less than needed to support the burden of the sediment load, deposition of the transported soil will occur.

Man's use of the land influences the rate of erosion. When land use changes from rural or farm use to urban use, soil erosion may increase from as little as 50 tons per square mile per year in rural areas to more than 50,000 tons per square mile on land that is coverted to urban uses. Most erosion occurs in the form of sheet, rill, gully, and stream channel erosion. Uncontrolled soil erosion on developing sites is a common man-made problem. Some of the factors that influence the rate of soil erosion on construction sites include: the extent and duration of exposure of bare soil during development; the erodibility of the soil; the intensity of rainfall; the slope and drainage characteristics of the project area; the amount and type of ground cover; and the construction methods and techniques employed by the developer.

The period during which most soil erosion occurs is from the time the land is denuded of protective cover until final construction and restabilization is completed. Some common construction activities that tend to accelerate soil erosion include: removal of protective vegetation and exposure of soil far in advance of other construction work; exposure of subsoils, mixtures of soil horizons, or geologic formations that are many times more erodible than original soil surfaces; compaction of soil by heavy equipment traffic; enlarged drainage areas caused by grading operations, diversions and street construction; prolonged exposure of disturbed areas due to the lack of adequate planning and scheduling of remedial conservation practices; reduction of time of concentration of storm runoff caused by changes

in topography, soil conditions and drainage patterns; increase in impervious surfaces associated with the construction of streets, buildings, sidewalks, driveways and parking lots; and placement of fill in or adjacent to drainage ways where it is subjected to concentrations of flow of storm water.

Accelerated soil erosion causes serious damages to construction sites and development areas. Some of these damages include depletion of soil fertility, cutting rills and gullies on construction sites, undercutting roads and other structures, scouring of natural and artificial stream channels, undercutting of banks, undermining of open and underground storm sewers, loss of valuable topsoil needed for revegetating the site, and creation of unsafe and hazardous working conditions.

Sedimentation

Sediment is the end product of erosion. Sedimentation involves four fundamental processes: weathering, erosion, transportation, and deposition. Sediment consists primarily of clay, silt, sand, gravel, rock fragments, and mineral particles. Sediment has a two-fold effect on the environment: it depletes the land resource from which it is derived, and it impairs the quality of the water resource in which it is entrained and deposited and may impair the quality of the land on which it is deposited. Sediment becomes a pollutant when it settles on productive land, destroys wildlife habitat, occupies water storage reservoirs, fills lakes and ponds, clogs stream channels, creates turbidity that detracts from recreational use of water and affects acquatic life, increases water treatment cost, damages water distribution systems or degrades water for human consumption or other uses.

Hazards

The impact of uncontrolled erosion and sediment from disturbed and unprotected land undergoing development is often severe. Areas containing combinations of outstanding natural resources are often damaged beyond recognition by uncontrolled erosion and sedimentation. Some of the adverse consequences of erosion and sediment include the following: large increases in areas that have had natural features such as topography, soils, vegetation and drainage patterns impaired or destroyed and the underlying soil exposed to storm runoff and accelerated soil erosion; increased rates and volumes of storm runoff, flooding, soil erosion, sedimentation and related destruction; alteration of the groundwater system adversely affecting the underground water table, drainage system, slope stability, and survival of natural or newly established vegetation; creation of exposed soil horizons that are acid, compact, droughty, wet, shallow, stony or of such low fertility level that establishment and growth of vegetation is greatly inhibited; and adverse alteration of surface runoff patterns by construction and development.

EROSION AND SEDIMENT CONTROL HANDBOOK

PART II

EROSION AND SEDIMENT CONTROL PLANNING AND PLANS

APRIL 1974

Emphasize Natural Terrain Development

Proper planning to fit the buildings and streets to the natural characteristics of the land helps decrease erosion and minimizes development and maintenance costs. Steep slopes, cut and fill slopes, and areas of highly erodible soils can be protected by conservation measures. Saving the natural vegetation, such as trees or shrubs, by minimum disturbance during grading can limit soil erosion.

The problems presented where erodible soils or steep slopes impose severe limitations may be solved best by using these areas as open spaces. Environmental quality is enhanced when open spaces, recreation areas, stream valleys, lakes, ponds, wildlife and other natural amenities are preserved.

Know the Soils

Virginia has about 400 soils which vary widely in their characteristics and properties. Soil characteristics and properties exert a strong influence on the manner in which man uses and should use the land. Therefore, to prevent costly mistakes, it is important to recognize these characteristics and properties prior to development.

Soil Surveys Can Help

Soil surveys can be used as a tool in determining the suitability of land for various uses. Soil surveys include soil maps, soil descriptions, and soil interpretations.

Soil maps are made by soil scientists who delineate on an aerial photograph boundaries of the different kinds of soil occurring on a tract of land. The soil map shows the location of different kinds of soil in relation to streams, roads, buildings, and other features on the landscape.

Technical information on the soils of Virginia has been assembled by soil scientists of the Soil Conservation Service of the U. S. Department of Agriculture and Virginia Polytechnic Institute and State University. Individual soils have been studied for mineral constituent, structure, texture, fragipan, erosion, water tables, acidity and other special properties which influence their use and management.

Soils are rated according to their limitations or difficulty of development for a given use. Soils with slight limitations have few problems which limit their use for a given purpose. Moderate limitations are generally easy to overcome with careful planning and design of structures during development. Severe limitations indicate the need for very careful consideration of a site prior to development. In some instances, for certain uses, the cost of overcoming a given soil limitation may be excessive; hence the site should not be selected for that purpose. In other instances, where the soil limitation is recognized prior to development, it may be feasible to design the structure or adopt measures which will overcome the limitation.

Storm Water Management

For most sites, designing a storm water management system should receive high priority during initial planning. The system should be compatible with the comprehensive land use plan and be designed to safely handle anticipated runoff from the respective watershed based upon the ultimate land use of the area.

Public Utilities

Special attention should be given to sanitary sewers, pipelines, and other underground transmission lines which require excavation and earth moving on steep slopes, along streams and other critical environmental areas.

Include Erosion and Sediment Control in the Development Plan

Since many of the soils in Virginia are highly erosive, it is extremely important that a program for erosion and sediment control is worked out during the planning and design stages, before options are lost and ideas become fixed.

Guidelines

The following are guidelines for erosion and sediment control planning:

- Study the development area and evaluate the soil limitations and other conditions such as topography, natural drainage, geology, and accessibility.
- Select a development that is compatible with the site conditions.
- Identify existing features that can be used in the development, such as vegetation, wildlife habitat, water areas, topsoil, etc.

- Prepare a development plan which will minimize existing site limitations and provide for erosion and sediment control measures.

- Limit grading to areas of workable size so as to limit the duration of exposure of disturbed and unprotected areas. All appropriate conservation practices should be applied on the first disturbed section of land before the next section is opened up.

- Strip and stockpile topsoil for later use on areas to be stabilized by permanent vegetation. Protect the stockpiled material with mulch or temporary vegetation.

- Control runoff either by diverting or conveying it safely through the areas with structural measures.

- Install debris basins and other appropriate erosion and sediment control structures prior to or during the first phase of land grading.

- Seed and mulch debris basins, diversions, waterways and related structures immediately after they are built.

- Install storm water management facilities and make them operational as quickly as possible during construction.

- Employ sediment traps to protect inlets of storm sewers below high silt-producing areas.

- Establish temporary cover by seeding and/or mulching graded areas (except streets and parking areas where underground utilities are planned) which may otherwise be exposed for a period greater than 30 days before permanent stabilization can be achieved. This practice should be accomplished as soon as rough grading work is done.

- Stabilize all streets and parking areas, within 30 days of final grading, with base coarse-crushed stone.

GUIDELINES FOR EROSION AND SEDIMENT CONTROL PLANS

The Plan

An erosion and sediment control plan is defined as:

> *A document containing material for the conservation of soil and water resources of a unit or group of units of land. It may include appropriate maps, an appropriate soil and water plan inventory and management information with needed interpretations, and a record of decisions contributing to conservation treatment. The plan shall contain all major conservation decisions to assure that the entire unit or units of land will be so treated to achieve the conservation objectives.**

The plan shall consist of two parts:

- A narrative report describing the project and giving the purposes, schedule or phasing of major construction activities, schedule of application of conservation practices, engineering assumption and calculations for the control measures;

- A map or maps of the same scale or a base map with overlays, depicting the topography of the area, the limits for clearing and grading, other proposed alterations of the area, and the location of the control measures and facilities.

The plan shall spell out the methods, techniques and procedures to be followed to control accelerated erosion and sedimentation.

The plan shall:

- Clearly identify the type, magnitude and location of both existing and anticipated conservation problems.

- Define the areas to be affected by clearing and grading.

- Show the areas to be mulched and the areas to be established to temporary or permanent vegetation.

- Account for the staging of major land disturbing activities and include the timing and sequence of installing the conservation practices and facilities.

- Show the location of erosion and sediment control practices, such as sediment basins, diversions, waterways, storm drains,

* Definition from Erosion and Sediment Control Law

dikes, terraces and similar structures when such practices are needed.

In addition the plan should:

- Identify the predominant soils and provide details on topography, drainage and existing vegetation.
- Be an integral part of any site plan, subdivision plan, or grading plan required by local government.

Conservation practices for erosion and sediment control shall meet or exceed standards and specifications contained in the local Erosion and Sediment Control Handbook. Practices for which standards and specifications are not contained in the local Erosion and Sediment Control Handbook may be approved by the local plan approving authority based on the merits of the practice as proposed for use in individual circumstances.

Even within a locality, the conservation practices needed to control accelerated erosion and sedimentation vary widely from site to site. Such factors as degree of slope, nature and types of soil, drainage characteristics, proximity to property boundaries and watercourses, acreage disturbed, amount of cut and fill, as well as other factors have a direct bearing on what combination of conservation practices will result in an adequate erosion and sediment control plan.

Recognizing the wide variations from one site to another, the following elements are to be considered in the development of a plan:

1. A general statement of the project (included in the narrative)
   - Brief description of the overall project.
   - Date project is to begin and expected date final stabilization will be completed.
   - Brief description of accelerated erosion control program.
   - Brief description of sediment control program.
   - Brief description of stormwater management program.
2. The topographic features (shown on the map)
   - The location of the project relative to highways, municipalities, major streams, or other identifiable landmarks.
   - Acreage of the project.
   - Contours at an interval and scale that will adequately describe the area

- Approximate limits of the flood plain.
- Critical environmental areas located within or in proximity of the project areas, such as streams, lakes, ponds, wetland areas.
- Nature and extent of existing vegetation.
- Other significant features including map scale and north arrow.

3. Information on the soils (presented in the narrative and shown on the map)
   - Adequate description of each soil, including soil name, texture, slope, depth, drainage, and structure.*
   - Surface area of each soil.
   - Estimate of soil loss by use of the Universal Soil Loss Formula or other acceptable methods. In the absence of a soil survey, a mechanical analysis of the soil will be made to the depth of planned disturbance or an on-site evaluation will be made by a qualified soil scientist. Soils data is readily available in areas having a modern soil survey and in other areas where a progressive survey is underway.

4. The amount of runoff from the project area and the upstream watershed (described in the narrative)
   - Runoff producing factors considered.
   - Peak runoff from a ten-year or 100-year frequency storm based on present and future developed conditions and according to the existing hazards and degrees of protection required. If the watershed is greater than one square mile in area, a peak runoff study of the 100-year frequency storm shall be prepared, taking into account present and future developed conditions and the existing hazards and degree of protection required. If the watershed is less than one square mile in area, a peak runoff study of the 10-year frequency storm shall be prepared, taking into account present and future developed conditions and the existing hazards and degree of protection required.
   - Methods of calculation.

5. The storm water management program (described in the narrative and the location of facilities shown on the map).
   - Brief analysis of problems posed by storm runoff on downstream areas.

* As defined in the Agricultural Handbook 18 - *Soil Survey Manual*, Soil Conservation Service, U.S.D.A.

- Analysis of the hydrologic factors of the project which may contribute to the off-site problem(s).
- Brief description of the permanent measures and facilities designed to cope with the problem.
- Plans for the long-range management of the control facilities.

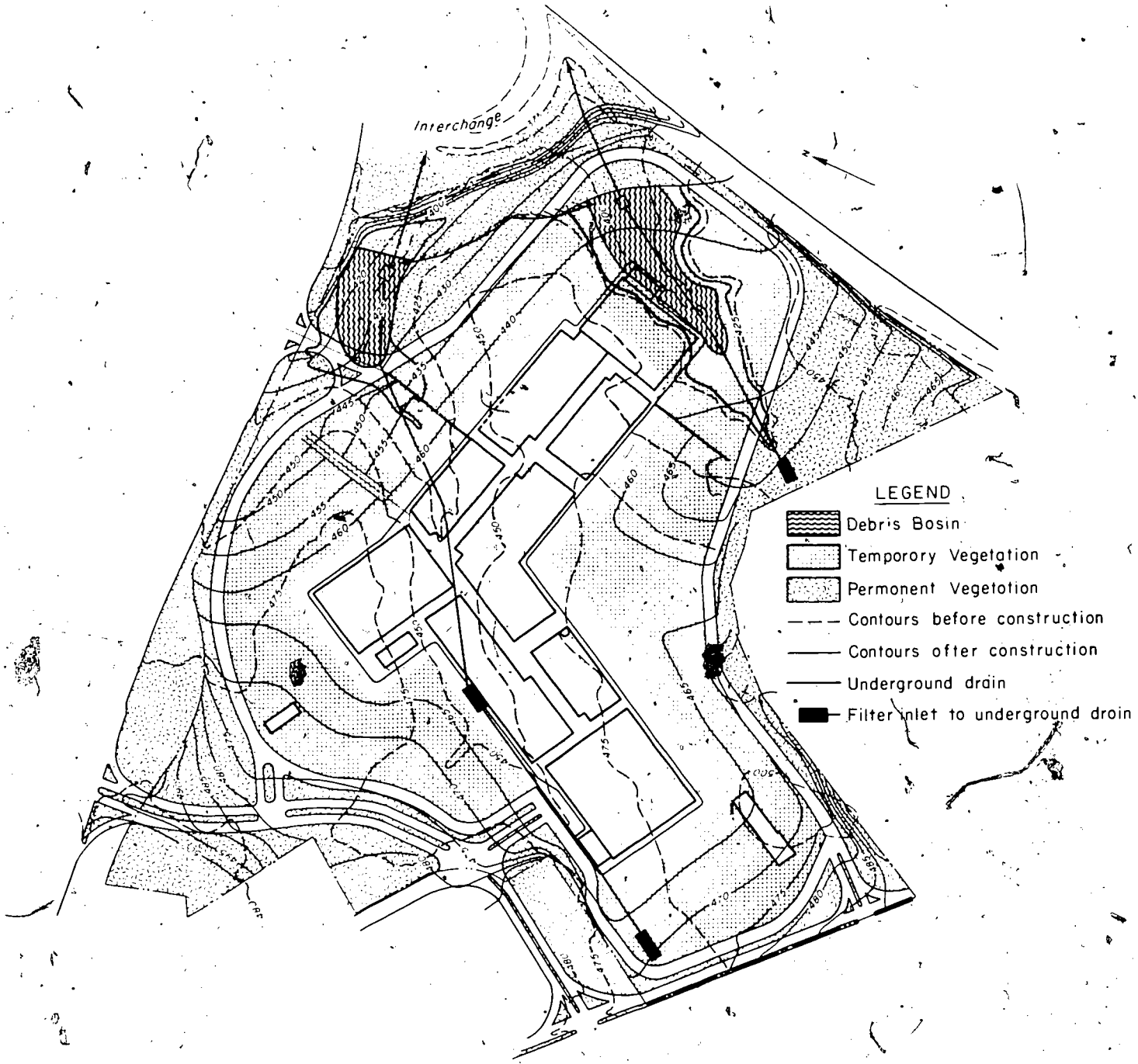
6. The proposed alteration of the area (shown on the map)
   - Limits of clearing and grading.
   - Areas of cuts and fills.
   - Roads, buildings, pond areas, and other structures.
   - Stormwater management facilities.
7. The phasing (or staging) of land disturbing activities (described in the narrative)
   - Sequence of land clearing operations.
   - Removal and stockpiling of topsoil.
   - Major earth moving and grading.
   - Control facility installation.
   - Program of operations.
8. Temporary erosion and sediment control (vegetative and mechanical) measures for use during active construction (included in the narrative and shown on the map)
   - Purpose.
   - Types of measures and facilities.
   - Location of measures and facilities.
   - Dimensional details of the facilities.
   - Design consideration and calculations (mechanical measures only)
9. Permanent erosion and sediment control measures for long-term protection (included in the narrative and shown on the map)
   - Purpose

- Types of measures and facilities.
- Location of measures and facilities.
- Dimensional details of facilities.
- Design considerations and calculations (mechanical measures only)

10. The maintenance program for the control facilities (described in the narrative)

- Inspection program including frequency and schedule.
- Resodding or reseeding of vegetated areas.
- Repair or reconstruction of damaged structural measures.
- The method and frequency of removal and disposal of solid waste materials removed from the control facilities or the project area.
- The method of disposing of temporary structural measures after they have served their purposes.

GENERAL CONSERVATION PLANNING MAP



Example of Erosion and Sediment Control Plan for a Large Commercial Development.

SUBMISSION OF EROSION AND SEDIMENT CONTROL PLANS

Plans Submitted to the Local Authority

When an erosion and sediment control plan is developed for submission to a local plan approving authority, the plan should be developed and submitted according to requirements of the local erosion and sediment control program. Such requirements would be available either in the local Erosion and Sediment Control Handbook or from the local government in charge of administering the local program.

Plans Submitted to the Virginia Soil and Water Conservation Commission

State agencies will submit plans in accordance with provisions of Part IV, "Commission Requirements for State Agency Projects", of the Virginia Erosion and Sediment Control Handbook to:

Virginia Soil and Water
Conservation Commission
P. O. Box 1163,
Richmond, VA 23209

(Commission's Office located on the 5th floor of the Life of Va. Building
911 E. Broad Street
Telephone: (804) 770-2064)

Land disturbing activities which will take place in more than one local control jurisdiction may be handled either by the submission of the erosion and sediment control plan to the appropriate local plan approving authorities in accordance with their requirements or to the Virginia Soil and Water Conservation Commission at the above address. Plans submitted to the Commission shall be in accordance with provisions of Part IV, "Multi-jurisdictional Land Disturbing Activities", of the Virginia Erosion and Sediment Control Handbook.

LAND DISTURBING ACTIVITES REQUIRING AN APPROVED PLAN

"Land disturbing activity" means any land change which may result in soil erosion from water or wind and the movement of sediments into State waters or onto lands in the state, including, but not limited to, clearing, grading, excavating, transporting and filling of land.

The term shall not include the following:

- Such minor land disturbing activities as home gardens and individual home landscaping, repairs and maintenance work.
- Individual service connections and construction or installation of public utility lines.
- Septic tank lines or drainage fields unless included in an overall plan for land disturbing activity relating to construction of the building to be served by the septic tank system.
- Surface or deep mining.
- Tilling, planting, or harvesting of agricultural, horticultural, or forest crops; or clearing and transporting on privately owned, occupied, or operated agricultural, horticultural or forest lands.
- Construction, repair or rebuilding of the tracks, right-of-way, bridges, communication facilities and other related structures and facilities of a railroad company.
- Preparation for single family residences separately built, unless in conjunction with multiple construction in subdivision development.
- Disturbed land areas for commercial or noncommercial uses of less than ten thousand square feet in size (the governing body of the county, city, town or district may reduce this exception to a smaller area of disturbed land and/or qualify the conditions under which this exception shall apply).
- Installation of fence and sign posts or telephone and electric poles and other kinds of posts or poles.
- Shore erosion control projects on tidal waters recommended by the soil and water conservation districts in which the projects are located or approved by the Marine Resources Commission.
- Emergency work to protect life, limb or property, and emergency repairs; provided that if the land disturbing activity would have required an approved erosion and sediment control plan and if the activity were not an emergency, then the land area disturbed shall be shaped and stabilized in accordance with the requirement of the local plan

approving authority or the Commission when applicable.

Land disturbing activities on federal lands.

Engineering operations on privately owned, occupied or operated agricultural, horticultural or forest lands such as the construction of terraces, terrace outlets, check dams, desilting basins, floodwater retarding structures, channel improvements, floodways, dikes, ponds, ditches, and the like; the utilization of strip cropping, lister furrowing, contour cultivating, contour furrowing; land drainage; land irrigation; seeding and planting of waste, sloping, abandoned, or eroded lands to water-conserving and erosion-preventing plants, trees and grasses; forestation and reforestation; rotation of crops; soil stabilization with trees, grasses, legumes, and other thick growing, soil holding crops; retardation of runoff by increasing absorption of rainfall; and retirement from cultivation of steep, highly erosive areas and areas now badly gullied or otherwise eroded.

Land disturbing activities of state agencies are exempt from local control programs; however, such activities are covered at the state level.

The Virginia Soil and Water Conservation Commission has adopted definitions for the following terms:

"Clearing" shall mean any activity which removes the vegetative ground cover including but not limited to the removal, root mat removal and/or topsoil removal.

"Filling" shall mean any depositing or stockpiling of earth materials.

"Excavating" shall mean any digging, scooping or other methods of removing earth materials.

"Grading" shall mean any excavating or filling of earth materials or any combination thereof, including the land in its excavated or filled condition.

"Transporting" shall mean any moving of earth materials from one place to another, other than such movement incidental to grading, when such movement results in destroying the vegetative ground cover either by tracking or the buildup of earth materials to the extent that erosion and sedimentation will result from the soil or earth materials over which such transporting occurs.

VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK

PART III

EROSION AND SEDIMENT CONTROL PRACTICES

OVERVIEW OF EROSION AND SEDIMENT CONTROL PRACTICES

Part III of this handbook contains standards and specifications on a variety of erosion and sediment control practices for use on construction sites and similarly disturbed areas. These practice standards are designed to establish uniformity in the selection, design, review, approval, installation and maintenance of practices contained in erosion and sediment control plans. They establish the minimum degree of technical adequacy in planning, designing and applying erosion and sediment control practices on disturbed areas. Alternate practices may be approved for individual erosion and sediment control plans. Such approval should be based on specific site conditions and where approval will not contravene the intent and purposes of the practice standards set forth herein.

Generally, erosion and sediment control practices for disturbed areas fall into two broad categories -- vegetative practices and mechanical practices. An overview of most of the practices for which standards and specifications have been prepared for this handbook is contained in the following pages.

Vegetative Practices

Vegetative practices may be either temporary or permanent. They may be applied singularly or in combination with other practices. Cutting, filling, and grading soils with heavy equipment results in areas of exposed subsoils or mixtures of soil horizons. Conditions such as acidity, low fertility, compaction, and dryness or wetness often prevail and are unfavorable to plant growth.

Excessively long slopes and steep grades are often encountered or created. Water disposal structures are normally subjected to hydraulic forces requiring both special establishment techniques and grasses that have high resistance to scouring. Plants and techniques, however, are available to provide both temporary and permanent protective cover on these difficult sites.

Temporary Vegetation. Earth moving activities such as heavy cutting, filling, and grading are generally performed in several stages and are often interrupted by lengthy periods during which the land lies idle and is subject to accelerated erosion. In addition, final land grading may be completed during a season not favorable for immediate establishment of permanent vegetation. These and similar sites can be temporarily stabilized by establishment of rapid-growing annual grasses such as ryegrass, rye, sudan grass and similar species. These types of vegetation provide quick protective cover and can later be worked into the soil for use as mulch when the site is prepared for establishment of permanent vegetation.

Permanent Vegetation. When areas are to be vegetated permanently, special care should be taken in selecting the types of plants to use. There is a fairly wide choice of grasses, legumes, ground covers, shrubs and trees from which to choose. If a high level of management can be provided, the

range of plants which can be used is broader. Final selection should be based on adaptation of the plants to the soils and climate, suitability for the specific use, ease of establishment, longevity or ability to reseed, maintenance requirements, aesthetics, and other special qualities. Plants which will provide long-lived stabilization with a minimum amount of required maintenance should be selected. Where management potential is limited because of specialized circumstances, the best plants to choose are those which are well-adapted to the site and to the specific purpose for which they are to be used. For example, grasses used for waterway stabilization must be able to withstand submergence and provide a dense cover to prevent scouring of the channel boundary. In playgrounds, grasses must lend themselves to close grooming and be able to withstand heavy trampling. In some places such as southern exposed cut and fill slopes, the plants needed are those that are adapted to full sunlight and droughty condition. In other places, plants must be able to tolerate shade or high moisture conditions. Some plants can be used for beautification as well as for soil stabilization.

Maintenance may be the most important consideration in selecting plants for permanent stabilization. Most domestic grasses and legumes require a high level of maintenance, or they will not survive and will gradually give way to more hardy native grasses, legumes, and shrubs. In some areas, native plants are preferred. On steep slopes and other inaccessible areas, it is preferable to select plants requiring little or no maintenance. Crown vetch, honeysuckle, and sericea lespedeza are examples of long-lived species that provide good erosion control with a minimum of maintenance. Most native grasses, trees, and shrubs grow well with little or no maintenance.

Mulching.

When final grading has not been completed, straw, woodchips, asphalt emulsion, jute matting or similar materials can be applied to provide temporary protection. Areas brought to final grade during mid-summer or winter can be mulched immediately and over-seeded at the proper season with a number of permanent grass and legume species. Application of mulch on disturbed areas allows for more infiltration of water into the soil, reduces runoff, holds seed, fertilizer and lime in place, retains soil moisture, helps maintain temperatures conducive to germination and greatly retards erosion. Mulch is essential in establishing good stands of grasses and legumes in disturbed areas. It is important to anchor mulch to prevent its blowing or washing off the site.

Mechanical Practices.

Where mulches and vegetative cover will not provide adequate protection against erosion and sediment damages, other erosion and sediment control measures will be needed. There are a number of mechanical practices which can be used to curb erosion and sedimentation during construction. These practices must be selected in the proper combination, carefully designed, and constructed to accomplish the most effective job. The design of all mechanical practices must be based on the maximum storm runoff which will result from a storm of a given frequency. The design storm frequency se-

lected should be balanced with the planned life, safety hazard, and damage potential of the structure or area to be protected. The following are some of the conservation structures appropriate for use on construction sites and similar disturbed areas:

Temporary Construction Entrance. This structure is a stone stabilized pad constructed at points where traffic will be entering or leaving a construction site from or onto public right-of-way, street, alley, sidewalk, or parking area. Its purpose is to reduce or eliminate the transport of mud from the construction area onto the public right-of-way by motor vehicles or by runoff.

Diversion Dike. This is a compacted earthen ridge constructed immediately above a cut or fill slope. Its purpose is to intercept storm runoff from small drainage areas above and divert the water away from the exposed slopes to a stabilized outlet.

Perimeter Dike. This is a compacted earthen dike constructed along the perimeter of a disturbed area in such a manner as to divert sediment-laden storm water to on-site trapping facilities. It is maintained until the disturbed area is permanently stabilized.

Interceptor Dike. This is a temporary ridge of compacted soil or, preferably, gravel constructed across disturbed rights-of-way. An interceptor dike reduces soil erosion by intercepting storm water and diverting it to stabilized outlets.

Straw or Hay Bale Barrier. This is a temporary barrier constructed across or at the toe of a slope. Its purpose is to intercept and detain sediment from areas one-half acre or smaller where only sheet erosion may be a problem.

Gravel Outlet Structure. This is an auxiliary structure installed in combination with and as a part of a diversion, interceptor, or perimeter dike, or other structures designed to temporarily detain sediment-laden storm water. The gravel outlet provides a means of draining off and filtering the storm water while retaining the sediment behind the structure.

Level Spreader. This is a temporary structure which is constructed at zero grade across a slope where concentrated runoff may be intercepted and diverted onto a stabilized outlet. The concentrated flow of storm water is converted to sheet flow at the outlet.

Waterways or Outlets. Waterways may serve as outlets for diversions, berms, terraces, or other structures. They may be natural or constructed, shaped to required dimensions, and vegetated or paved for disposal of runoff water. Usually they are constructed to one of three general cross sections; parabolic, trapezoidal, or V-shaped. Where they are to be vegetated, parabolic waterways are the most commonly used. Successful function of a waterway depends on protection from erosion. This is

achieved by designing for flow velocities that are nonerosive for the vegetation used or by paving with concrete or rock.

Diversions. These are designed, graded channels with a supporting ridge on the lower side constructed across the slope. Their purpose is to intercept surface water. Diversons structures may be temporary or permanent and graded or level, and are useful above cut slopes, borrow areas, gully heads, and similar areas. They can be constructed across cut slopes to reduce slope length into nonerosive segments and can be used to move runoff water away from critical construction sites. They may be used at the base of cut or fill slopes to carry sediment-laden flow to traps or basins. Diversions should be located so that water will empty into established disposal areas, natural outlets, or prepared individual outlets. Individual outlets can be designed as grassed or paved waterways, chutes, or buried pipes.

Grade Stabilization Structures. Grade stabilization structures can be constructed from such materials as earth, pipe, concrete, masonry, steel, aluminum, wood or a combination of these. Grade stabilization structures are used to safely convey water from one level to a lower level without damage, to reduce grade in a watercourse, to stabilize headcutting of watercourses, or to change the direction of flow of water. They can consist of straight drop spillways, box inlet drop spillways, drop box culverts, chutes, pipe drop inlets, or hood inlets. An earthen embankment is usually incorporated as a part of the structure.

Sediment Basins. Sediment basins can be used to trap runoff waters and sediment from disturbed areas. The water is temporarily detained to allow sediment to drop out and be retained in the basin while the water is automatically released. Sediment basins usually consist of a dam or embankment, a pipe outlet, and an emergency spillway. They are usually situated in natural drainageways or at the low corner of a site. In situations where embankments may not be feasible, a basin excavated below the earth's surface may serve the same purpose. A special provision, however, must be made for draining such an impoundment. Sediment basins may be temporary or permanent. Temporary ones serve only during the construction stage and are eliminated when vegetation is established and the area is stabilized. Permanent structures are so designed that they fit into the overall plan for permanent installation. These may be converted to storm water detention facilities to reduce peak flows downstream. Size of the structure will depend upon the location, size of drainage area, soil type, and rainfall pattern. Sufficient space for sediment should be provided to store the expected sediment yield from the drainage area for the planned life of the structure or provisions made for periodic cleanout of sediment from the basin. State and local safety regulations must be observed regarding design, warning signs and fencing of these structures.

Sediment Trap. A sediment trap is a structure of limited capacity designed to create a temporary pond around storm drain inlets or at points where silt-laden storm water is discharged. It is used to trap sediment on construction sites, prevent storm drains from being

blocked, and prevent sediment pollution of watercourses.

- Land Grading. Grading should be held to a minimum level that makes the site suitable for its intended purpose without appreciably increasing runoff. Grading only those areas going into immediate construction, as opposed to grading the entire site, greatly helps in controlling erosion. Large tracts should be graded in units of workable size with construction phased so that the first unit is stabilized before the next unit is opened up. This technique helps minimize the area and duration of exposure of bare land to erosion.

- Storm Drain Outlet Protection. This practice involves putting paving or riprap on channel sections immediately below storm drain outlets. A storm drain outlet is designed to reduce the velocity of flow and prevent channel erosion below storm drain outlets.

- Riprap. This is a layer of loose rock placed over the soil surface to prevent erosion by surface flow or wave action. Riprap may be used, as appropriate, at storm drain outlets, channel banks and/or bottoms, road side ditches, drop structures, etc.

- Subsurface Drains. Subsurface drains, used to remove excess groundwater, are sometimes required at the base of fill slopes or around building foundations. When heavy gra[redacted] done and natural drainage channels are filled, subsurface drai[redacted] be used to prevent accumulation of groundwater. Subsurface drains may be needed in vegetated channels to lower a high water table and to improve drainage conditions so vegetation can be established and maintained.

- Flexible Down Drain. This is a temporary structure used to convey stormwater from one elevation to another without causing erosion. It is made of heavy duty fabric or other material which can be removed when the permanent water disposal system is installed.

Miscellaneous Practices.

There are other conservation principles which should be observed during construction in order to make erosion and sediment control measures more effective:

- Locate storage and shop yards where erosion and sediment hazards are slight. Where this is not possible, apply necessary paving and erosion control practices.

- Saturate ground or apply dust suppressors. Keeping dust down to tolerable limits on construction sites and haul roads is very important.

- Use temporary bridges or culverts where fording of streams is objectionable. Avoid borrow areas where pollution from this operation is inevitable.

- Protect streams from chemicals, fuel, lubricants, sewage, or other pollutants.
- Avoid disposal of fill in floodplains or drainageways.

Conservation planning often involves the use of combinations of mechanical and vegetative practices for effective control of soil erosion and sediment.

STANDARDS AND SPECIFICATIONS
FOR
MECHANICAL PRACTICES

TABLE OF CONTENTS

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY CONSTRUCTION ENTRANCE

Definition

A stone stabilized pad located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk, or parking area.

Purpose

To reduce or eliminate the transport of mud from the construction area onto public rights-of-way by motor vehicles or by runoff.

Conditions Where Practice Applies

This practice is applied at appropriate points of construction ingress and egress.

Design Criteria

Aggregate size:	will be in accordance with V.D.H. size #1.
Pad thickness:	6-inch minimum
Pad width:	not less than full width of all points of vehicular ingress or egress.
Pad length:	not less than 50 feet.
Washing:	wheels must be cleaned to remove mud prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with crushed stone which drains into an approved sediment trap or sediment basin.
Location:	entrance shall be located or protected so as to prevent sediment from leaving the site.

Maintenance

The entrance shall be maintained in a condition which will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with 2-inch stone, as conditions demand, and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicle or site onto roadway or into storm drain must be removed immediately.

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY DIVERSION DIKE

Definition

A ridge of compacted soil with a general life expectancy of one year or less constructed immediately above cut or fill slopes.

Purpose

To intercept storm runoff from small higher areas and to divert it away from exposed slopes to a stabilized outlet.

Conditions Where Practice Applies

At the top or toe of newly constructed slopes to prevent excessive erosion until permanent storm drainage features are installed and the slopes are stabilized. It does not apply where the slope of the channel behind dike exceeds 10%. However, slopes greater than 5% are usually undesirable without special stabilization techniques.

Design Criteria

A design is not required. The following criteria will be used:

Drainage areas: not more than 5 acres.

Top width: 2-foot minimum.

Height (compacted fill): 18-inch minimum
(height measured from the natural ground at the upslope toe to the top of the dike).

Side slopes: 2:1 or flatter.

Grade: dependent upon topography, but must have positive drainage to the outlet; where slope of channel behind dike is less than 2%, stabilization may not be required; where the slope is 2% or greater, stabilization shall be required.

See Standard Drawing T.D.D.-1 for details.

Outlet

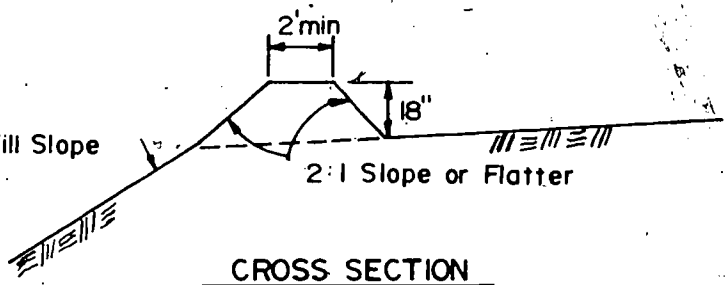
Diverted runoff must outlet directly onto an undisturbed stabilized area, a level spreader, or into a grade stabilization structure.

CONSTRUCTION SPECIFICATIONS

1. All dikes must be machine compacted.
2. All diversion dikes must have positive grade to an outlet.
3. Diverted runoff must outlet directly onto an undisturbed stabilized area, a level spreader, or into a grade stabilization structure.
4. Periodic inspection and required maintenance must be provided.
5. Dikes must be located far enough away from disturb area to permit machine regrading and clean-out.
6. Diversion dikes must be seeded and mulched immediately after construction.

TEMPORARY DIVERSION DIKE

(Not To Scale)



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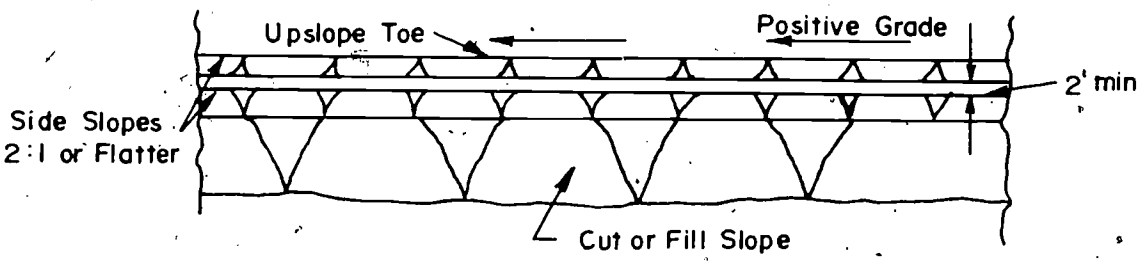


PLAN VIEW

VIRGINIA	TEMPORARY DIVERSION DIKE	STANDARD DRAWING
		T.D.D. - I

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY INTERCEPTOR DIKE

Definition

A ridge of compacted soil or gravel, to remain for a period usually less than one year, constructed across disturbed rights-of-way and similar sloping areas.

Purpose

To shorten the length of exposed slopes, thereby reducing the potential for erosion by intercepting storm runoff and diverting it to stabilized outlets.

Conditions Where Practice Applies

Constructed across disturbed rights-of-way and similar sloping areas, until they are permanently stabilized.

Design Criteria

A design is not required. The following criteria will be used:

Top width: 2-foot minimum

Height: 18-inch minimum unless otherwise noted on the plans (height measured from the upslope toe to top of the dike).

Side slopes: 2:1 or flatter (flat enough to allow construction traffic to cross if desired).

Grade: 1.0% to 1.5%

Spacing:

distance between dikes:	150 feet	200 feet	300 feet
maximum slope of right-of-way above dike:	> 10%	5-10%	< 5%

See Standard Drawing T.I.D.-1 for details.

Outlet

Interceptor dikes must have an outlet that functions with a minimum of erosion. The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet.

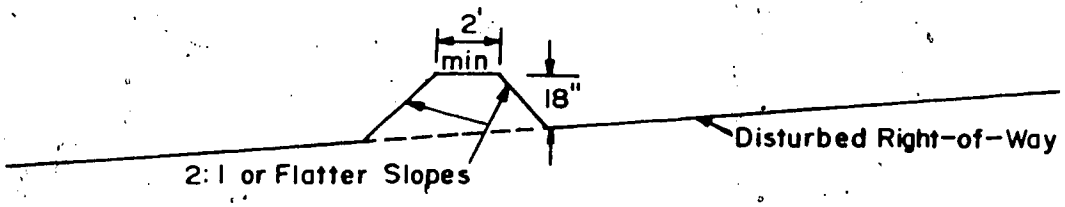
CONSTRUCTION SPECIFICATIONS

1. All earthen dikes must be machine compacted.
2. All interceptor dikes must have positive grade to an outlet.
3. Top width may be wider and side slopes may be flatter if desired.
4. Field location should be adjusted as needed to utilize a stabilized safe outlet.
5. Diverted runoff must outlet directly onto an undisturbed stabilized area, a level spreader, or into a grade stabilization structure.
6. Periodic inspection and required maintenance must be provided.

TEMPORARY

INTERCEPTOR DIKE

(Not To Scale)



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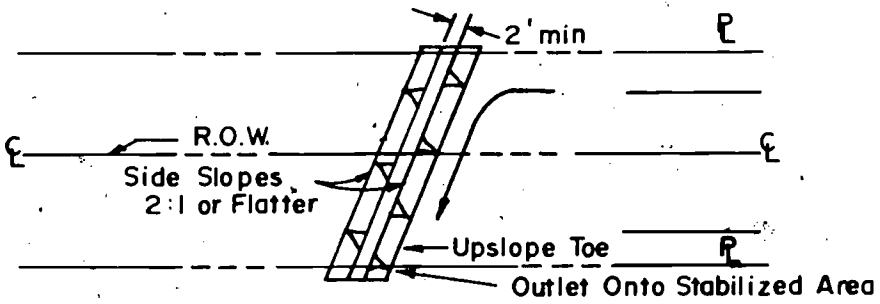


PLAN VIEW

VIRGINIA	TEMPORARY INTERCEPTOR DIKE	STANDARD DRAWING T.I.D.-1

STANDARD AND SPECIFICATIONS FOR TEMPORARY PERIMETER DIKE

Definition

A ridge of compacted soil, with a life expectancy of one year or less, constructed along the perimeter of the disturbed area.

Purpose

To divert sediment-laden storm runoff to on-site trapping facilities.

Conditions Where Practice Applies

At the perimeter of the site or disturbed area to direct sediment-laden water to a trapping facility. This dike will remain in place until the site is permanently stabilized.

Design Criteria

A design is not required. The following standards will be used:

Drainage areas: not more than 5 acres.

Top width: 2-foot minimum.

Height (compacted fill): 18-inch minimum unless otherwise noted on the plans. (Height measured from the natural ground at the upslope toe to top of the dike.)

Side slopes: 2:1 or flatter.

Grade: dependent upon topography, but must have positive drainage to the outlet; where slope of channel behind dike is less than 2%, stabilization may not be required, where 2% or more stabilization will be required.

See Standard Drawing T.P.D.-1 for details.

Outlet

Diverted runoff must be discharged directly into a sediment trapping facility such as a sediment basin, sediment trap, or gravel outlet structure.

CONSTRUCTION SPECIFICATIONS

1. All dikes must be machine compacted.

2. All perimeter dikes must have positive grade draining to a sediment trapping facility.

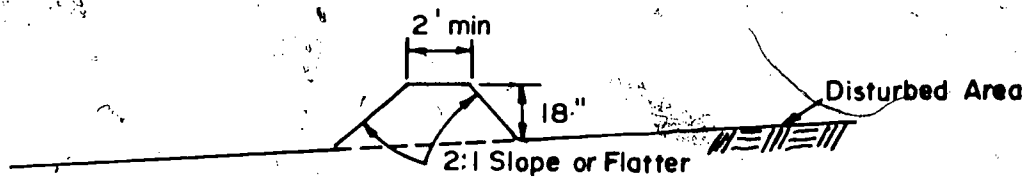
3. Periodic inspection and required maintenance must be provided.

4. Dikes must be located far enough away from disturbed area to permit machine regrading and clean-out.

5. Diversion dikes must be seeded and mulched immediately following construction.

TEMPORARY

PERIMETER DIKE
(not to scale)



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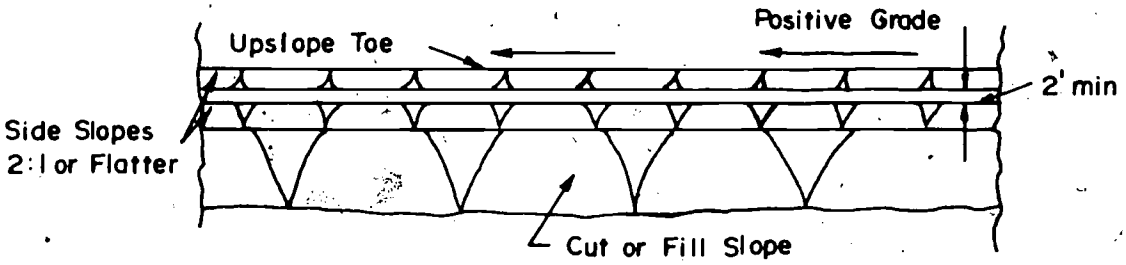


PLAN VIEW

VIRGINIA	TEMPORARY PERIMETER DIKE	STANDARD DRAWING
		T.P.D.-1

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY STRAW (OR HAY) BALE BARRIER

Definition

A barrier installed across, or at the toe of, a slope to intercept and detain sediment.

Purpose

To intercept and detain small amounts of sediment from unprotected areas of less than 1/2 acre.

Conditions Where Practice Applies

. Where it is feasible.

. Contributing area is approximately 1/2 acre, or less.

. There is no concentration of water in a channel above the barrier.

. Erosion would normally occur in form of sheet erosion

. Length of slope above the barrier is less than 100 feet.

Straw bales must not be used on high sediment producing areas, above "high risk" areas, where water concentrates, or where there would be a possibility of a washout.

Design Criteria

No design required. Bales must be securely tied.

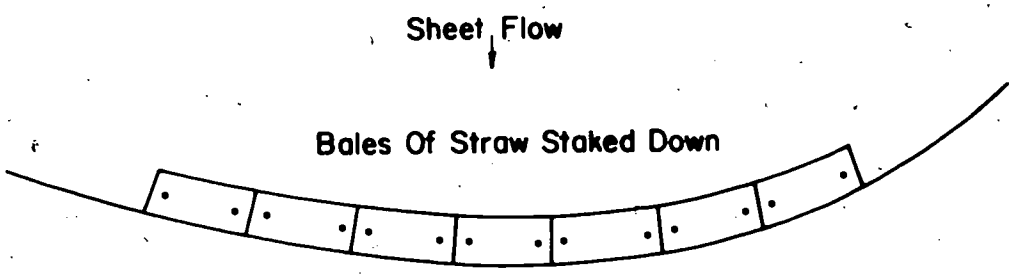
See Standard Drawing T.S.B.-1 for details.

. CONSTRUCTION SPECIFICATIONS

1. Bales will be placed in a single row, lengthwise, on the contour and embedded in the soil to a depth of 3 inches.

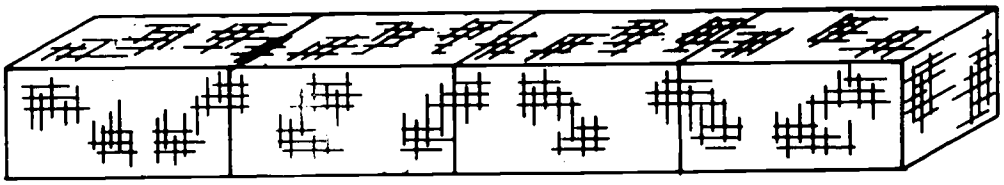
2. Bales must be securely anchored in place by stakes or re-bars driven through the bales or by other acceptable means to prevent displacement.

3. Inspection must be frequent and repair or replacement must be made promptly as needed.

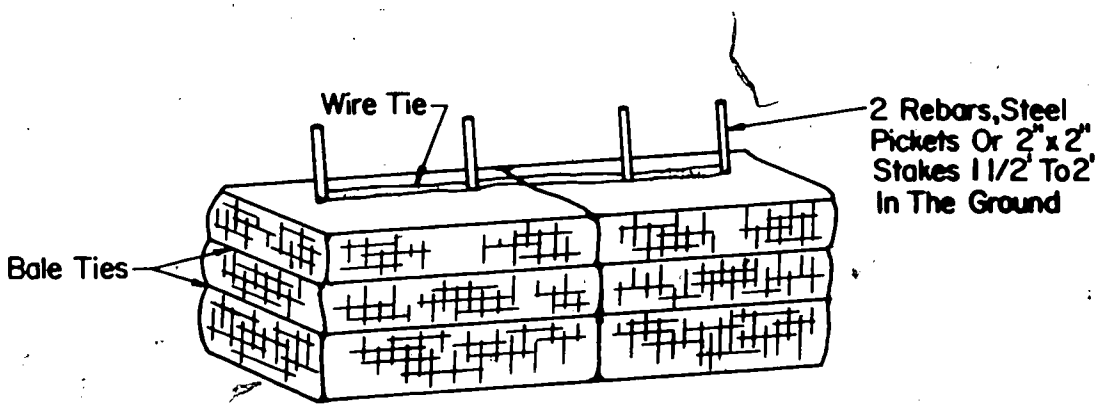


Single Row Of Bales Of Straw
To Be Placed Prior To The
Start Of Rough Grading

PLAN VIEW



FRONT VIEW



Securely Bound Bales
Required For Durability

ANCHORING BALES

VIRGINIA	TEMPORARY STRAW BALE SEDIMENT BARRIER	STANDARD DRAWING
		T.S.B.-1

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY GRAVEL OUTLET STRUCTURE

Definition

An auxiliary structure installed in conjunction with and as a part of a diversion, interceptor or perimeter dike, or other structure designed to temporarily pond sediment-laden surface runoff.

Purpose

To provide a means of draining the storm runoff which is collected behind a structure while retaining the sediment.

Conditions Where Practice Applies

To any site where there is need to collect, detain, and dispose of sediment-laden storm runoff at a protected outlet. The contributing watershed shall be no greater than 5 acres.

Design Criteria

The minimum capacity shall be that required to pass the peak flow expected from a ten-year frequency storm without causing damage to the dike. Minimum length in feet, of the gravel outlet structure, shall be equal to six times the number of acres of contributing drainage area. The invert of the gravel outlet shall not be less than 6 inches lower than the minimum elevation of the top of the dike. The gravel will be V.D.H. size #2 or its equivalent.

See Standard Drawing T.G.O.S.-1, for details.

Outlet

Gravel outlet will be discharged onto an already stabilized area or into a stable watercourse.

Maintenance

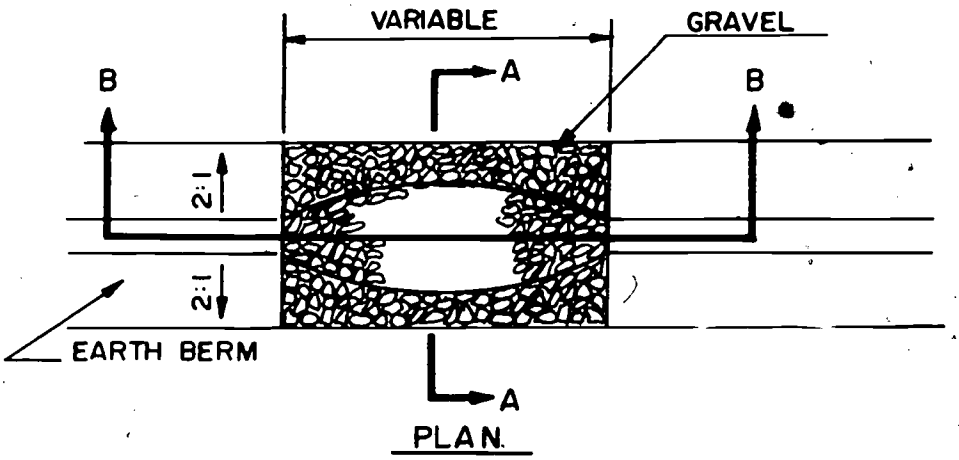
The gravel outlet structure shall be inspected after each runoff-producing rain. The gravel must be replaced when the structure ceases to function as intended due to silt accumulation among the gravel.

CONSTRUCTION SPECIFICATIONS

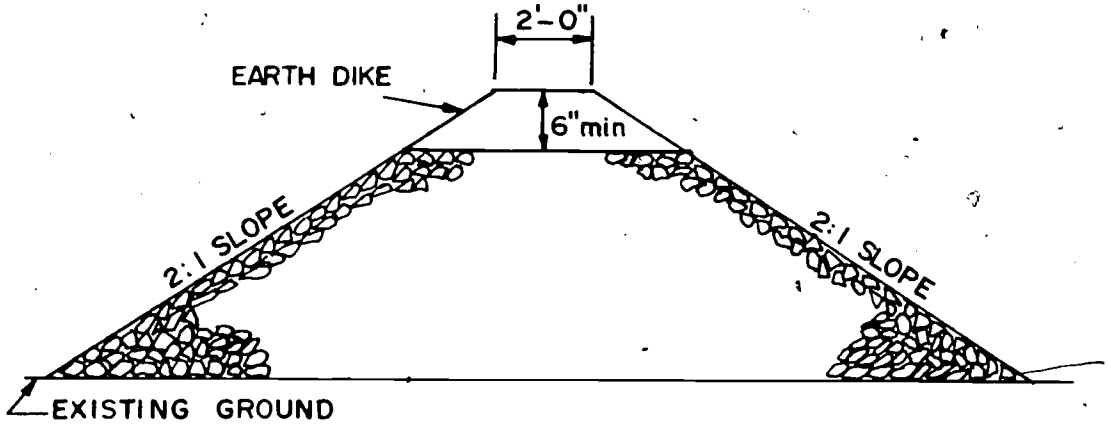
1. The bases and side slopes of the gravel will be placed so as to conform to the dike configuration.

2. The invert of the gravel outlet shall be not less than 6 inches lower than the top of the adjoining earth dike.

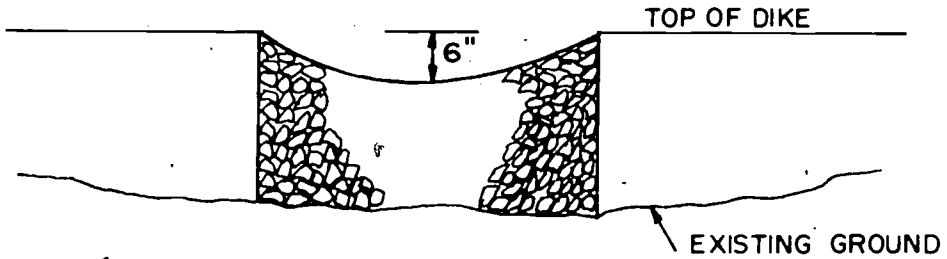
3. The gravel shall extend to the top of the dike.



PLAN



SECTION A-A



SECTION B-B
NOT TO SCALE

VIRGINIA	TEMPORARY GRAVEL OUTLET STRUCTURE	STANDARD DRAWING T.G.O.S.-1

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY LEVEL SPREADER

Definition

An outlet constructed at zero grade across the slope whereby concentrated runoff may be discharged at non-erosive velocities onto undisturbed areas stabilized by existing vegetation.

Purpose

To convert a concentrated flow of storm runoff into sheet flow and to outlet it onto areas stabilized by existing vegetation without causing erosion.

Conditions Where Practice Applies

Where storm runoff is intercepted and diverted from graded areas onto undisturbed stabilized areas (i.e., at diversion outlets, etc.). This practice applies only in those situations where the spreader can be constructed on undisturbed soil and where the area directly below the level lip is stabilized by existing vegetation. The water must not be allowed to reconcentrate below the point of discharge.

Design Criteria

A specific design for level spreaders will not be required. However, spreader length will be determined by estimating Q_{10} flow and selecting the appropriate length from Table 1.

See Standard Drawing T.L.S.-1, for details.

Outlets

Final discharge will be over the level lip onto an undisturbed stabilized area.

CONSTRUCTION SPECIFICATIONS

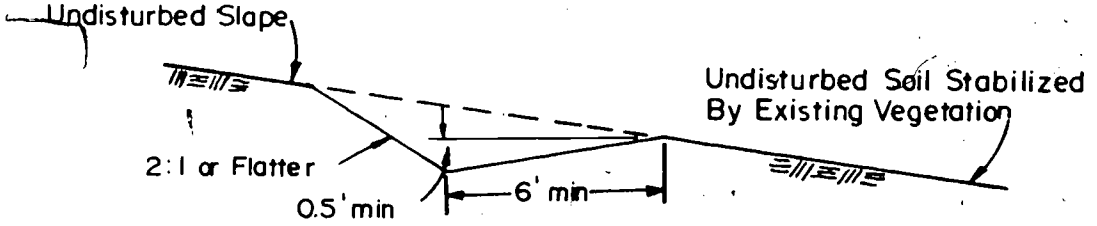
1. Construct level lip on zero per cent grade to insure uniform spreading of storm runoff (converting channel flow to sheet flow).
2. Level spreaders must be constructed on undisturbed soil (not on fill).
3. Entrance to spreader must be graded in a manner to insure that runoff

enters directly onto the zero per cent graded channel.

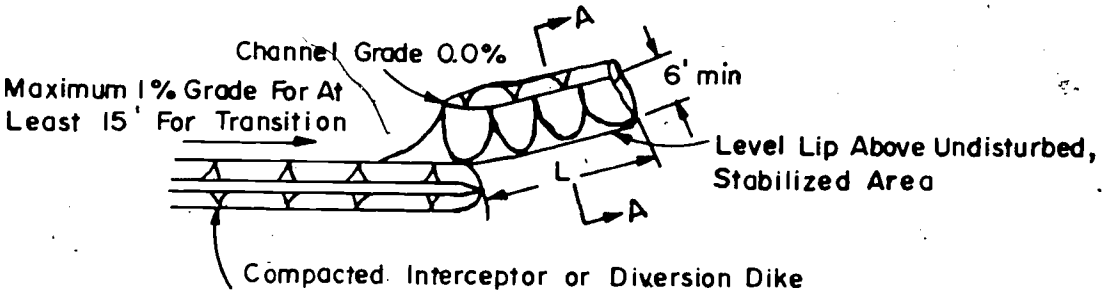
4. Storm runoff converted to sheet flow must outlet onto undisturbed stabilized areas.

5. Periodic inspection and maintenance must be provided to insure intended purpose is accomplished.

TEMPORARY
LEVEL SPREADER
(Not To Scale)



SECTION A-A



PLAN VIEW

TABLE I

DESIGNED Q (CFS)	MINIMUM LENGTH ("L" IN FEET)
Up to 10	15
10 to 20	20
20 to 30	26
30 to 40	36
40 to 50	44

VIRGINIA	TEMPORARY LEVEL SPREADER	STANDARD DRAWING
		T.L.S.-I

STANDARD AND SPECIFICATIONS
FOR
WATERWAY OR OUTLET

Definition

A natural or constructed waterway or outlet shaped and/or graded and stabilized as needed for the safe disposal of runoff.

Purpose

To dispose of runoff without causing damage either by erosion or by flooding.

Conditions Where Practice Applies

To all sites where added channel capacity and/or stabilization is required to control erosion resulting from concentrated runoff and where such control can be achieved by this practice alone or in combination with others.

Design Criteria

Capacity

The minimum capacity shall be that required to convey the peak runoff expected from a storm of ten-year frequency. Peak runoff values used in determining the capacity requirements shall be as outlined in Chapter 2, "Estimating Runoff", Engineering Field Manual for Conservation Practices, Soil Conservation Service, USDA, or by other accepted methods.

Velocity

Permissible velocities of flow for the stated conditions of stabilization are shown on the following Table.

PERMISSIBLE DESIGN VELOCITIES

Cover	Range of Channel Gradient (percent)	Permissible Velocity (Ft. per second)
Vegetative [1/]		
1. Bermudagrass [2/]	0-5	6
	5-10	5
	Over 10	4
2. Reed canarygrass	0-5	5
Tall fescue	5-10	4
Kentucky bluegrass	Over 10	3
3. Grass-legume mixtures	0-5	4
	5-10	3
4. Red fescue	0-5	2.5
Redtop		
Sericea lespedeza		
5. Annuals	0-5	2.5
Annual lespedeza		
Small grain		
(rye, oats, barley)		
Ryegrass		
Mechanical - Vegetative		
Stone center	All	(as determined by stone size from riprap standar and specifications)
Mechanical		
Paved	All	Any

1/ To be used only below stabilized or protected areas.
2/ Recommended varieties of Bermudagrass are Tufcote, common, U3, Midland, and Coastal.

Cross Section

The minimum design depth of a waterway or outlet receiving water from developing areas, diversions, or other tributary channels shall be that depth required to keep the design water surface elevation in the diversion or other tributary channels at their junctions when both are flowing at their designed hydraulic gradient.

The bottom width of waterways or outlets shall not exceed 50 feet unless multiple or divided waterways or other means are provided to control meandering of low flows within this limit. The design requirements for a parabolic channel can be found in Appendix A, (sheets 1-14). See Standard Drawing W.W.-1, for details.

Drainage

Tile or other suitable subsurface drainage measures shall be provided for sites having high water tables or seepage problems, except where water tolerant vegetation such as Reed Canarygrass can be used. Where there is base flow, a stone center or paved waterway will be required.

Stabilization

Channels shall be stabilized in accordance with Item 5 of the construction specifications.

CONSTRUCTION SPECIFICATIONS

1. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the waterway.

2. The waterway or outlet shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified herein, free of bank projections or other irregularities which will impede normal flow.

3. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the completed waterway.

4. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the waterway.

5. Stabilization

   a. Vegetative protection (use only below stabilized or protected areas).

      i. Applicable vegetative standards shall be followed for time of seeding, sprigging or sodding, liming and fertilizing, and site and seedbed preparation.

      ii. Mulching shall be a requirement for all seeded or sprigged channels and shall be performed according to standard and specifications for disturbed area stabilization (with mulching only).

iii. Temporary protection during establishment should be provided, when conditions permit, through temporary diversions or other means to dispose of water.

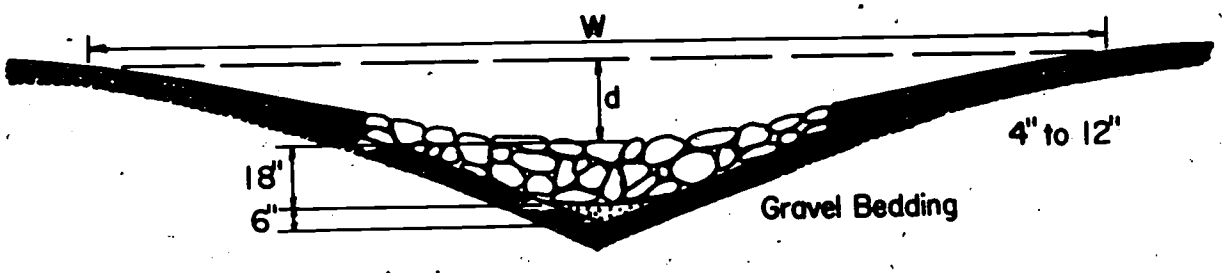
b. Mechanical - Vegetative Protection

Stone center waterways shall be constructed as shown on Standard Drawing W.W.-1. The waterways shall be stabilized with riprap according to standard and specifications for riprap.

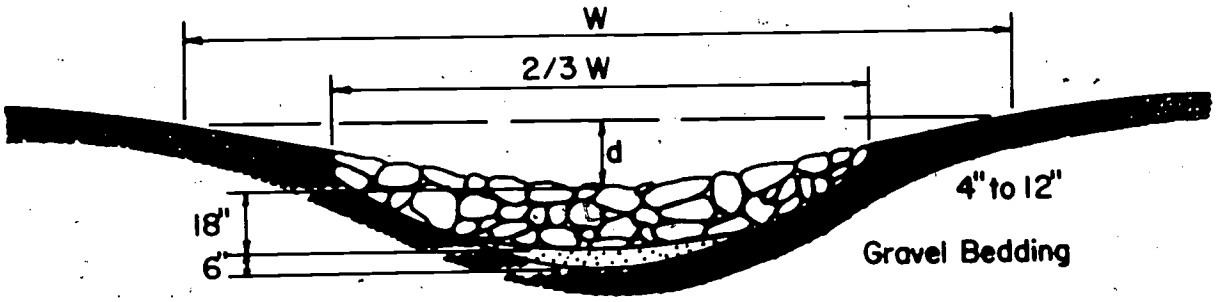
c. Mechanical Protection

Paving shall be performed according to State Department of Highways specifications for paved ditches.

Jute erosion matting properly installed in waterway prevents damage from erosion and aids establishment of vegetation.



Waterway With Stone Center Drain
V Section Shaped By Motor Patrol



Waterway With Stone Center Drain
Rounded Section Shaped By Bulldozer

WATERWAY WITH STONE CENTER

Not To Scale

VIRGINIA	WATERWAY OR OUTLET	STANDARD DRAWING
		W.W.-1

STANDARD AND SPECIFICATIONS
FOR
DIVERSION

Definition

An earthen channel, with a supporting ridge on the lower side, constructed across the slope.

Purpose

To intercept and convey surface water to stable outlets at non-erosive velocities.

Conditions Where Practice Applies

1. Runoff from higher areas is or has potential for damaging property, causing erosion, contributing to pollution, flooding, or interfering with or preventing the establishment of vegetation on lower areas.
2. Surface and/or shallow subsurface flow is damaging sloping upland.
3. The length of slope needs to be reduced so that soil loss will be reduced to a minimum.

Diversions are only applicable below stabilized or protected areas. Avoid establishment on slopes greater than fifteen percent. Diversions should be used with caution on soils subject to slippage. Construction of diversions and outlets must be in compliance with state drainage and water control laws.

Design Criteria

Location

Diversion location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, seep planes (when seepage is a problem), and the development layout.

Capacity

Peak runoff values used in determining the capacity requirements shall be as outlined in Chapter 2, "Estimating Runoff", Engineering Field Manual for Conservation Practices, Soil Conservation Service, USDA, or by other accepted methods. The constructed diversion must have capacity to carry, as a minimum, a ten-year frequency storm with freeboard of not less than 0.3 foot. Diversions designed to protect

homes, schools, industrial buildings, roads, parking lots, playfields, and comparable high risk areas, and those designed to function in connection with other structures, shall have sufficient capacity to carry peak runoff expected from a storm frequency consistent with the hazard involved.

Velocity and Grade

The permissible velocity for the specified method of stabilization will determine the maximum grade. Permissible design velocities shall be determined by use of the following tables:

PERMISSIBLE DESIGN VELOCITIES

Cover	Range of Channel Gradient (percent)	Permissible Velocity (Ft. per second)
Vegetative 1/		
1. Bermudagrass 2/	0-5	6
	5-10	5
	Over 10	4
2. Reed canarygrass Tall fescue Kentucky bluegrass	0-5	5
	5-10	4
	Over 10	3
3. Grass-legume mixtures	0-5	4
	5-10	3
4. Red fescue Redtop Sericea lespedeza	0-5	2.5
5. Annuals Annual lespedeza Small grain (rye, oats, barley) Ryegrass	0-5	2.5
Mechanical - Vegetative		
Stone center	All	(as determined by stone size from riprap standard and specifications)
Mechanical		
Paved	All	Any

1/ To be used only below stabilized or protected areas.
2/ Recommended Bermudagrass varieties are Tufcote, U3, Midland, Coastal, and common.

Cross Section

The channel may be parabolic, V-shaped, or trapezoidal. The design requirements for a parabolic channel can be found in Appendix A, (sheets 1-14). The diversion must be designed to have stable side slopes. The side slopes shall not be steeper than 2:1. The ridge shall have a minimum width of four feet at the design water elevation; a minimum of 0.3 foot freeboard and a reasonable settlement factor must be provided. The side slopes will be flat enough to insure ease of maintenance of the structure and its protective vegetative cover. See Standard Drawing D.-1 for details.

Outlets

Each diversion must have an adequate outlet. The outlet may be a constructed or natural waterway, a stabilized vegetated area or a stabilized open channel. In all cases, the outlet must discharge in such a manner as not to cause an erosion problem. Protected outlets shall be constructed and stabilized prior to construction of the diversion.

Stabilization

Channels shall be stabilized in accordance with Item 5 of the construction specifications

CONSTRUCTION SPECIFICATIONS

1. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.

2. The diversion shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified herein, free of irregularities which will impede normal flow.

3. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the complete diversion.

4. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the diversion.

5. Stabilization

a. Vegetative Protection

i. Follow appropriate standard and specifications for disturbed area stabilization for time of seeding, sprigging or sodding, liming and fertilizing, and site and seedbed preparation.

ii. Mulching shall be a requirement for all seeded or sprigged channels and shall be performed according to Standard and Specifications for disturbed area stabilization (with mulching only).

iii. Temporary protection during establishment should be provided when conditions permit the use of temporary diversions or other means to dispose of water.

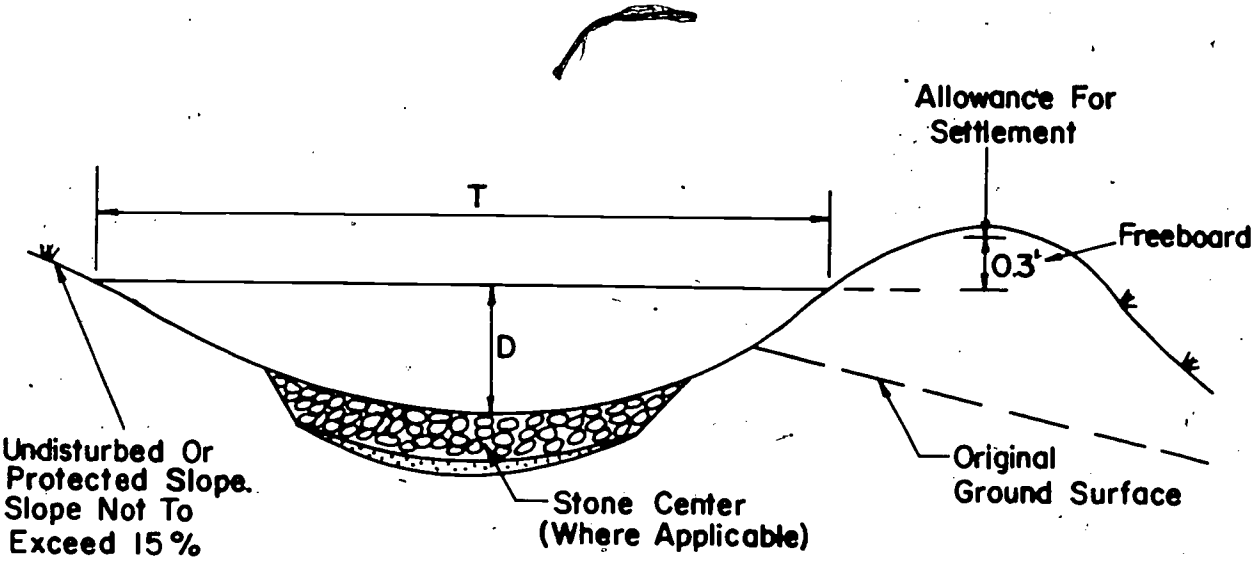
b. Mechanical - Vegetative Protection

Stone center diversions shall be constructed as shown on Standard Drawing D.-1 and shall be stabilized with riprap according to the standard and specifications for riprap.

c. Mechanical Protection

Paving shall be performed according to State Department of Highways specifications for paved ditches.

DIVERSION



T=Top Width
D=Depth

Not To Scale

VIRGINIA	DIVERSION	STANDARD DRAWING
		D.-1

STANDARD AND SPECIFICATIONS
FOR
A TEMPORARY GRADE STABILIZATION STRUCTURE
(PAVED CHUTE OR FLUME)

Definition

A paved channel of bituminous concrete, Portland Cement concrete, or comparable non-erodible material used to conduct surface runoff from the top of a slope to the bottom of slope.

Purpose

To convey runoff safely down slopes without causing erosion.

Conditions Where Practice Applies

Where concentrated flow of surface runoff over slopes would otherwise cause excessive erosion.

Design Criteria

The chutes or flumes are divided into two size groups as follows:

Size Group A

1. The height of the dike at the entrance (H) equals 1.5 feet.
2. The depth of flow down the chute (d) equals 8 inches.
3. The length of the inlet and outlet sections (L) equals 5 feet.

Size Group B

1. The height of the dike at the entrance (H) equals 2 feet.
2. The depth of flow down the chute (d) equals 10 inches.
3. The length of the inlet and outlet sections (L) equals 6 feet.

Each size group has various bottom widths and allowable drainage areas as shown on the following table:

Size 1/	Bottom Width, b, ft.	Maximum Drainage Area acres	Size 1/	Bottom Width, b, ft.	Maximum Drainage Area acres
A-2	2	5	B-4	4	14
A-4	4	8	B-6	6	20
A-6	6	11	B-8	8	25
A-8	8	14	B-10	10	31
A-10	10	18	B-12	12	36

1/ The size is designated with a letter and a number, such as A-6 which means a chute or flume in Size Group A with a 6-foot bottom width.

If a minimum of 75% of the drainage area will have a good grass or woodland cover throughout the life of the structure, the drainage areas listed above may be increased by 50%. If a minimum of 75% of the drainage area will have a good mulch cover throughout the life of the structure, the drainage areas listed above may be increased by 25%.

For dimensions, grades, and construction details, see the drawing T.G. S. S. -1.

CONSTRUCTION SPECIFICATIONS

1. The structure shall be placed on undisturbed soil or on well-compacted fill.

2. The cut or fill slope shall not be steeper than 1 vertical to 1.5 horizontal (1.5:1) and should not be flatter than 20:1.

3. The top of the earth dikes shall not be lower at any point than the top of the lining at the entrance of the structure.

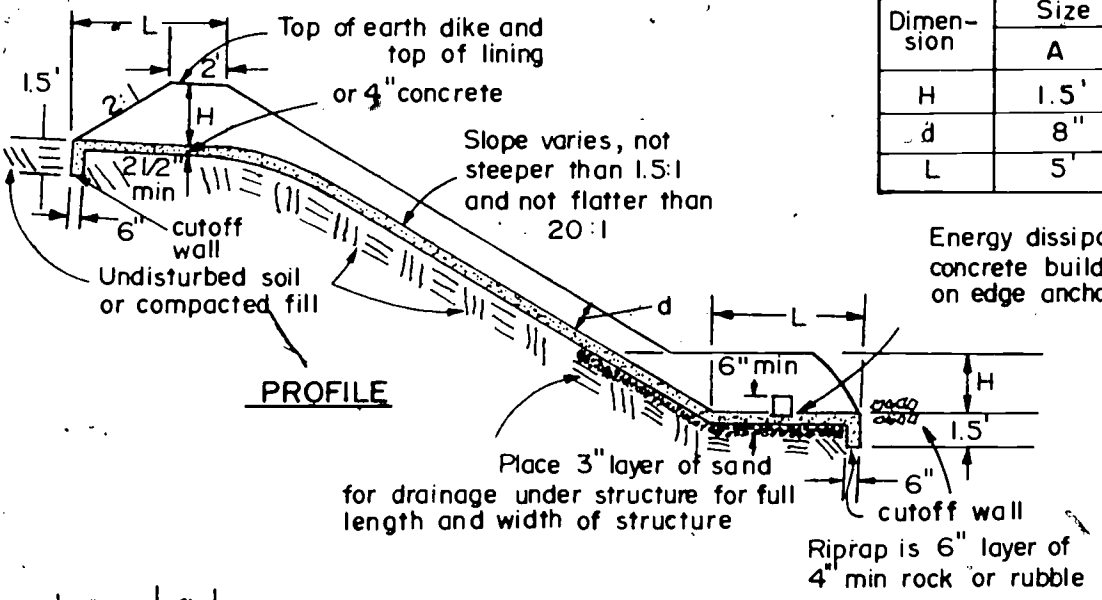
4. The lining at the entrance to the structure should extend to the top of the earth dikes on either side.

5. The lining should be placed beginning at the lower end and proceeding up the slope to the upper end. The lining shall be well compacted and free of voids. The lining surface shall be reasonably smooth.

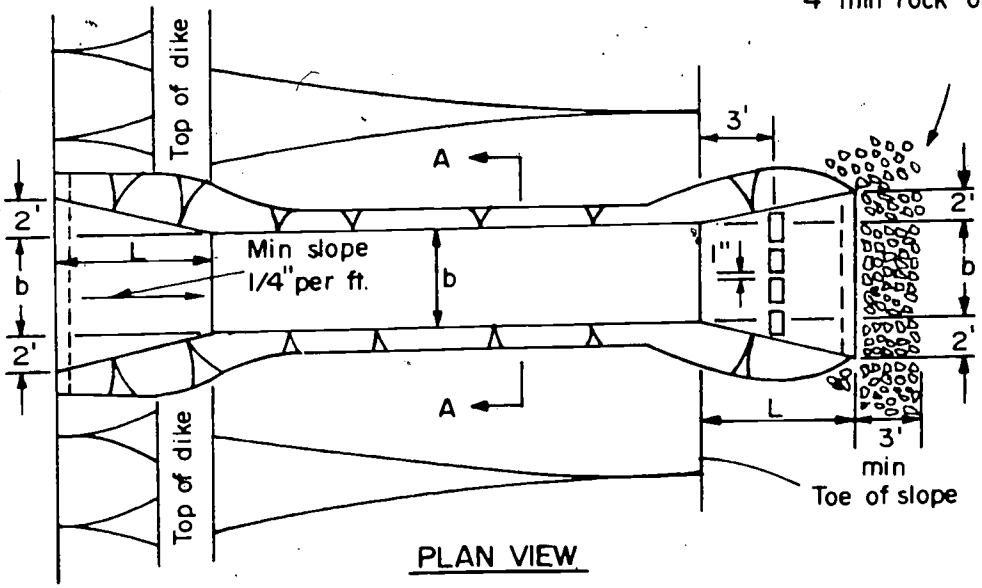
6. The entrance floor at the upper end of the structure shall have a slope toward the outlet of 1/4 to 1/2 inch per foot.

7. The cutoff walls (footers) at the entrance and at the end of the discharge aprons shall be continuous with the lining.

Dimension	Size Group	
	A	B
H	1.5'	2.0'
d	8"	10"
L	5'	6'



Energy dissipator is concrete building blocks on edge anchored to lining



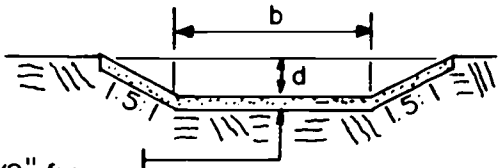
PLAN VIEW

Note:

Lining shall be Portland Cement concrete, bituminous concrete or comparable non-erodible material.

Some type of energy dissipator, such as the one shown above, must be used to prevent erosion at the outlet.

The size is designated with a letter and a number, such as A-6, which means Size Group A with a 6 ft. bottom width (b). For structure dimensions, see table in upper right hand corner.



2 1/2" for bituminous concrete

4" for concrete

SECTION A-A

VIRGINIA	TEMPORARY GRADE STABILIZATION STRUCTURE	STANDARD DRAWING
		TGSS-1

STANDARD AND SPECIFICATIONS
FOR
SEDIMENT BASIN

Definition

A basin created by the construction of a barrier or dam across a waterway or by excavating a basin or by a combination of both. These usually consist of a dam, a pipe outlet, and an emergency spillway. The size of the structure will depend upon the location, size of drainage area, soil type, and rainfall pattern.

Purpose

To detain runoff waters and trap sediment from erodible areas in order to protect properties and drainage ways below the installation from damage by excessive sedimentation and debris. The water is temporarily stored, and the bulk of the sediment, which is carried by the water, drops out and is retained in the basin while the water is automatically released.

Scope

This standard applies to the installation of temporary (to be removed within 18 months) sediment basins on sites where: (1) failure of the structure would not result in loss of life or interruption of use or service of public utilities, and (2) the drainage area does not exceed 150 acres.1/ For the purpose of this standard, sediment basins are classified as follows:

Classification of Sediment Basins

A. Temporary Basins

Type	Max. Drainage Area (Acres)	Max. Height 2/ of Dam (ft.)	Embankment side slopes
1	150	10	2:1 or flatter
2	150	15	2 1/2:1 or flatter

1/ This practice may be used on larger drainage areas if designed on an individual basis by a qualified engineer.

2/ Height is measured from the low point of original ground along the centerline of dam to the top of dam.

B. Permanent Basins

Permanent (to function more than 18 months) sediment basins, or temporary basins exceeding the classification requirements for type 2, shall conform to design criteria appropriate for permanent structures. Such criteria are available from the Soil Conservation Service technical guides or other sources acceptable to the local jurisdiction. The storage capacity of permanent sediment basins shall equal or exceed the capacity requirements for temporary basins contained herein.

Conditions Where Practice Applies

This practice applies to critical areas where physical site conditions, construction schedules, or other restrictions preclude the installation or establishment of erosion control practices to satisfactorily reduce runoff, erosion, and sedimentation. The structure may be used in combination with other practices and should remain in effect until the sediment-producing area is permanently stabilized.

Design Criteria For Temporary Sediment Basins

Compliance With Laws and Regulations

Design and construction shall comply with State and local laws, ordinances, rules, and regulations.

Location

Locate the dam to provide maximum volume capacity for trapping sediment behind the structure as well as for greatest ease of cleanout.

Storage

The capacity of the sediment basin, as measured to the elevation of the crest of the emergency spillway, or the principal spillway if there is no emergency, shall be at least 67 cubic yards per acre of drainage area (0.5 watershed inches).

Sediment basins shall be cleaned out when the storage capacity as described above is reduced by sedimentation to 27 cubic yards per acre of drainage area (0.2 watershed inches). In no case shall the sediment level be permitted to build up higher than one foot below the principal spillway crest. The elevation corresponding to this level shall be determined and will be stated in the design data as a distance below the top of the riser.

Spillway Design

Runoff will be computed by the method outlined in Chapter 2, "Estimating Runoff", Engineering Field Manual for Conservation Practices, Soil Conservation Service, U.S. Department of Agriculture, or

by other acceptable methods. Runoff computations shall be based upon the soil cover conditions expected to prevail in the contributing drainage area during the anticipated effective life of the structure. The combined capacities of the principal and emergency spillways shall be sufficient to pass the peak rate of runoff from a ten-year frequency storm.

Principal spillway. A spillway consisting of a vertical pipe or box type riser joined (watertight connection) to a pipe (barrel) which will extend through the embankment and outlet beyond the downstream toe of the fill. The riser will be perforated to provide for a gradual drawndown after each storm event. The minimum capacity of the principal spillway will be sufficient to discharge 5 inches of runoff from the drainage area in 24 hours (0.21 C. F. S. per acre of drainage area) when the water surface is at the emergency spillway crest elevation. For those basins with no emergency spillway, the principal spillway shall have capacity to handle the ten-year frequency peak flow. The minimum size of the barrel will be 8 inches in diameter. See Appendix B for principal spillway sizes and capacities.

- Crest elevation. When used in combination with emergency spillways, the crest elevation of the riser shall be one foot below the elevation of the control section of the emergency spillway. If no emergency spillway is provided, the crest elevation of the riser shall be a minimum of three feet below the crest elevation of the embankment.

- Perforated riser. The sediment basin pool shall be drained by using a perforated riser or by some other approved means. The riser shall be perforated with 1/2-inch diameter holes spaced 8 inches vertically and 10-12 inches horizontally. Additional drainage of the sediment to facilitate periodic cleanout may be accomplished by installation of a drain in the bottom of the basin as shown in Appendix B.

- Anti-vortex device and trash rack. An anti-vortex device and trash rack shall be securely installed on top of the riser. An approved anti-vortex device is a rigid vertical plate firmly attached to the pipe and oriented normal to the centerline of dam. The plate dimensions shall be: length = diameter of the riser plus 12 inches; height = diameter of the barrel. Another approved device is the concentric cover trash rack which also functions as an anti-vortex device. See Appendix B-6.

- Base. The bottom of the riser shall be located at the low point in the basin to insure complete drainage. The riser shall have a base attached with a watertight connection and shall have sufficient weight to prevent flotation of the riser. Two approved bases are: (1) a concrete base 18" thick with the riser imbedded 6" in the base; (2) a 1/4" minimum thickness steel plate with continuous weld all around the base of the riser to form a watertight connection. The plate shall have 2 feet of

stone, gravel, or tamped earth placed on it to prevent flotation. In either case, each side of the square base shall be twice the riser diameter.

- Anti-seep collars. Anti-seep collars shall be installed around the pipe conduit within the normal saturation zone to increase the seepage length at least 10% when any of the following conditions exist:

  (i) The settled height of dam exceeds 10 feet.

  (ii) The embankment material has a low silt-clay content and the pipe diameter is 10 inches or greater.

  The anti-seep collar and its connection to the pipe shall be watertight. The maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe.

- Outlet protection. Protection against scour at the discharge end of the pipe spillway shall be provided. Measures may include impact basin, riprap, revetment, excavated plunge pools, or other approved methods.

Emergency spillways. Emergency spillways shall not be constructed on fill. The emergency spillway cross section shall be trapezodial with a minimum bottom width of 8 feet.

- Capacity. The minimum capacity of the emergency spillway shall be that required to pass the peak rate of runoff from the ten-year frequency storm, less any reduction due to flow in the pipe spillway. Emergency spillway dimensions may be determined by using the method in Appendix B-9.

- Velocities. The maximum allowable velocity of flow in the exit channel shall be 6 feet per second for vegetated channels. For channels with erosion protection other than vegetation, velocities shall be within the allowable safe range for the type of protection used.

- Erosion protection. Erosion protection shall be provided for by vegetation as prescribed in this publication or by other suitable means such as riprap, asphalt, concrete, etc.

- Freeboard. Freeboard is the difference between the design flow elevation in the emergency spillway and the top of the settled embankment. If there is no emergency spillway, it is the difference between the elevation required to pass the design flow through the pipe and the top of the settled embankment. The minimum freeboard shall be 1 foot.

Embankment Cross Section

Type 1 Basins. The minimum top width shall be 8 feet. The side slopes shall not be steeper than 2:1.

Type 2 Basins. The minimum top width shall be 10 feet. Side slopes shall be no steeper than 2 1/2:1.

Provision for Lowering Runoff into Basin

Points of entrance of surface runoff into excavated sediment basins should be protected to prevent development of an erosion problem. Diversion or interceptor dikes should be installed as necessary to insure direction of runoff to protect points of entry. Points of entrance should be located so as to insure maximum travel of entering runoff to point of exit from the basin.

Safety

Sediment basins are attractive to children and can be very dangerous. Therefore, they should be fenced and posted or otherwise made inaccessible to persons or animals unless this is deemed unnecessary due to the remoteness of the site or other circumstances. In any case, local ordinances and regulations regarding health and safety must be adhered to.

CONSTRUCTION SPECIFICATIONS

Site preparation

Areas under the embankment and any structural works shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material. In order to facilitate clean-out and restoration, the pool area (measured at the top of the pipe spillway) will be cleared of all brush and trees.

Cut-Off Trench

A cut-off trench will be excavated along the dam centerline on earth fill embankments. The minimum depth shall be 2 feet. The cut-off trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1. Compaction requirements shall be the same as those for embankment. The trench shall be drained during the backfilling-compacting operations.

Embankment

The fill material shall be taken from approved borrow areas. It shall be clean mineral soil, free of roots, woody vegetation, oversized stones, rocks, or other objectionable material. Areas on which fill is to be placed

shall be scarified prior to placement of fill. The fill material should contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Fill material will be placed in 6-to-8 inch continuous layers over the entire length of the fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of the fill is traversed by at least one wheel or tread track of the equipment, or by using a compactor. The embankment shall be constructed to an elevation 10% higher than the design height to allow for settlement if compaction is obtained with hauling equipment. If compactors are used for compaction, the overbuild may be reduced to not less than 5%.

Pipe Spillways

The riser shall be securely attached to the barrel, and all connections shall be watertight. The barrel and riser shall be placed on a firm smooth foundation. The fill material around the pipe spillway will be placed in 4-inch layers and compacted under the shoulders and around the pipe to at least the same density as the adjacent embankment. A minimum of 2 feet of hand compacted backfill should be placed over the pipe spillway before crossing it with construction equipment.

Emergency Spillway

The emergency spillway must not be installed in fill. Elevations, design width, entrance, and exit channel slopes are critical to the successful operation of the emergency spillway.

Vegetative Treatment

Stabilize embankment and emergency spillway in accordance with the appropriate standards and specifications.

Erosion and Pollution Control

Construction operations will be carried out in such a manner that erosion and water pollution will be minimized. State and local laws concerning pollution abatement shall be complied with.

Safety

State and local requirements shall be met concerning fencing and signs warning the public of hazards of soft sediment and floodwater.

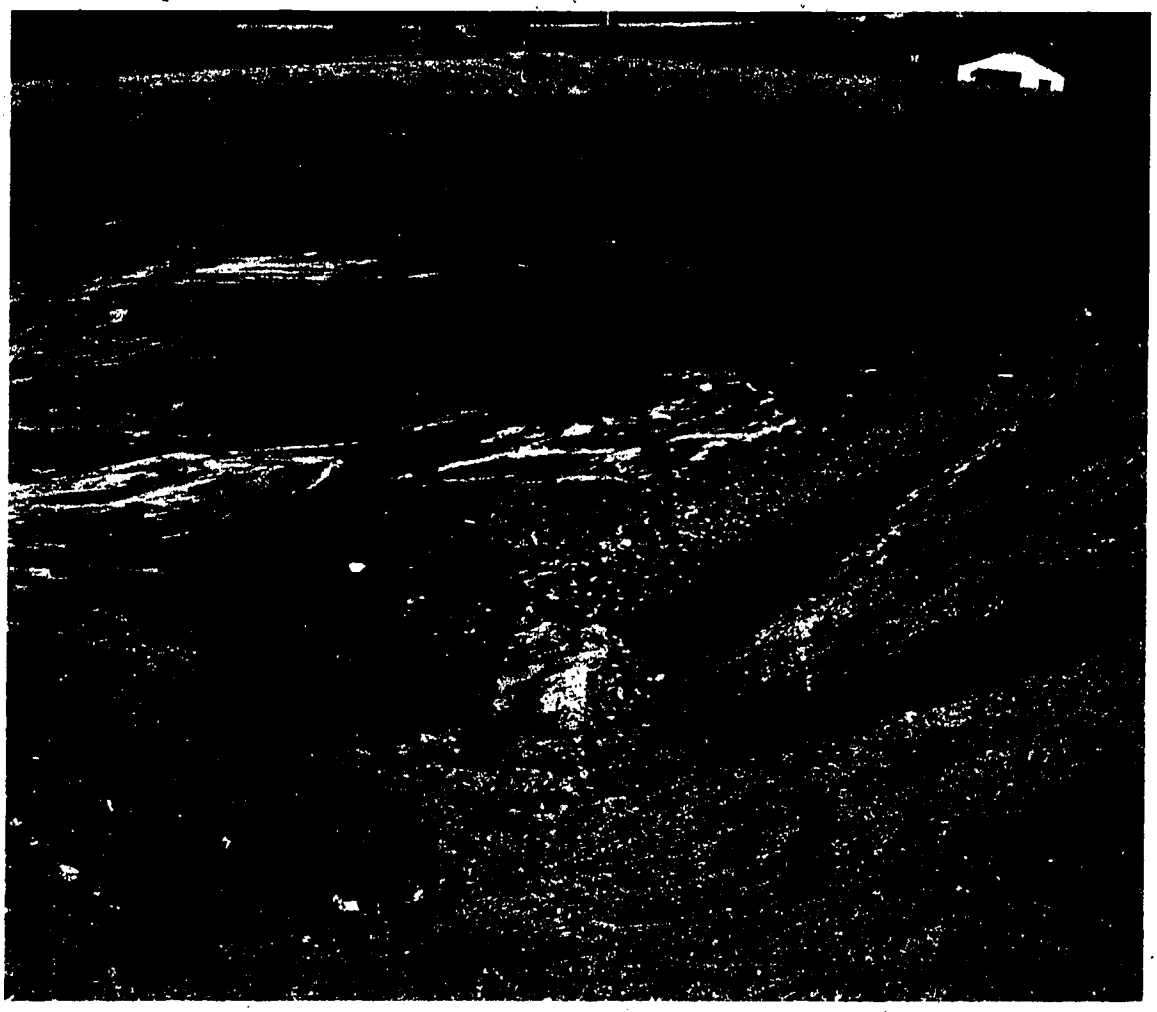
Maintenance

- Repair all damages cause by soil erosion or construction equipment at or before end of each working day.
- Sediment shall be removed from the basin and deposited in a suitable area when it reaches the specified distance below the top of the riser.

- Keep trash rack and anti-vortex device clear of debris (plastic, boards, logs, etc.).

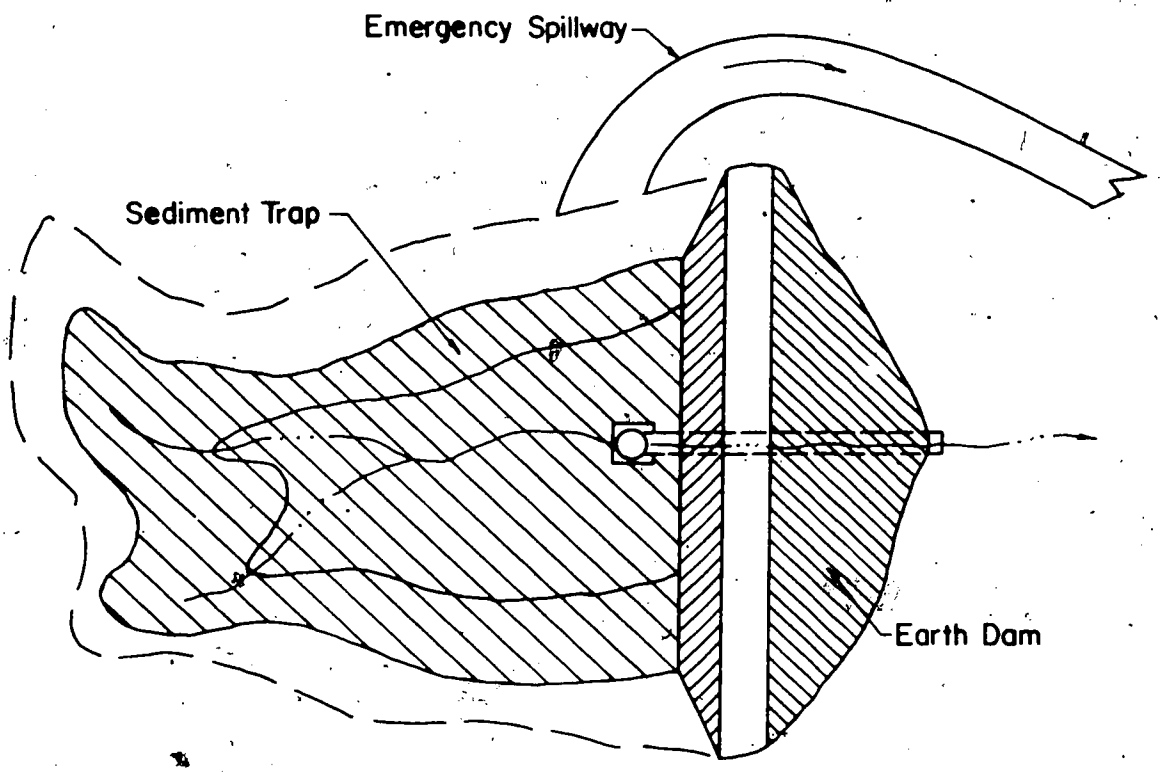
Final Disposal

Temporary sediment basins may be disposed of when the intended purpose has been accomplished, and the contributing drainage area has been properly stabilized. The embankment and resulting sediment deposits are to be leveled or otherwise disposed of in accordance with the sediment control plan.

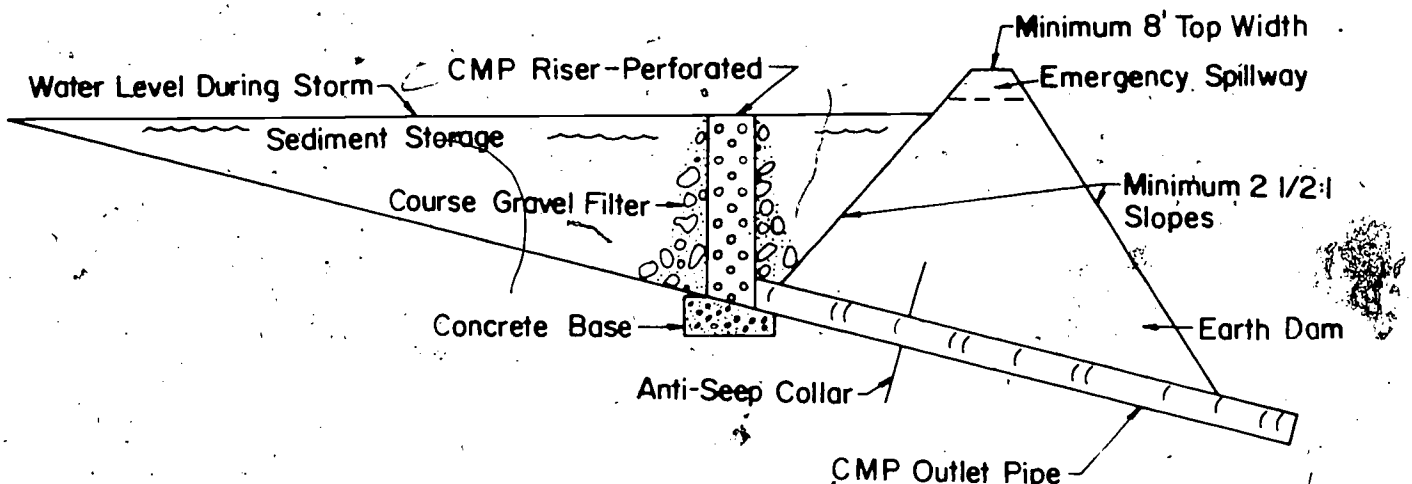


Sediment basin is one of a number of mechanical practices used to control erosion and sediment on disturbed areds.

SKETCH OF SEDIMENT BASIN



PLAN VIEW



SECTION

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY SEDIMENT TRAP

Definition

An impounding area formed by excavation or barrier to trap sediment being transported by storm runoff from a disturbed area of very limited size.

Purpose

To prevent sediment from leaving the site, or from entering natural or constructed drainageways or storm drainage systems, prior to permanent stabilization of the disturbed area.

Conditions Where Practice Applies

Where construction schedules or other considerations preclude erosion control treatment on sediment-producing areas not exceeding 1 acre in extent. Traps are usually excavated or installed at or around storm drain inlets, in drainageways, or at points of discharge of sediment-laden storm runoff.

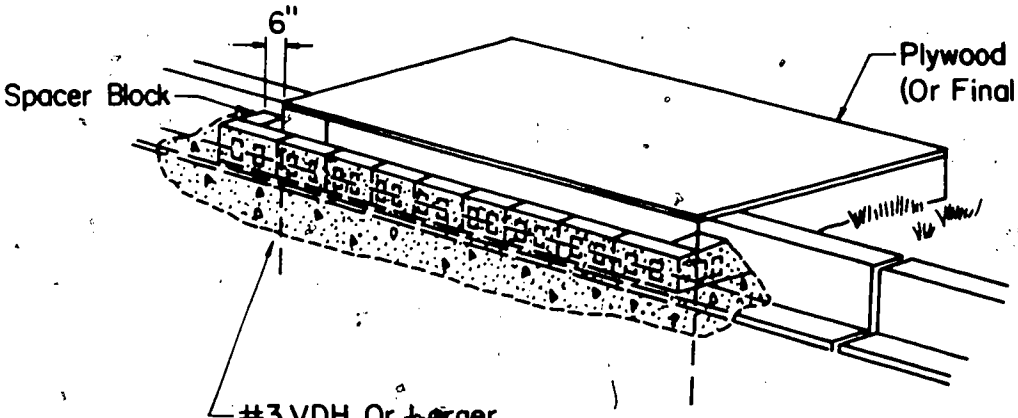
Design Criteria

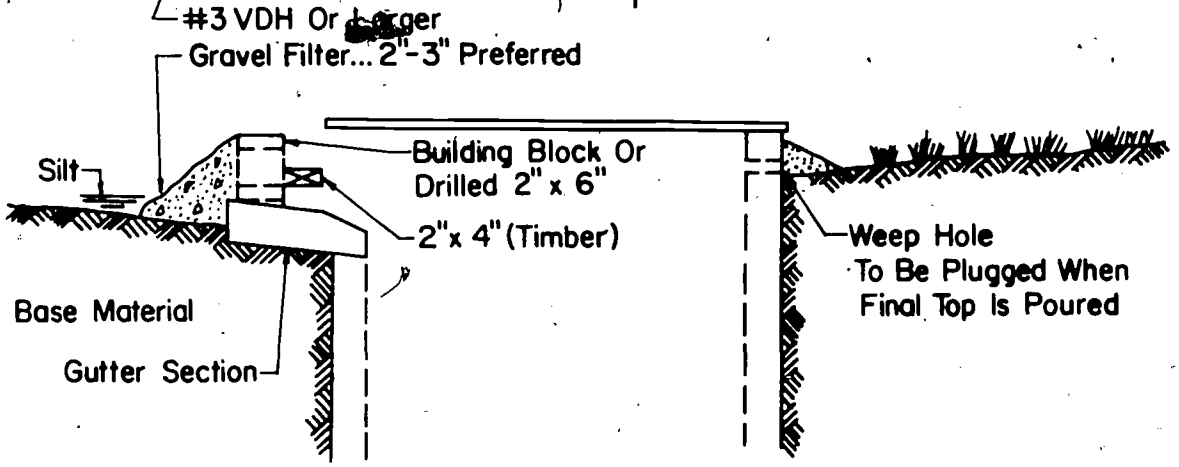
The trap shall be sized to provide a minimum storage capacity of 67 cubic yards per acre of contributing drainage area. It should be dimensioned to fit the site conditions and located so as to not interfere with construction operations and to facilitate periodic cleanout. Traps shall be not less than 1 foot nor more than 2 foot deep measured from the invert of the outlet. The minimum length of flow through the trap shall be 10 feet. Side slopes shall not be steeper than 1:1. Sediment traps must be self-draining unless they are otherwise protected in an approved fashion so as not to present a safety hazard. See Standard Drawings T.S.T.-1, T.S.T.-2 or T.S.T.-3 for three acceptable details of sediment traps at storm drain inlets.

CONSTRUCTION SPECIFICATIONS

1. Sediment traps may be constructed on natural ground surface, on an excavated surface, or on machine compacted fill provided they have a non-erodible outlet.
2. They must be checked at the end of each working day and repaired or cleaned as necessary to insure that they will operate as intended.

Building Block Laid 6" From Throat Web Horizontal





Note That Full Throat Is Available For Heavy Flow

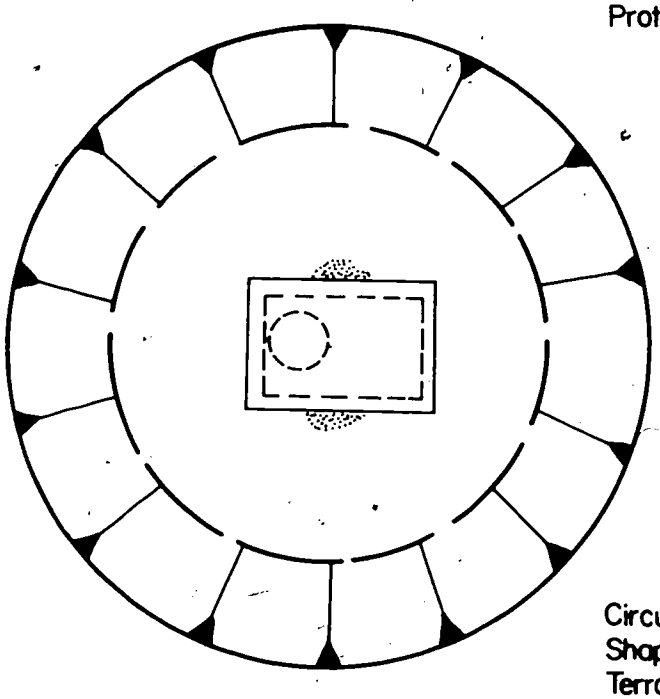
Expanded Metal Or Hardware Cloth In Front Of Block Prevents Gravel From Washing Into Structure

2"x 4" Behind Block And Across Throat Helps Keep Block In Place. Place In Outer Hole Of Spacer Block.

(USE DURING STREET CONSTRUCTION)

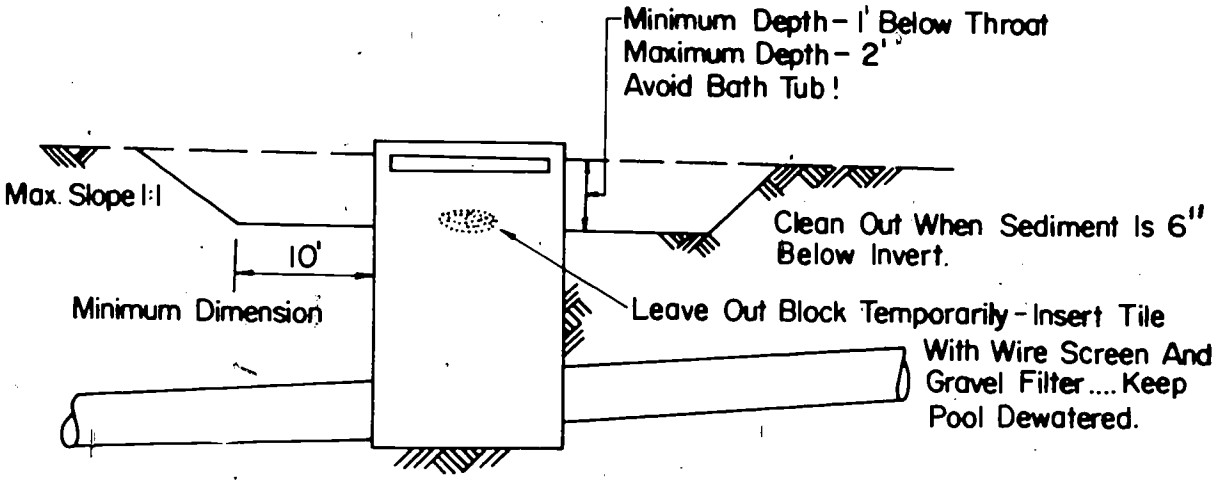
VIRGINIA	TEMPORARY SEDIMENT TRAP AT CURB INLET	STANDARD DRAWING T.S.T.-1

Protect Inlets During Construction. Keep Sediment Out Of The Storm Drainage System! Use Half-Circle Behind Curb Inlets During Street Construction. Modify Protection As Construction Progresses.



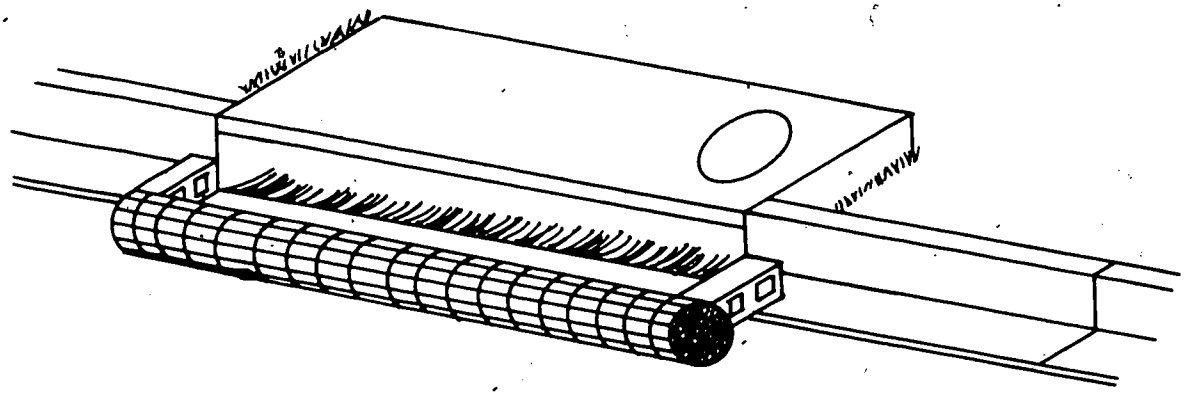
PLAN

Circular Shape Is Not Essential - Vary Shape To Fit Drainage Area And Terrain. Observe To Check Trap Efficiency And Modify As Necessary To Insure Satisfactory Trapping Of Sediment.



SECTION

VIRGINIA	TEMPORARY SEDIMENT TRAP AT STORM DRAIN INLET	STANDARD DRAWING T.S.T. - 2



Spacer Block, Roll Of 12 1/2 Gauge Welded Fence, 2"x 2" Mesh, 8"–10" Diameter Filled With 3" Stone.

Easily Made And Placed
Easy To Clean
Can Be Moved And Re-Used

Prevents Storm Sewer From Becoming Clogged With Silt During Construction
Prevents Silt From Getting In Stream

Source: Chantilly Construction Co.

MINI-GABIONS FOR INLET PROTECTION (USE DURING STREET CONSTRUCTION)

VIRGINIA	TEMPORARY SEDIMENT TRAP AT CURB INLET	STANDARD DRAWING T.S.T.–3

STANDARD AND SPECIFICATIONS FOR LAND GRADING

Definition

Reshaping the ground surface by grading to plan as determined by engineering survey and layout.

Purpose

The practice is for one or more of the following purposes: (1) provide sites more suitable for buildings, facilities, and other land uses; (2) improve surface drainage; and (3) control erosion and reduce sediment.

Conditions Where Practice Applies

This practice is applicable where grading to planned elevations is practical for the purposes enumerated above.

Design Criteria

The grading plan shall be based upon adequate surveys and investigations. The plan must show the locations, slopes, cuts, fills, and finish elevations of the surfaces to be graded together with auxiliary practices for erosion control, slope stabilization, safe disposal of runoff water, and drainage facilities such as waterways, lined ditches, diversions, grade stabilization structures, and surface and subsurface drains. The following requirements shall be incorporated into the plan:

1. Where feasible, cut and fill slopes shall not be steeper than 2:1.
2. Where feasible, benches or diversions shall be provided on slopes steeper than 3:1 when vertical height of slope exceeds 15 feet.
3. Provisions must be made to safely conduct surface runoff to storm drains or to stable water courses to insure that surface runoff will not damage slopes or other graded areas.
4. Subsurface drainage must be provided where necessary to intercept seepage that would adversely affect slope stability or create excessively wet site conditions.
5. Slopes shall not be created so close to property lines as to endanger adjoining properties without adequately protecting such properties against erosion, slippage, settlement, subsidence, or other related damages.

6. Fills must consist of approved clean material from cut areas, borrow pits, or other acceptable sources. Fill shall be placed in lifts not to exceed 1 foot and compacted at density shown on plan.

STANDARD AND SPECIFICATIONS FOR STORM DRAIN OUTLET PROTECTION

Definition

Paved and/or riprap channel sections, placed below storm drain outlets.

Purpose

To reduce velocity of flow before entering receiving channels below storm drain outlets.

Conditions Where Practice Applies

To all storm drain outlets, road culverts, paved channel outlets, etc., discharging into natural or constructed channels. Analysis and/or treatment will extend from the end of the conduit, channel or structure to the point of entry into an existing stream or publicly maintained drainage system.

Design Criteria

Show plan view, profile, and cross section of receiving channel to existing publicly maintained system or natural stream channel. Indicate the actual velocity for the following: 1) outlet (pipe or structure), 2) riprap or paved channel section, and 3) each channel reach and/or to point of entry into existing system or natural stream. Show on plan the proposed method of stabilizing the channel consistent with computed velocities.

Length: Minimum total length of riprap and/or paved section below outlet equals 6 times the diameter of the pipe or 6 times the depth of flow in the outlet channel.

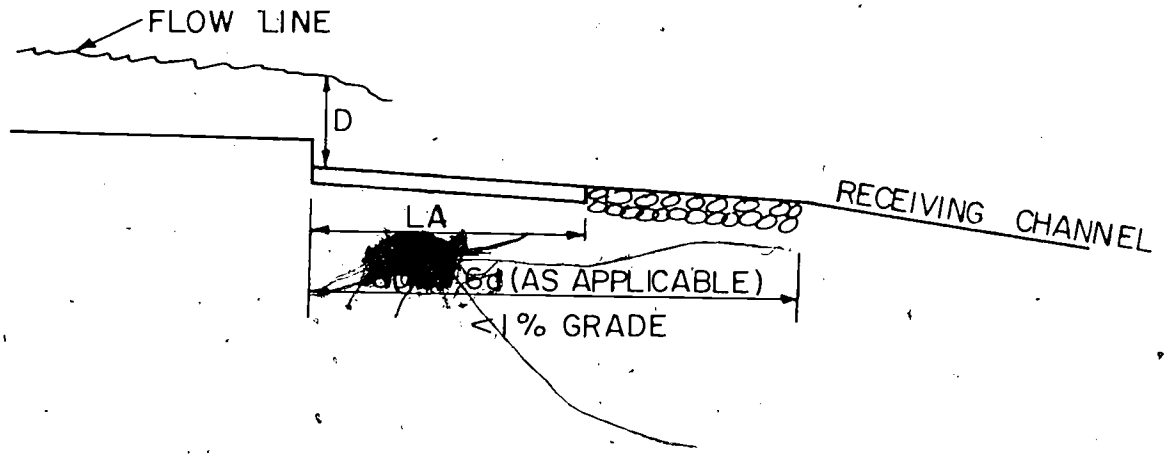
Grade: Less than 1%.

Riprap: Riprap shall be sized according to standard and specifications for riprap. Where size of riprap is impractical, a concrete apron may be used with length according to Table 1, and riprap the remainder of the length specified above.

TABLE 1

APRON LENGTHS (IN FEET)

ACTUAL OUTLET VELOCITY F.P.S.	d - INCHES													
	15	18	21	24	27	30	33	36	42	48	54	60	66	72
6	3	3	3	3	3	4	4	4	4	4	5	5	5	5
8	3	4	4	4	4	5	5	5	6	6	6	7	7	7
10	4	5	5	5	6	6	6	6	7	7	8	8	9	9
12	5	5	6	6	7	7	7	8	8	9	10	10	11	11
14	6	6	7	7	8	8	9	9	10	10	11	12	12	13
16	7	7	8	8	9	9	10	10	11	12	13	13	14	15
18	8	8	9	10	10	11	11	12	13	13	14	15	16	16
20	8	9	10	11	11	12	12	13	14	15	16	17	18	18
22	9	10	11	12	12	13	14	14	15	16	17	18	19	20
24	10	11	12	13	13	14	15	16	17	18	19	20	21	22
26	11	12	13	14	15	15	16	17	18	19	21	22	23	24
28	12	13	14	15	16	17	17	18	20	21	22	23	25	26
30	13	14	15	16	17	18	19	19	21	22	24	25	26	27



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STANDARD AND SPECIFICATIONS FOR RIPRAP

Definition

A layer of loose rock or aggregate placed over an erodibile soil surface.

Purpose

To protect the soil surface from the erosive forces of water.

Scope

Applicable to channels where the rate of flow does not exceed 1,000 cfs., the channel bottom grade does not exceed 10 percent (0.1 ft/ft) and the channel is essentially straight.

Conditions Where Practice Applies

To soil-water interfaces where the soil conditions, water turbulence and velocity, expected vegetative cover, etc., are such that the soil may erode under the design flow conditions. Riprap may be used, as appropriate, at storm drain outlets, channel banks and/or bottoms, roadside ditches, drop structures, etc.

Design Criteria

The design discharge shall equal or exceed the maximum discharge required by local jurisdictions for each reach of channel and shall be based on maximum watershed development during the life of the structure.

Riprap and filters (bedding) shall be designed in accordance with criteria set forth in the National Cooperative Highway Research Program Report 108, Tentative Design Procedure for Riprap & Lined Channels, available from the Highway Research Board, National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C. 20418, or from Hydraulic Engineering Circular No. 11 prepared by the Hydraulic Branch, Bridge Division, Office of Engineering and Operations, Bureau of Public Roads, Washington, D.C. 20591.

Quality

Stone for riprap shall consist of field stone or rough, unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering, and it shall be suitable in all other respects for the purpose intended.

CONSTRUCTION SPECIFICATIONS

The subgrade for the riprap or filter shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density as shown on plan.

The rock or gravel shall conform to the specified grading limits when installed in the riprap or filter, respectively.

The stone for the filter and riprap may be placed by equipment. Both filter and riprap shall each be constructed to the full course thickness in one operation and in such a manner to avoid displacement of the underlying materials. The stone for filter and riprap shall be delivered and placed in a manner that will insure that the filter and riprap each shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Riprap shall be placed in a manner to prevent damage to the filter structures. Hand placing will be required to the extent necessary to prevent damage to the permanent works.

STANDARD AND SPECIFICATIONS
FOR
SUBSURFACE DRAIN

Definition

A conduit such as tile, pipe, or tubing installed beneath the ground surface to intercept, collect, and/or convey ground water.

Purpose

A drain may serve one or more of the following purposes:

- Improve quality of vegetation in grassed or lawn areas by lowering the ground water table.
- Intercept and prevent additional ground water movement into an already wet area.
- Relieve artesian pressure.
- Remove surface runoff.
- Serve as an outlet for other drains.
- Replace natural subsurface drainage patterns that are interrupted or destroyed by construction operations.
- Collect ground water for beneficial uses.
- Vector control.

Scope

This standard covers the installation of subsurface drains in urban or developing areas. It does not apply to the installation of foundation drainage systems for buildings.

Conditions Where Practice Applies

Drains are used in areas having a high water table where benefits of lowering or controlling ground water or surface runoff justify the cost of installation of such a system. They may also be used to intercept and divert "seeps," especially on cut or fill slopes, before they can surface and cause problems. The soil must have sufficient depth and permeability to permit installation of an effective and economically feasible system.

An outlet for the drainage system must be available, either by gravity flow or through pumping. The outlet shall be adequate for the quantity and quality of effluent to be discharged with consideration of possible damage above or below the point of discharge which might involve legal actions under State or local law.

Design Criteria

Required Capacity of Drains

The required capacity may be determined by one or more of the following:

1. Measurement of the rate of subsurface flow at the site.
2. The application of Darcy's Law to lateral or artesian subsurface flow.
3. Surveys and comparison of the site with other similar sites where subsurface drainage yields have been measured.

The minimum capacity shall provide a removal rate from the contributing area of not less than 1/2 inch per 24 hours. Where seepage is intercepted by randomly installed lines, the minimum capacity of the drain shall be as determined from the following chart:

Soil Texture	Unified Soil Classification	Inflow rate per 1,000 ft. of line in cfs. 1) 2)
Coarse Sand and Gravel	GP, FW, SP, SW	0.15 - 1.00
Sandy loam	SM, SC, GM, GC	0.07 - 0.25
Silt loam	CL, ML	0.04 - 0.10
Clay and Clay loam	CL, CH, MH	0.02 - 0.20

1) For interceptor lines on sloping land, increase the inflow rates as follows:

Land Slope %	Inflow Rate Increase %
2 - 5	10
5 - 12	20
12 - Plus	30

2) Discharge of flowing springs or direct entry of surface flow through a surface inlet or filter will require additional designed capacity. Such flow should be measured or estimated by an approved method prior to design.

Size of Drain

Size of drain shall not be less than indicated in the drain design charts found in Appendix C. Four-inch diameter drain shall be the minimum acceptable size. Where local experience has shown it to be desirable, larger drain size may be required.

Depth, Spacing, and Location

The minimum depth of cover of subsurface drains in mineral soils shall be 24 inches. This minimum depth shall apply to normal ground levels and may exclude sections through minor depressions where the drain is not subject to damage by frost action or equipment loading, and where site conditions justify specifying a lesser depth.

The minimum depth of cover in organic soils shall be 30 inches for normal ground levels as defined above, after initial subsidence. Structural measures shall be installed where feasible to control the water table in organic soils within the optimum range of depths.

The spacing of laterals will be dependent on the permeability of the soil, the depth of installation of the drains, and degree of drainage required.

Minimum Velocity and Grade

A minimum velocity of not less than 1.4 feet per second shall be used to establish the minimum design grades if site conditions permit. Otherwise, the minimum gradient for the various drain sizes shall be in accordance with the following table:

Diameter of Drain	Minimum Grade feet/100
4 inches	0.20
5 inches	0.15
6 inches	0.10
8 inches	0.08
10 inches	0.06
12 inches	0.05

When topography dictates, flatter gradients may be used in soils not containing excessive amounts of fine sand and/or silt. Flatter gradients may also be used in soils where rapid siltation hazards exist, provided that the drain line shall be encased in a filter. In either case, minimum gradient of line shall be in accordance with the following table:

Diameter of Drain	Minimum Grade Ft/100	Max. Length of Line
4 inches	0.10	(Usually inflow rate
5 inches	0.07	will govern maximum
6 inches	0.05	length.)

Maximum Grade and Protection

On sites where topographic conditions require the use of drain lines on grades steeper than two percent or where design velocities will be greater than indicated in the table below, special measures shall be used to protect the drain. These measures shall be specified for each job based on the particular conditions of the job site. The protective measures shall be made following one or more of these directives:

- Use only drains that are uniform in size and shape and with smooth ends.
- Lay the drains so as to secure a tight fit with the inside diameter of one section matching that of the adjoining sections.
- Wrap open joints with tar-impregnated paper, burlap, or special filter material such as plastic, fiberglass fabrics, or spun bounded nylon.
- Select the least erodible soil available for blinding.
- Tamp blinding material around the drain before backfilling.
- For continuous pipe or tubing with perforations, completely enclose the pipe with filter material of plastic, fiberglass, or properly graded sand and gravel. The thickness of the envelope shall not be less than 3 inches and shall consist of good concrete sand, or clean pit run gravel, conforming closely to such concrete sand.

Maximum Permissible Velocity in Drains Without Protective Measures

Soil Texture	Velocity-Feet Per Second
Sand and Sandy Loam	3.5
Silt and Silt Loam	5.0
Silty Clay Loam	6.0
Clay and Clay Loam	7.0
Coarse Sand and Gravel	9.0

Materials for Drains

Drains include conduits of [illegible]ncrete, bituminized fiber, metal, plastic, or other materials of [illegible]ptable quality. The conduit shall meet strength and durability requirements of the site. Current specifications as listed below, or as included in this standard, shall be used in determining the quality of the conduit. The following specifications cover the products currently acceptable for use as drains or for use in determining quality of materials used in drainage installations:

	Specification
Clay drain tile	ASTM*C 4
Clay drain tile, perforated	ASTM C 498
Clay sewer pipe, standard strength	ASTM C 13
Clay pipe, extra strength	ASTM C 200
Clay pipe, perforated, standard, and extra strength	ASTM C 211
Clay pipe, testing	ASTM C 301
Concrete drain tile	ASTM C 412
Concrete pipe for irrigation or drainage	ASTM C 118
Concrete pipe or tile, determining physical properties of	ASTM C 497
Concrete sewer, storm drain, and culvert pipe	ASTM C 14

*American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

Reinforced concrete culvert, storm drain, and sewer pipe	ASTM C 76
Perforated concrete pipe	ASTM C 444
Portland cement	ASTM C 150
Asbestos-cement non-pressure sewer pipe	ASTM C 428
Asbestos-cement perforated underdrain pipe	ASTM C 508
Asbestos-cement pipe, testing	ASTM C 500
Pipe, bituminized fiber, (and fittings)	Fed. Spec. *SS-P-1540
Homogeneous bituminized fiber pipe, testing	ASTM D 2314
Laminated-wall bituminized fiber perforated pipe for agricultural, land, and general drainage	ASTM D 2417
Laminated-wall bituminized fiber pipe, physical testing of	ASTM D 2315
Styrene rubber plastic drain and building sewer pipe and fittings Perforations, if needed, are to be as specified in ASTM D 2311	ASTM D 2852
Plastic drainage tubing, corrugated	Soil Conservation Service Specifications
Pipe, corrugated (aluminum alloy)	Fed. Spec. WW-P-402
Pipe, corrugated (iron or steel, zinc coated)	Fed. Spec. WW-P-405

(Loading -- Maximum allowable drain depth will be in conformance with those shown in Appendix C-3.)

Filters and Filter Material

Suitable filter shall be used around drains where required by site conditions to prevent sediment accumulation in the conduit. The need for a filter shall be determined by the characteristics of the soil materials at drain depth and the velocity of flow in the conduit.

*Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

Not less than 3 inches of filter material shall be used for sand-gravel filters. A recommended method of installation is to place filter material to a depth of 3 inches under the drain and cover the drain with a sheet of plastic. The filter shall be designed to prevent the material in which the installation is made from entering the drain. Not more than 10% of the filter shall pass the No. 60 sieve.

Where fiberglass filter material is used, it shall be manufactured from borosilicate type glass, and the manufacturer of the material shall certify that it is suitable for underground use. The fibers shall be of variable size, with some larger fibers intertwined in the mat in a random manner. The material shall cover all open joints and perforations.

Envelopes and Envelope Material

Envelopes shall be used around the drains where required for proper bedding of the conduit or where necessary to improve the characteristics of flow of groundwater into the conduit.

Materials used for envelopes do not need to meet the gradation requirements of filters, but they shall not contain materials which will cause an accumulation of sediment in the conduit or render the envelope unsuitable for bedding of the conduit.

Auxiliary Structures and Drain Protection

Outlet ditches shall be deep enough to provide a minimum depth for mains and all laterals. There should be at least 1 foot of clearance between the invert of the drain and its outlet and the low water stage in the ditch. This clearance may be reduced to 0.3 foot where the outlet ditch is on such a grade that silting or stoppage by vegetative growth will not occur. A continuous section of pipe, at least 10 feet long, without open joints or perforations shall be used at the outlet end of the line. This pipe shall be fire and weather resistant.

A watertight conduit strong enough to withstand the loads upon it shall be used where subsurface drains cross under ditches. Conduits under roadways shall be designed to withstand the expected loads. Shallow drains through depressionable areas and near outlets shall be protected against hazards of equipment, freezing, and thawing.

Junction boxes shall be used where more than two main lines join.

Where surface water is to be admitted to the drain lines, inlets shall be designed to exclude debris and prevent sediment from entering the conduit. Drain lines flowing under pressure shall be designed to withstand the resulting pressures and velocity of flow. Auxiliary surface waterways shall be used where feasible.

The upper end of each drain line shall be capped with concrete or

other durable material unless connected to a structure.

CONSTRUCTION SPECIFICATIONS

Inspection and Handling of Materials

Material for drains shall be given a rigid inspection before installation. Where applicable, clay and concrete tile shall be checked for damage from freezing and thawing prior to installation. Bituminized fiber and plastic pipe and tubing shall be protected from hazards causing deformation or warping. All material shall be satisfactory for its intended use and shall meet applicable specifications and requirements.

Placement and Bedding

Placement of all drains shall be in keeping with the provisions of the standard. In addition, the following applies when a filter is required:

All openings in the drain shall be covered by the filter, or approximately the lower half of the drain is to be covered by the filter and the rest of the drain covered by a sheet of impervious plastic. No portion of the drain containing openings is to be left exposed under conditions which require the use of a filter.

When sand-gravel filter material is used, the trench shall be over excavated 3 inches and backfilled to grade with filter material. After placement of the drain upon the filter material, additional filter material shall be placed over the drain to fill the trench to a depth of 3 inches over the drain. A plastic sheet and friable soil can be used in lieu of filter material as the backfill over the drain when specified. The sand-gravel filter material shall be a mixture of sand and gravel within the gradation required by the base material in the trench.

Backfilling

Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur and so that the filter material, after backfilling, will meet the requirements shown in the plan.

No reversals in grade of the conduit shall be permitted. Where the conduit is to be laid in rock trench, or where rock is exposed at the bottom of the trench, the rock shall be removed below grade enough that the trench may be backfilled, compacted, and bedded; and when completed, the conduit shall be not less than 2 inches from rock.

The outlet will be protected from surface flow over and along the line by mounding earth over the line and immediately behind the outlet to an elevation of not less than 1 foot above natural ground. All outlets will be protected with an animal guard as shown in Appendix C-4.

Final Clean-up

All trenches excavated for drain lines shall be completely backfilled with excavated spoil in such a manner that the ground is left reasonably smooth and suitable for establishing vegetation over the installed drain lines.

STANDARD AND SPECIFICATIONS
FOR
TEMPORARY DOWNDRAINAGE STRUCTURE
(Flexible)

Definition

A flexible conduit of heavy duty fabric or other material used as a temporary structure to convey concentration of stormwater down the face of cut and fill slopes.

Purpose

To safely conduct storm runoff from one elevation to another without causing erosion of slope.

Conditions Where Practice Applies

Flexible downdrains are used on slopes where concentration of stormwater would cause erosion damages. These structures are removed once the permanent water disposal system is installed.

Design Criteria

Formal design is generally not required.

Placement

On undisturbed soil or well-compacted fill.

Diameter

Sufficient capacity required to convey maximum runoff expected during the life of the drain.

End Sections

Standard metal. Entrance section should slope toward outlet at rate of at least 1/2" per foot. Selected soil should be placed and thoroughly compacted around entrance section to insure against piping failure along end section and extension collar.

Extension Collars

Twelve-inch long, corrugated metal pipe. Avoid use of Helical pipe.

Securing Straps

Fabric, metal, etc., secure in at least one corrugation of extension collar.

Anchors

Metal "T" pins anchored in soil through grommets attached to flexible downdrain, 20 foot centers.

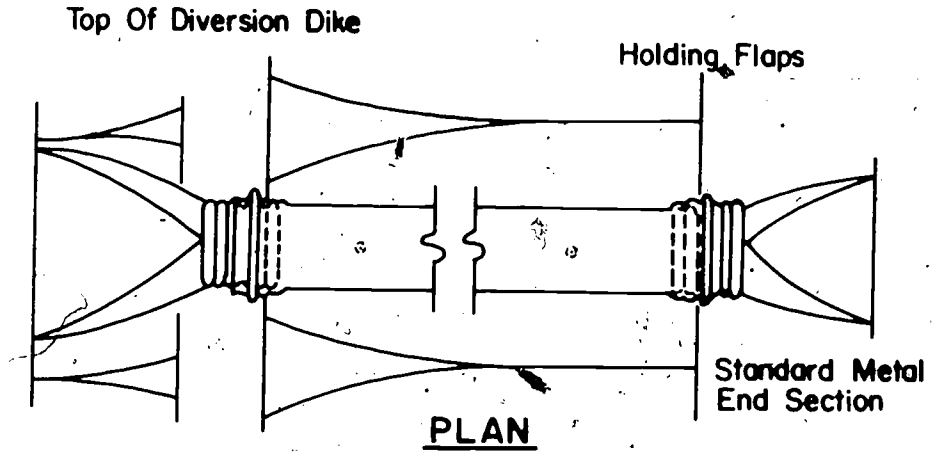
Outlet

To stabilized area where erosion will not be a problem.

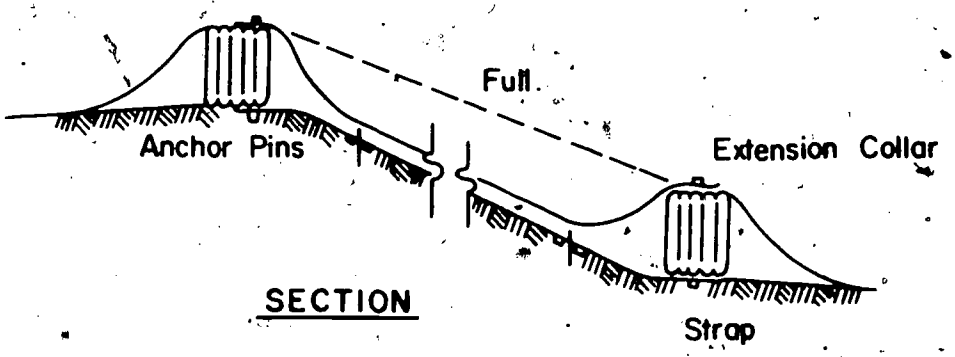
Maintenance

Inlet section should be inspected often for indications of piping along metal sections. Anchors should be re-secured as necessary. Avoid placement of any material on collapsed downdrain. Inspect for clogging or damage after each storm.

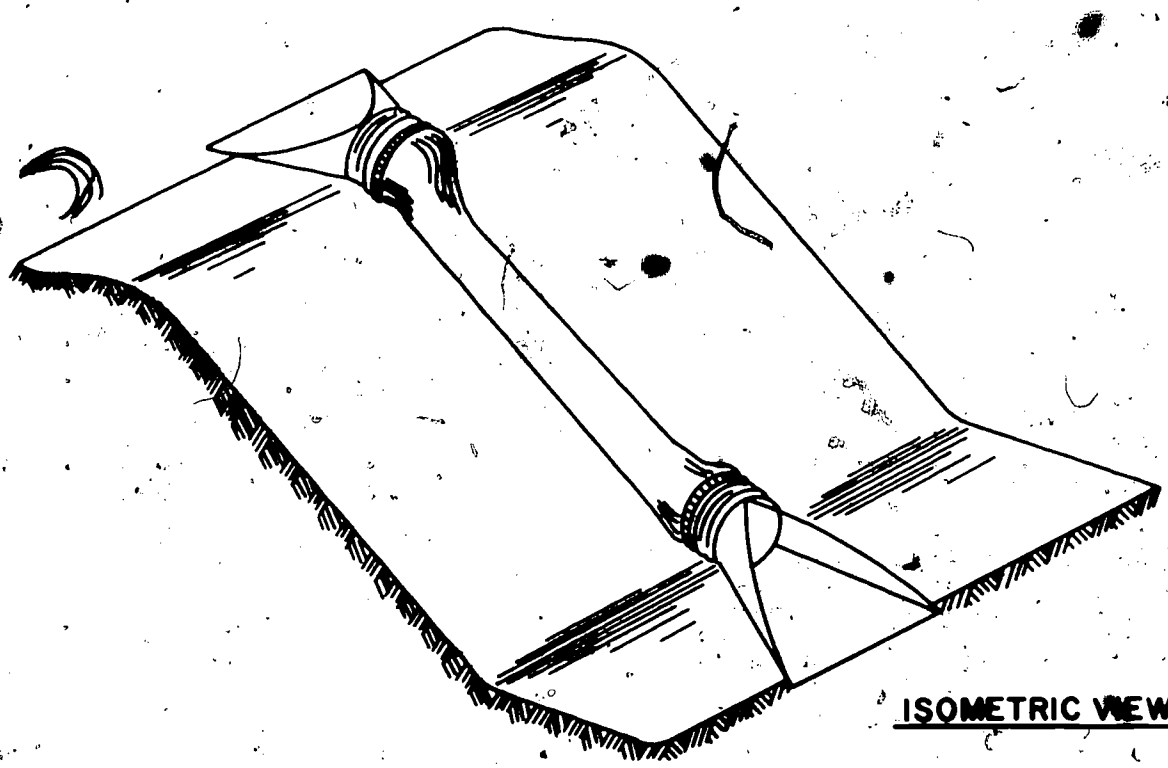
FLEXIBLE DOWNDRAIN



PLAN



SECTION



ISOMETRIC VIEW

TEMPORARY DOWNDRAINAGE STRUCTURE

APPENDICES FOR MEGHANICAL PRACTICES

TABLE OF CONTENTS

APPENDIX A

Parabolic Channel Design

Grade 0.25 Percent

Q cfs	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15																		
20																		
25	10	2.4																
30	11	2.3																
35	13	2.3																
40	15	2.3	10	2.7														
45	17	2.2	12	2.6														
50	19	2.2	13	2.6														
55	20	2.2	14	2.6														
60	22	2.2	15	2.5														
65	24	2.2	17	2.5														
70	26	2.2	18	2.5	13	3.1												
75	28	2.2	19	2.5	13	3.0												
80	29	2.2	20	2.5	14	3.0												
90	33	2.2	23	2.5	16	3.0												
100	38	2.2	25	2.5	18	3.0												
110	40	2.2	28	2.5	19	2.9												
120	44	2.2	30	2.5	21	2.9	15	3.6										
130	48	2.2	33	2.5	23	2.9	16	3.6										
140	51	2.2	35	2.5	25	2.9	18	3.5										
150	55	2.2	37	2.5	26	2.9	19	3.5										
160	58	2.2	40	2.5	28	2.9	20	3.5										
170	62	2.2	42	2.5	30	2.9	21	3.5	17	4.0								
180	66	2.2	45	2.5	31	2.9	22	3.5	18	4.0								

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 0.50 Percent

Q cfs	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	9	1.6																
20	11	1.6																
25	14	1.6	9	1.9														
30	17	1.6	11	1.9	8	2.2												
35	20	1.6	12	1.9	9	2.1												
40	22	1.6	14	1.8	11	2.1												
45	25	1.5	16	1.8	12	2.0												
50	28	1.5	18	1.8	13	2.0	10	2.4										
55	31	1.5	19	1.8	15	2.0	11	2.4										
60	33	1.5	21	1.8	16	2.0	11	2.4										
65	36	1.5	23	1.8	17	2.0	12	2.4										
70	39	1.5	24	1.8	18	2.0	13	2.3										
75	42	1.5	26	1.8	20	2.0	14	2.3	11	2.7								
80	44	1.5	28	1.8	21	2.0	15	2.3	12	2.7								
90	50	1.5	31	1.8	24	2.0	17	2.3	13	2.7								
100	55	1.5	35	1.8	26	2.0	19	2.3	15	2.6	12	3.0						
110	61	1.5	38	1.8	29	2.0	21	2.3	16	2.6	13	3.0						
120	66	1.5	42	1.8	31	2.0	22	2.3	18	2.6	14	2.9						
130	72	1.5	45	1.8	34	2.0	24	2.3	19	2.6	15	2.9						
140	77	1.5	48	1.8	36	2.0	26	2.3	20	2.6	16	2.9						
150	83	1.5	52	1.8	39	2.0	28	2.3	22	2.6	18	2.9	14	3.3				
160	88	1.5	55	1.8	41	2.0	30	2.3	23	2.6	19	2.9	15	3.3				
170	93	1.5	59	1.8	44	2.0	32	2.3	25	2.6	20	2.9	16	3.3				
180	99	1.5	62	1.8	47	2.0	33	2.3	26	2.6	21	2.9	17	3.3				

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
= Depth in Feet

Parabolic Channel Design

Grade 0.75 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	12	1.3	7	1.6														
20	16	1.3	9	1.5														
25	19	1.3	11	1.5	8	1.7												
30	23	1.3	13	1.5	10	1.7	8	1.9										
35	27	1.3	15	1.5	11	1.7	9	1.9										
40	31	1.3	18	1.5	13	1.7	10	1.9										
45	35	1.3	20	1.5	14	1.7	11	1.8										
50	38	1.3	22	1.5	16	1.6	13	1.8	9	2.2								
55	42	1.3	24	1.5	18	1.6	14	1.8	10	2.1								
60	46	1.3	26	1.5	19	1.6	15	1.8	11	2.1								
65	50	1.3	28	1.5	21	1.6	16	1.8	12	2.1	10	2.4						
70	53	1.3	30	1.5	22	1.6	17	1.8	13	2.1	11	2.4						
75	57	1.3	33	1.5	24	1.6	19	1.8	14	2.1	11	2.3						
80	61	1.3	35	1.5	25	1.6	20	1.8	15	2.1	12	2.3						
90	68	1.3	39	1.5	28	1.6	22	1.8	16	2.1	13	2.3	11	2.6				
100	76	1.3	43	1.5	32	1.6	25	1.8	18	2.1	15	2.3	12	2.6				
110	83	1.3	48	1.5	35	1.6	27	1.8	20	2.0	16	2.3	13	2.6				
120	91	1.3	52	1.5	38	1.6	30	1.8	22	2.1	18	2.3	15	2.5	12	2.9		
130	98	1.3	56	1.5	41	1.6	32	1.8	23	2.1	19	2.2	16	2.5	13	2.8		
140	106	1.3	60	1.5	44	1.6	34	1.8	25	2.0	21	2.3	17	2.5	14	2.8		
150	113	1.3	65	1.5	47	1.6	37	1.8	27	2.0	22	2.2	18	2.5	15	2.8		
160	121	1.3	69	1.5	50	1.6	39	1.8	29	2.0	24	2.2	19	2.5	16	2.8	13	3.1
170	128	1.3	73	1.5	53	1.6	42	1.8	30	2.0	25	2.2	20	2.5	17	2.8	14	3.1
180	135	1.3	77	1.5	56	1.6	44	1.8	32	2.0	27	2.2	22	2.5	18	2.8	15	3.1

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 1.0 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	13	1.1	8	1.3														
20	18	1.1	11	1.3	8	1.5												
25	22	1.1	14	1.3	9	1.5	8	1.6										
30	27	1.1	17	1.3	11	1.5	9	1.6										
35	31	1.1	19	1.3	13	1.5	11	1.6	8	1.8								
40	35	1.1	22	1.3	15	1.4	12	1.6	9	1.8								
45	40	1.1	25	1.3	17	1.5	13	1.6	10	1.8								
50	44	1.1	28	1.3	19	1.4	15	1.6	11	1.8	9	2.0						
55	48	1.1	30	1.3	20	1.4	16	1.5	12	1.8	10	2.0						
60	53	1.1	33	1.3	22	1.4	18	1.5	14	1.7	10	2.0						
65	57	1.1	36	1.3	24	1.4	19	1.5	15	1.7	11	2.0	9	2.2				
70	61	1.1	38	1.3	26	1.4	21	1.5	16	1.7	12	2.0	10	2.2				
75	66	1.1	41	1.3	28	1.4	22	1.5	17	1.7	13	2.0	11	2.2				
80	70	1.1	44	1.3	29	1.4	24	1.5	18	1.7	14	2.0	11	2.2				
90	79	1.1	49	1.3	33	1.4	27	1.5	20	1.7	15	1.9	13	2.2	11	2.4		
100	87	1.1	55	1.3	37	1.4	29	1.5	22	1.7	17	1.9	14	2.2	12	2.4		
110	96	1.1	60	1.3	40	1.4	32	1.5	24	1.7	19	1.9	15	2.1	13	2.4	11	2.6
120	104	1.1	65	1.3	44	1.4	35	1.5	27	1.7	20	1.9	17	2.1	14	2.4	12	2.6
130	113	1.1	71	1.3	47	1.4	38	1.5	29	1.7	22	1.9	18	2.1	15	2.4	13	2.6
140	121	1.1	76	1.3	51	1.4	41	1.5	31	1.7	24	1.9	20	2.1	16	2.3	14	2.6
150	130	1.1	81	1.3	55	1.4	44	1.5	33	1.7	25	1.9	21	2.1	17	2.4	15	2.6
160	138	1.1	87	1.3	58	1.4	47	1.5	35	1.7	27	1.9	22	2.1	19	2.3	16	2.5
170	147	1.1	92	1.3	62	1.4	50	1.5	38	1.7	29	1.9	24	2.1	20	2.3	17	2.5
180	155	1.1	97	1.3	65	1.4	53	1.5	40	1.7	30	1.9	25	2.1	21	2.3	18	2.5

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet

D = Depth in Feet

Parabolic Channel Design

Grade 1.25 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	15	1.0	10	1.2	7	1.4												
20	20	1.0	13	1.1	9	1.3	7	1.5										
25	25	1.0	16	1.1	11	1.3	8	1.5	7	1.6								
30	31	1.0	19	1.1	13	1.3	10	1.4	8	1.6								
35	36	1.0	23	1.1	15	1.3	11	1.4	9	1.6	7	1.8						
40	41	1.0	26	1.1	17	1.3	13	1.4	11	1.6	8	1.8						
45	46	1.0	29	1.1	19	1.3	14	1.4	12	1.5	9	1.7						
50	50	1.0	32	1.1	21	1.3	16	1.4	13	1.5	10	1.7	8	2.0				
55	55	1.0	35	1.1	23	1.3	18	1.4	14	1.5	11	1.7	9	1.9				
60	60	1.0	38	1.1	26	1.3	19	1.4	16	1.5	12	1.7	10	1.9				
65	65	1.0	41	1.1	28	1.3	21	1.4	17	1.5	13	1.7	11	1.9	9	2.2		
70	70	1.0	45	1.1	30	1.3	22	1.4	18	1.5	14	1.7	11	1.9	9	2.2		
75	75	1.0	48	1.1	32	1.3	24	1.4	19	1.5	15	1.7	12	1.9	10	2.1		
80	80	1.0	51	1.1	34	1.3	25	1.4	21	1.5	16	1.7	13	1.9	11	2.1	9	2.3
90	90	1.0	57	1.1	38	1.3	29	1.4	23	1.5	18	1.7	15	1.9	12	2.1	10	2.3
100	100	1.0	63	1.1	42	1.3	32	1.4	26	1.5	20	1.7	16	1.9	13	2.1	11	2.3
110	109	1.0	70	1.1	46	1.3	35	1.4	28	1.5	22	1.7	18	1.9	14	2.1	12	2.2
120	119	1.0	76	1.1	51	1.3	38	1.4	31	1.5	24	1.7	19	1.8	16	2.1	14	2.2
130	129	1.0	82	1.1	55	1.3	41	1.4	33	1.5	26	1.7	21	1.8	17	2.1	15	2.2
140	139	1.0	88	1.1	59	1.3	44	1.4	36	1.5	28	1.7	23	1.8	18	2.1	16	2.2
150	148	1.0	94	1.1	63	1.3	47	1.4	38	1.5	30	1.7	24	1.8	19	2.0	17	2.2
160	158	1.0	101	1.1	67	1.3	50	1.4	41	1.5	32	1.7	26	1.8	21	2.1	18	2.2
170	168	1.0	107	1.1	71	1.3	54	1.4	43	1.5	34	1.7	27	1.8	22	2.1	19	2.2
180	177	1.0	113	1.1	75	1.3	57	1.4	46	1.5	36	1.7	29	1.8	23	2.1	20	2.2

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 1.50 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	17	0.9	11	1.1	8	1.2												
20	23	0.9	15	1.0	10	1.2	7	1.4	6	1.5								
25	28	0.9	19	1.0	12	1.2	9	1.4	7	1.5								
30	34	0.9	22	1.0	15	1.2	10	1.3	8	1.5	7	1.6						
35	40	0.9	26	1.0	17	1.1	12	1.3	10	1.4	8	1.6						
40	45	0.9	30	1.0	20	1.2	14	1.3	11	1.4	9	1.6	7	1.8				
45	51	0.9	33	1.0	22	1.1	15	1.3	12	1.4	10	1.5	8	1.8				
50	56	0.9	37	1.0	25	1.1	17	1.3	14	1.4	11	1.5	9	1.8				
55	62	0.9	41	1.0	27	1.1	19	1.3	15	1.4	12	1.5	10	1.7	8	1.9		
60	67	0.9	44	1.0	30	1.1	20	1.3	16	1.4	14	1.5	11	1.7	9	1.9		
65	73	0.9	48	1.0	32	1.1	22	1.3	18	1.4	15	1.5	11	1.7	10	1.9		
70	78	0.9	51	1.0	34	1.1	24	1.3	19	1.4	16	1.5	12	1.7	10	1.9	9	2.1
75	83	0.9	55	1.0	37	1.1	25	1.3	21	1.4	17	1.5	13	1.7	11	1.9	9	2.1
80	89	0.9	59	1.0	39	1.1	27	1.3	22	1.4	18	1.5	14	1.7	12	1.9	10	2.1
90	100	0.9	66	1.0	44	1.1	30	1.3	25	1.4	20	1.5	16	1.7	13	1.9	11	2.0
100	111	0.9	73	1.0	49	1.1	33	1.3	27	1.4	22	1.5	17	1.7	15	1.9	12	2.0
110	121	0.9	80	1.0	54	1.1	37	1.3	30	1.4	25	1.5	19	1.7	16	1.8	14	2.0
120	132	0.9	87	1.0	58	1.1	40	1.3	33	1.4	27	1.5	21	1.7	18	1.9	15	2.0
130	143	0.9	95	1.0	63	1.1	43	1.3	35	1.4	29	1.5	22	1.7	19	1.8	16	2.0
140	154	0.9	102	1.0	68	1.1	47	1.3	38	1.4	31	1.5	24	1.7	20	1.8	17	2.0
150	164	0.9	109	1.0	73	1.1	50	1.3	41	1.4	33	1.5	26	1.7	22	1.8	18	2.0
160	175	0.9	116	1.0	78	1.1	53	1.3	43	1.4	36	1.5	27	1.7	23	1.8	20	2.0
170	186	0.9	123	1.0	82	1.1	57	1.3	46	1.4	38	1.5	29	1.7	25	1.8	21	2.0
180	196	0.9	130	1.0	87	1.1	60	1.3	49	1.4	40	1.5	31	1.7	26	1.8	22	2.0

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
= Depth in Feet

Parabolic Channel Design

Grade 1.75 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	19	0.9	12	1.0	9	1.1	6	1.3										
20	25	0.9	16	1.0	11	1.1	8	1.3	7	1.3								
25	31	0.9	20	1.0	14	1.1	10	1.2	8	1.3	7	1.5						
30	37	0.9	24	1.0	17	1.1	12	1.2	10	1.3	8	1.4						
35	43	0.9	28	1.0	20	1.1	13	1.2	11	1.3	9	1.4	7	1.6				
40	49	0.9	32	1.0	22	1.1	15	1.2	13	1.3	10	1.4	8	1.6				
45	55	0.9	36	1.0	25	1.1	17	1.2	14	1.3	12	1.4	9	1.6	8	1.7		
50	61	0.9	40	1.0	28	1.1	19	1.2	16	1.3	13	1.4	10	1.5	8	1.7		
55	67	0.9	44	1.0	31	1.1	21	1.2	17	1.3	14	1.4	11	1.5	9	1.7	8	1.9
60	73	0.9	48	1.0	33	1.1	23	1.2	19	1.3	15	1.4	12	1.5	10	1.7	8	1.9
65	78	0.9	52	1.0	36	1.1	25	1.2	21	1.3	17	1.4	13	1.5	11	1.7	9	1.9
70	84	0.9	56	1.0	39	1.1	27	1.2	22	1.3	18	1.4	14	1.5	12	1.7	10	1.9
75	90	0.9	59	1.0	42	1.1	29	1.2	24	1.3	19	1.4	15	1.5	12	1.7	10	1.9
80	96	0.9	63	1.0	44	1.1	30	1.2	25	1.3	20	1.4	16	1.5	13	1.7	11	1.9
90	108	0.9	71	1.0	50	1.1	34	1.2	28	1.3	23	1.4	18	1.5	15	1.7	12	1.9
100	120	0.9	79	1.0	55	1.1	38	1.2	31	1.3	25	1.4	20	1.5	16	1.7	13	1.9
110	131	0.9	87	1.0	61	1.1	42	1.2	34	1.3	28	1.4	22	1.5	18	1.7	15	1.8
120	143	0.9	94	1.0	66	1.1	45	1.2	38	1.3	30	1.4	24	1.5	20	1.7	16	1.8
130	155	0.9	102	1.0	71	1.1	49	1.2	41	1.3	33	1.4	26	1.5	21	1.7	17	1.8
140	166	0.9	110	1.0	77	1.1	53	1.2	44	1.3	35	1.4	28	1.5	23	1.6	19	1.8
150	178	0.9	117	1.0	82	1.1	56	1.2	47	1.3	38	1.4	30	1.5	24	1.6	20	1.8
160	189	0.9	125	1.0	88	1.1	60	1.2	50	1.3	40	1.4	31	1.5	26	1.6	21	1.8
170	201	0.9	132	1.0	93	1.1	64	1.2	53	1.3	43	1.4	33	1.5	28	1.6	23	1.8
180	212	0.9	140	1.0	98	1.1	67	1.2	56	1.3	45	1.4	35	1.5	29	1.6	24	1.8

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 2.0 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	21	0.8	13	0.9	9	1.0	7	1.2										
20	28	0.8	17	0.9	12	1.0	9	1.1	7	1.3	5	1.4						
25	35	0.8	21	0.9	15	1.0	11	1.1	8	1.3	7	1.4						
30	41	0.8	26	0.9	18	1.0	13	1.1	10	1.2	8	1.3	7	1.5				
35	48	0.8	30	0.9	22	1.0	15	1.1	11	1.2	9	1.3	8	1.5				
40	55	0.8	34	0.9	25	1.0	18	1.1	13	1.2	11	1.3	9	1.5	7	1.7		
45	62	0.8	38	0.9	28	1.0	20	1.1	14	1.2	12	1.3	10	1.4	8	1.6		
50	68	0.8	42	0.9	31	1.0	22	1.1	16	1.2	13	1.3	11	1.4	9	1.6	8	1.7
55	75	0.8	46	0.9	34	1.0	24	1.1	17	1.2	14	1.3	12	1.4	10	1.6	8	1.7
60	82	0.8	51	0.9	37	1.0	26	1.1	19	1.2	16	1.3	13	1.4	11	1.6	9	1.7
65	88	0.8	55	0.9	40	1.0	28	1.1	21	1.2	17	1.3	14	1.4	11	1.6	10	1.7
70	95	0.8	59	0.9	43	1.0	30	1.1	22	1.2	18	1.3	15	1.4	12	1.6	10	1.7
75	101	0.8	63	0.9	46	1.0	32	1.1	24	1.2	20	1.3	16	1.4	13	1.6	11	1.7
80	108	0.8	67	0.9	48	1.0	35	1.1	25	1.2	21	1.3	17	1.4	14	1.6	12	1.7
90	121	0.8	75	0.9	54	1.0	39	1.1	28	1.2	23	1.3	19	1.4	16	1.6	13	1.7
100	134	0.8	83	0.9	60	1.0	43	1.1	31	1.2	26	1.3	21	1.4	17	1.6	15	1.7
110	147	0.8	92	0.9	66	1.0	47	1.1	34	1.2	28	1.3	23	1.4	19	1.5	16	1.7
120	160	0.8	100	0.9	72	1.0	52	1.1	38	1.2	31	1.3	26	1.4	21	1.5	18	1.7
130	173	0.8	108	0.9	78	1.0	56	1.1	41	1.2	34	1.3	28	1.4	23	1.5	19	1.7
140	186	0.8	116	0.9	84	1.0	60	1.1	44	1.2	36	1.3	30	1.4	24	1.5	21	1.7
150	199	0.8	124	0.9	90	1.0	64	1.1	47	1.2	39	1.3	32	1.4	26	1.5	22	1.7
160	212	0.8	132	0.9	96	1.0	69	1.1	50	1.2	41	1.3	34	1.4	28	1.5	23	1.7
170	225	0.8	140	0.9	102	1.0	73	1.1	53	1.2	44	1.3	36	1.4	29	1.5	25	1.7
180	238	0.8	148	0.9	108	1.0	77	1.1	56	1.2	46	1.3	38	1.4	31	1.5	26	1.7

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 3.0 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	24	0.7	16	0.8	11	0.8	9	0.9	7	1.0	5	1.2						
20	31	0.7	22	0.8	15	0.8	12	0.9	9	1.0	7	1.1	6	1.2				
25	39	0.7	27	0.8	19	0.8	15	0.9	11	1.0	8	1.1	7	1.2	6	1.3		
30	47	0.7	32	0.8	23	0.8	17	0.9	13	1.0	10	1.1	9	1.2	7	1.2	6	1.4
35	55	0.7	38	0.8	26	0.8	20	0.9	15	1.0	11	1.1	10	1.1	8	1.2	7	1.4
40	62	0.7	43	0.8	30	0.8	23	0.9	17	1.0	13	1.1	12	1.1	9	1.2	8	1.4
45	70	0.7	48	0.8	34	0.8	26	0.9	19	1.0	15	1.1	13	1.1	11	1.2	9	1.3
50	77	0.7	54	0.8	38	0.8	29	0.9	21	1.0	16	1.1	14	1.1	12	1.2	9	1.3
55	85	0.7	59	0.8	41	0.8	32	0.9	23	1.0	18	1.1	16	1.1	13	1.2	10	1.4
60	93	0.7	64	0.8	45	0.8	35	0.9	26	1.0	19	1.1	17	1.1	14	1.2	11	1.3
65	100	0.7	70	0.8	49	0.8	37	0.9	28	1.0	21	1.1	19	1.1	15	1.2	12	1.3
70	107	0.7	74	0.8	52	0.8	40	0.9	30	1.0	22	1.1	20	1.1	16	1.2	13	1.3
75	115	0.7	79	0.8	56	0.8	43	0.9	32	1.0	24	1.1	21	1.1	18	1.2	14	1.3
80	122	0.7	85	0.8	59	0.8	46	0.9	34	1.0	26	1.1	23	1.1	19	1.2	15	1.3
90	137	0.7	95	0.8	67	0.8	51	0.9	38	1.0	29	1.1	26	1.1	21	1.2	17	1.3
100	152	0.7	105	0.8	74	0.8	57	0.9	42	1.0	32	1.1	28	1.1	23	1.2	19	1.3
110	167	0.7	116	0.8	81	0.8	63	0.9	46	1.0	35	1.1	31	1.1	26	1.2	21	1.3
120	181	0.7	126	0.8	89	0.8	68	0.9	51	1.0	38	1.1	34	1.1	28	1.2	22	1.3
130	196	0.7	136	0.8	96	0.8	74	0.9	55	1.0	41	1.1	37	1.1	30	1.2	24	1.3
140	211	0.7	146	0.8	103	0.8	79	0.9	59	1.0	44	1.1	39	1.1	32	1.2	26	1.3
150	225	0.7	156	0.8	110	0.8	85	0.9	63	1.0	47	1.1	42	1.1	35	1.2	28	1.3
160	239	0.7	166	0.8	117	0.8	90	0.9	67	1.0	50	1.1	45	1.1	37	1.2	30	1.3
170	254	0.7	176	0.8	124	0.8	96	0.9	71	1.0	54	1.1	48	1.1	39	1.2	32	1.3
180	268	0.7	186	0.8	131	0.8	101	0.9	75	1.0	57	1.1	50	1.1	41	1.2	33	1.3

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 4.0 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	28	0.6	20	0.7	14	0.7	10	0.8	8	0.9	6	0.9	5	1.1				
20	37	0.6	27	0.7	19	0.7	14	0.8	11	0.8	8	0.9	6	1.0	6	1.1		
25	46	0.6	33	0.7	23	0.7	17	0.8	13	0.8	11	0.9	8	1.0	7	1.1	6	1.2
30	55	0.6	40	0.7	28	0.7	20	0.8	16	0.8	13	0.9	10	1.0	8	1.1	7	1.2
35	64	0.6	46	0.7	32	0.7	24	0.8	18	0.8	15	0.9	11	1.0	10	1.1	8	1.2
40	73	0.6	52	0.7	37	0.7	27	0.8	21	0.8	17	0.9	13	1.0	11	1.0	9	1.1
45	82	0.6	59	0.7	41	0.7	30	0.8	23	0.8	19	0.9	14	1.0	12	1.1	10	1.1
50	91	0.6	65	0.7	46	0.7	34	0.8	26	0.8	21	0.9	16	1.0	14	1.1	11	1.1
55	100	0.6	72	0.7	50	0.7	37	0.8	29	0.8	23	0.9	17	1.0	15	1.0	12	1.1
60	109	0.6	78	0.7	55	0.7	40	0.8	31	0.8	25	0.9	19	1.0	16	1.0	13	1.1
65	117	0.6	84	0.7	59	0.7	44	0.8	34	0.8	27	0.9	20	1.0	18	1.1	14	1.1
70	126	0.6	90	0.7	63	0.7	47	0.8	36	0.8	29	0.9	22	1.0	19	1.0	15	1.1
75	135	0.6	97	0.7	68	0.7	50	0.8	39	0.8	31	0.9	24	1.0	20	1.0	17	1.1
80	143	0.6	103	0.7	72	0.7	53	0.8	41	0.8	33	0.9	25	1.0	21	1.0	18	1.1
90	161	0.6	115	0.7	81	0.7	60	0.8	46	0.8	37	0.9	28	1.0	24	1.0	20	1.1
100	178	0.6	128	0.7	90	0.7	66	0.8	51	0.8	41	0.9	31	1.0	27	1.0	22	1.1
110	195	0.6	140	0.7	99	0.7	73	0.8	56	0.8	45	0.9	34	1.0	29	1.0	24	1.1
120	213	0.6	153	0.7	107	0.7	79	0.8	61	0.8	49	0.9	37	1.0	32	1.0	26	1.1
130	230	0.6	165	0.7	116	0.7	86	0.8	66	0.8	53	0.9	40	1.0	35	1.0	28	1.1
140	247	0.6	177	0.7	125	0.7	92	0.8	71	0.8	57	0.9	43	1.0	37	1.0	31	1.1
150	264	0.6	189	0.7	133	0.7	99	0.8	76	0.8	61	0.9	47	1.0	40	1.0	33	1.1
160	280	0.6	201	0.7	142	0.7	105	0.8	81	0.8	65	0.9	50	1.0	42	1.0	35	1.1
170	297	0.6	213	0.7	150	0.7	112	0.8	86	0.8	69	0.9	53	1.0	45	1.0	37	1.1
180	314	0.6	225	0.7	159	0.7	118	0.8	91	0.8	73	0.9	56	1.0	48	1.0	39	1.1

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 5.0 Percent

Q cfs	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	29	0.6	21	0.6	15	0.7	12	0.7	9	0.8	7	0.8	6	0.9	5	1.0		
20	39	0.6	28	0.6	20	0.7	16	0.7	12	0.8	10	0.8	8	0.9	6	1.0	5	1.1
25	49	0.6	35	0.6	25	0.7	20	0.7	15	0.8	12	0.8	10	0.9	8	1.0	7	1.0
30	58	0.6	42	0.6	30	0.7	24	0.7	18	0.8	14	0.8	11	0.9	9	1.0	8	1.0
35	68	0.6	49	0.6	35	0.7	28	0.7	21	0.8	17	0.8	13	0.9	11	0.9	9	1.0
40	77	0.6	56	0.6	40	0.7	32	0.7	24	0.8	19	0.8	15	0.9	12	0.9	10	1.0
45	86	0.6	63	0.6	44	0.7	36	0.7	27	0.8	21	0.8	17	0.9	14	0.9	12	1.0
50	96	0.6	69	0.6	49	0.7	40	0.7	30	0.8	24	0.8	19	0.9	15	0.9	13	1.0
55	105	0.6	76	0.6	54	0.7	44	0.7	33	0.8	26	0.8	21	0.9	17	0.9	14	1.0
60	114	0.6	83	0.6	59	0.7	48	0.7	36	0.8	28	0.8	22	0.9	18	0.9	15	1.0
65	123	0.6	89	0.6	63	0.7	52	0.7	38	0.8	31	0.8	24	0.9	19	0.9	17	1.0
70	132	0.6	96	0.6	68	0.7	56	0.7	41	0.8	33	0.8	26	0.9	21	0.9	18	1.0
75	142	0.6	102	0.6	73	0.7	59	0.7	44	0.8	35	0.8	28	0.9	22	0.9	19	1.0
80	151	0.6	109	0.6	78	0.7	63	0.7	47	0.8	37	0.8	30	0.9	24	0.9	20	1.0
90	169	0.6	122	0.6	87	0.7	71	0.7	53	0.8	42	0.8	33	0.9	27	0.9	23	1.0
100	187	0.6	136	0.6	97	0.7	79	0.7	59	0.8	47	0.8	37	0.9	30	0.9	26	1.0
110	205	0.6	149	0.6	106	0.7	86	0.7	64	0.8	51	0.8	41	0.9	33	0.9	28	1.0
120	223	0.6	162	0.6	115	0.7	94	0.7	70	0.8	56	0.8	44	0.9	35	0.9	31	1.0
130	241	0.6	175	0.6	125	0.7	102	0.7	76	0.8	60	0.8	48	0.9	38	0.9	33	1.0
140	259	0.6	188	0.6	134	0.7	109	0.7	81	0.8	65	0.8	52	0.9	41	0.9	36	1.0
150	276	0.6	201	0.6	143	0.7	117	0.7	87	0.8	69	0.8	55	0.9	44	0.9	38	1.0
160	294	0.6	213	0.6	152	0.7	124	0.7	93	0.8	74	0.8	59	0.9	47	0.9	40	1.0
170	311	0.6	226	0.6	162	0.7	132	0.7	98	0.8	78	0.8	62	0.9	50	0.9	43	1.0
180	329	0.6	239	0.6	171	0.7	139	0.7	104	0.8	83	0.8	66	0.9	53	0.9	45	1.0

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

III-85

A-1

Parabolic Channel Design

Grade 6.0 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	35	0.5	23	0.6	17	0.6	13	0.7	10	0.7	8	0.8	7	0.8	5	0.9	4	1.0
20	46	0.5	30	0.6	22	0.6	17	0.7	13	0.7	11	0.7	9	0.8	7	0.9	6	1.0
25	57	0.5	37	0.6	28	0.6	21	0.7	17	0.7	13	0.7	11	0.8	9	0.9	7	0.9
30	69	0.5	45	0.6	33	0.6	25	0.7	20	0.7	16	0.7	13	0.8	10	0.9	8	0.9
35	80	0.5	52	0.6	38	0.6	29	0.7	23	0.7	19	0.7	15	0.8	12	0.9	10	0.9
40	91	0.5	59	0.6	44	0.6	33	0.7	26	0.7	21	0.7	17	0.8	14	0.9	11	0.9
45	102	0.5	67	0.6	49	0.6	37	0.7	30	0.7	24	0.7	19	0.8	16	0.9	13	0.9
50	113	0.5	74	0.6	54	0.6	42	0.7	33	0.7	26	0.7	22	0.8	17	0.9	14	0.9
55	123	0.5	81	0.6	60	0.6	46	0.7	36	0.7	29	0.7	24	0.8	19	0.8	15	0.9
60	134	0.5	88	0.6	65	0.6	50	0.7	39	0.7	32	0.7	26	0.8	21	0.8	17	0.9
65	145	0.5	95	0.6	70	0.6	54	0.7	42	0.7	34	0.7	28	0.8	22	0.9	18	0.9
70	155	0.5	102	0.6	75	0.6	58	0.7	45	0.7	37	0.7	30	0.8	24	0.9	19	0.9
75	166	0.5	109	0.6	81	0.6	62	0.7	49	0.7	39	0.7	32	0.8	26	0.8	21	0.9
80	176	0.5	116	0.6	86	0.6	65	0.7	52	0.7	42	0.7	34	0.8	27	0.9	22	0.9
90	198	0.5	130	0.6	96	0.6	73	0.7	58	0.7	47	0.7	38	0.8	31	0.8	25	0.9
100	219	0.5	144	0.6	107	0.6	81	0.7	64	0.7	52	0.7	42	0.8	34	0.9	28	0.9
110	240	0.5	158	0.6	117	0.6	89	0.7	71	0.7	57	0.7	47	0.8	37	0.8	30	0.9
120	261	0.5	172	0.6	127	0.6	97	0.7	77	0.7	62	0.7	51	0.8	41	0.8	33	0.9
130	282	0.5	185	0.6	138	0.6	105	0.7	83	0.7	67	0.7	55	0.8	44	0.8	36	0.9
140	302	0.5	199	0.6	148	0.6	113	0.7	89	0.7	72	0.7	59	0.8	47	0.8	38	0.9
150	323	0.5	213	0.6	158	0.6	121	0.7	96	0.7	77	0.7	63	0.8	50	0.8	41	0.9
160	343	0.5	226	0.6	168	0.6	129	0.7	102	0.7	82	0.7	67	0.8	54	0.9	44	0.9
170	363	0.5	240	0.6	178	0.6	136	0.7	108	0.7	87	0.7	71	0.8	57	0.8	46	0.9
180	383	0.5	253	0.6	188	0.6	144	0.7	114	0.7	92	0.7	75	0.8	60	0.9	49	0.9

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

Parabolic Channel Design

Grade 8.0 Percent

Q	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
cfs	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	37	0.5	27	0.5	19	0.5	15	0.6	12	0.6	9	0.7	8	0.7	6	0.7	5	0.8
20	49	0.5	35	0.5	25	0.5	20	0.6	16	0.6	13	0.7	10	0.7	9	0.7	7	0.8
25	61	0.5	44	0.5	31	0.5	25	0.6	19	0.6	16	0.7	13	0.7	11	0.7	9	0.8
30	73	0.5	53	0.5	37	0.5	30	0.6	23	0.6	19	0.7	16	0.7	13	0.7	11	0.8
35	85	0.5	61	0.5	43	0.5	35	0.6	27	0.6	22	0.6	18	0.7	15	0.7	12	0.8
40	97	0.5	70	0.5	49	0.5	40	0.6	31	0.6	25	0.6	21	0.7	17	0.7	14	0.8
45	109	0.5	78	0.5	55	0.5	45	0.6	35	0.6	28	0.6	23	0.7	19	0.7	16	0.8
50	120	0.5	87	0.5	61	0.5	50	0.6	38	0.6	31	0.7	26	0.7	21	0.7	17	0.8
55	132	0.5	95	0.5	67	0.5	55	0.6	42	0.6	34	0.7	28	0.7	23	0.7	19	0.8
60	143	0.5	103	0.5	73	0.5	60	0.6	46	0.6	37	0.7	31	0.7	25	0.7	21	0.8
65	155	0.5	111	0.5	79	0.5	65	0.6	50	0.6	40	0.7	33	0.7	27	0.7	23	0.8
70	166	0.5	120	0.5	85	0.5	69	0.6	53	0.6	43	0.6	36	0.7	29	0.7	24	0.8
75	177	0.5	128	0.5	91	0.5	74	0.6	57	0.6	46	0.7	38	0.7	31	0.7	26	0.8
80	188	0.5	136	0.5	96	0.5	79	0.6	61	0.6	49	0.6	41	0.7	33	0.7	28	0.8
90	211	0.5	152	0.5	108	0.6	88	0.6	68	0.6	55	0.7	46	0.7	37	0.7	31	0.8
100	234	0.5	168	0.5	120	0.6	98	0.6	75	0.6	61	0.7	51	0.7	41	0.7	34	0.8
110	256	0.5	185	0.5	131	0.6	108	0.6	83	0.6	67	0.7	57	0.7	46	0.7	38	0.8
120	278	0.5	201	0.5	143	0.6	117	0.6	90	0.6	73	0.7	61	0.7	50	0.7	41	0.8
130	300	0.5	217	0.5	154	0.6	126	0.6	97	0.6	78	0.7	65	0.7	54	0.7	44	0.8
140	322	0.5	233	0.5	166	0.6	136	0.6	104	0.6	84	0.7	70	0.7	58	0.7	48	0.8
150	344	0.5	248	0.5	177	0.6	145	0.6	112	0.6	90	0.7	75	0.7	62	0.7	51	0.8
160	366	0.5	264	0.5	188	0.6	154	0.6	119	0.6	96	0.7	80	0.7	66	0.7	54	0.8
170	387	0.5	280	0.5	199	0.6	164	0.6	126	0.6	102	0.7	85	0.7	70	0.7	58	0.8
180	408	0.5	295	0.5	210	0.6	173	0.6	133	0.6	107	0.7	90	0.7	74	0.7	61	0.8

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet
D = Depth in Feet

III-87

A-1-F

Parabolic Channel Design

Grade 10.0 Percent

Q cfs	V = 2.0		V = 2.5		V = 3.0		V = 3.5		V = 4.0		V = 4.5		V = 5.0		V = 5.5		V = 6.0	
	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
15	45	0.4	33	0.5	23	0.5	17	0.5	13	0.6	11	0.6	9	0.6	7	0.7	6	0.7
20	60	0.4	43	0.5	30	0.5	22	0.5	18	0.6	14	0.6	12	0.6	10	0.7	8	0.7
25	75	0.4	54	0.5	38	0.5	28	0.5	22	0.6	18	0.6	15	0.6	12	0.7	10	0.7
30	89	0.4	64	0.5	45	0.5	33	0.5	27	0.6	21	0.6	18	0.6	15	0.6	12	0.7
35	104	0.4	75	0.5	53	0.5	38	0.5	31	0.6	25	0.6	21	0.6	17	0.7	14	0.7
40	118	0.4	85	0.5	60	0.5	44	0.5	35	0.6	28	0.6	24	0.6	20	0.7	16	0.7
45	132	0.4	95	0.5	67	0.5	49	0.5	40	0.6	32	0.6	27	0.6	22	0.7	18	0.7
50	146	0.4	105	0.5	74	0.5	54	0.5	44	0.6	35	0.6	30	0.6	24	0.7	20	0.7
55	160	0.4	115	0.5	82	0.5	60	0.5	48	0.6	39	0.6	32	0.6	27	0.6	22	0.7
60	174	0.4	125	0.5	87	0.5	65	0.5	52	0.6	42	0.6	35	0.6	29	0.7	24	0.7
65	188	0.4	135	0.5	96	0.5	70	0.5	57	0.6	45	0.6	38	0.6	32	0.7	26	0.7
70	201	0.4	145	0.5	103	0.5	75	0.5	61	0.6	49	0.6	41	0.6	34	0.7	28	0.7
75	215	0.4	155	0.5	110	0.5	80	0.5	65	0.6	52	0.6	44	0.6	36	0.7	30	0.7
80	228	0.4	164	0.5	116	0.5	85	0.5	69	0.6	55	0.6	47	0.6	39	0.7	32	0.7
90	255	0.4	184	0.5	131	0.5	96	0.5	76	0.6	62	0.6	52	0.6	43	0.7	36	0.7
100	282	0.4	204	0.5	145	0.5	106	0.5	86	0.6	69	0.6	58	0.6	48	0.7	40	0.7
110	309	0.4	223	0.5	158	0.5	116	0.5	94	0.6	76	0.6	64	0.6	53	0.7	44	0.7
120	336	0.4	242	0.5	172	0.5	126	0.5	103	0.6	82	0.6	69	0.6	57	0.7	48	0.7
130	362	0.4	262	0.5	186	0.5	137	0.5	111	0.6	89	0.6	75	0.6	62	0.7	52	0.7
140	388	0.4	281	0.5	200	0.5	147	0.5	119	0.6	95	0.6	81	0.6	67	0.7	56	0.7
150	414	0.4	299	0.5	213	0.5	157	0.5	127	0.6	102	0.6	86	0.6	71	0.7	60	0.7
160	440	0.4	318	0.5	227	0.5	166	0.5	135	0.6	108	0.6	92	0.6	76	0.7	64	0.7
170	466	0.4	337	0.5	240	0.5	176	0.5	143	0.6	115	0.6	97	0.6	80	0.7	67	0.7
180	491	0.4	355	0.5	253	0.5	186	0.5	151	0.6	121	0.6	103	0.6	85	0.7	71	0.7

Q = Flow in Cubic Feet per Second V = Velocity in Feet per Second T = Top Width in Feet

D = Depth in Feet

PARABOLIC STONE CENTER CHANNEL

Velocity, Top Width and Depth

	Grade 6 Percent		Grade 8 Percent		Grade 10 Percent		Grade 12 Percent		Grade 15 Percent	
V	8.0	10	8.0	10.0	8.0	10.0	8.0	10.0	8.0	10.0
D	1.3	1.6	1.1	1.3	1.0	1.2	0.9	1.1	0.8	0.9
Q					Top Widths					
20							5		5	
25					5		6		6	4
30			5		6		7		7	5
35			6		7		8	5	8	6
40	6		7		8	5	9	6	10	7
45	7		8		9	6	10	6	11	7
50	7		9	6	10	7	11	7	12	8
55	8		9	6	11	7	12	8	13	9
60	9		10	7	12	8	13	8	14	9
65	9		11	7	12	9	14	9	16	11
70	10	7	12	8	13	9	15	10	17	11
75	11	7	13	9	14	10	16	10	18	12
80	12	8	14	9	15	10	18	11	19	13
90	13	9	15	10	17	12	20	13	21	15
100	14	10	17	11	19	13	22	14	24	16
110	16	11	19	13	21	14	24	15	26	18
120	17	11	21	14	23	16	26	17	29	20
130	19	12	22	15	25	17	29	18	31	21
140	20	13	24	16	27	18	31	19	33	23
150	22	14	26	17	29	20	33	21	36	24
160	23	15	27	18	31	21	35	22	38	26
170	25	16	29	19	33	22	37	24	40	28
180	26	17	31	20	34	23	39	25	43	29
190	27	18	32	22	36	25	42	26	45	31
200	29	19	34	23	38	26	44	28	47	33
220	32	21	38	25	42	29	48	31	52	38
240	35	23	41	27	46	31	53	33	57	39
260	38	25	44	30	50	34	57	36	62	42
280	40	27	48	32	54	36	61	39	67	45
300	43	29	51	34	57	39	66	42	71	49

REFERENCE

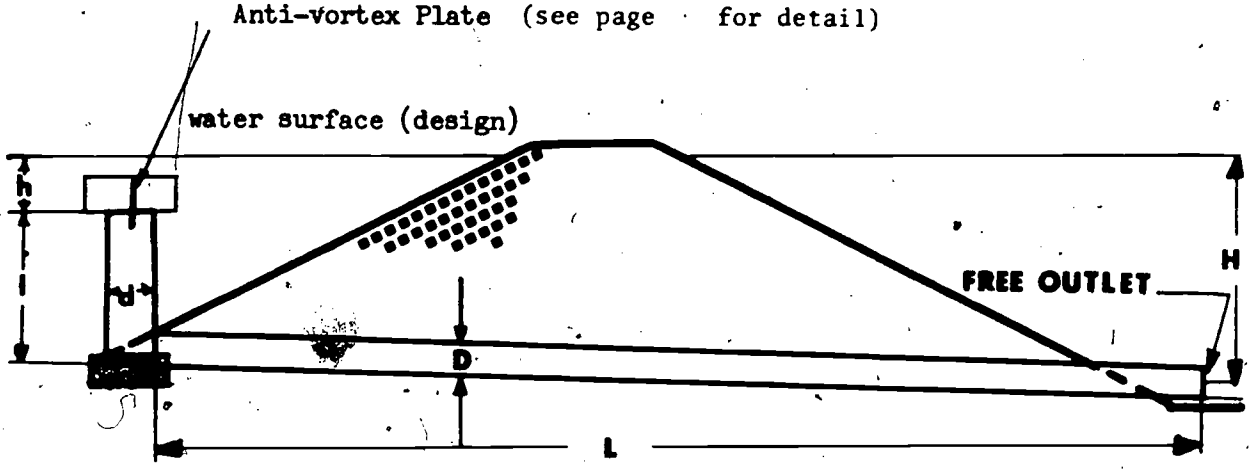
SCS - TP - 61

III-89

Appendix A-2

APPENDIX B

PIPE SPILLWAY DESIGN



H = Head operating pipe spillway (pipe flow) ft.
h = Head operating inlet riser (water flow) ft. h = 1' min.
L = Length of pipe in ft.
l = Length of operating inlet riser.
D = Diameter of pipe conduit
d = Diameter of pipe riser.

Spillway discharge capacities should be reduced 40% if no anti-vortex device is used.

To use charts:

Enter chart, page , or with H. Read discharge under diameter of pipe conduit.

Enter chart, page , with h. Read discharge under diameter of riser. Spillway discharge, Q = smaller of values obtained.

Example

Given: D = 12" CMP
L = 60'
H = 9' to centerline of pipe - Free outlet
h = 1.5'
Find Q of spillway & size of riser
From inlet proportion table on page for 12" pipe use 15" riser
Q pipe = 6.0 cfs x (correction factor) 1.07 = 6.4 cfs from page

Q riser = 11.0 cfs from page > 6.4 cfs
Q ps = 6.4 cfs

Appendix B-2

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

Computed by _____ Date _____

Checked by _____ Date _____

Project _____

Basin # _____ Location _____

Total Drainage Area _____ Acres. Total Disturbed Area _____ Acres.

SEDIMENT STORAGE DESIGN

1. Min. required storage = 0.5 inches x ___ ac. drainage x 1/12= _____ ac.ft.
2. Approx. Vol. of basin = (0.4) (Surface ac.) (Max. depth in ft.)= _____ ac.ft.
3. Excavate _____ c.y. to obtain required capacity.
   Elevation corresponding to scheduled time of clean out _____
   Distance below top of riser _____

DESIGN DATA

Runoff

4. Q_T = CIA = _____ x _____ X _____ = _____ cfs (or other appropriate method)

Pipe Spillway (Q_{ps})

5. Min. pipe spillway capacity, Q_{ps} = 0.21 x _____ D.A. Ac. = _____ cfs
6. Barrel: Diam. _____ inches; Length _____ ft.; Fall _____ ft.
7. Riser: Diam. _____ inches; Length _____ ft.
8. Actual Discharge (from APPENDIX B)
   M = _____ ft. h = _____ ft.
   Q_{ps} = _____ cfs

Emergency Spillway Flow Q_{es}

9. $Q_{es} = Q_T - Q_{ps}$ = _____ - _____ = _____ cfs

Emergency Spillway Design (from APPENDIX B)

10. Width _____ ft. H _____ ft.
    Entrance channel slope _____ %
    Exit channel slope _____ %

DESIGN ELEVATIONS

11. Riser Crest = _____ Design High Water = _____
    Em. Spwy. Crest = _____ Top of Dam = _____

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET
INSTRUCTIONS FOR USE OF FORM

1. Minimum required trap efficiency requires storage of 0.5" of sediment from each acre of drainage. Values larger than 0.5" may be used for greater protection. Compute volume using entire drainage area although only part may be disturbed.

2. Approximate volume of basin is obtained using formula V = 0.4 A d. Volume may be computed from contour information or other suitable methods.

3. If volume of basin is not adequate for required storage, excavate to obtain volume.
   Conversions: 1 ac. ft. = 43,560 cu. ft. = 1,613 c.y.

4. If rational method is used to compute runoff, obtain appropriate values for "I" and "C", depending on watershed conditions during development. The method described in the SCS Engineering Field Manual, Chapter 2, is also an acceptable method for runoff computation.

5. Required discharge from pipe spillway equals 0.21 cfs/ac. times total drainage area. This is equivalent to a uniform runoff of 5 inches per 24 hours. The pipe may be designed to carry Q_T (if site conditions preclude installation of an emergency spillway to protect the structure).

6. Record appropriate sizes.

7. Determine value of "H" from field conditions; "H" is interval between design flow crest and centerline of outlet pipe. "h" is interval between design flow crest and riser crest. Use rating curves to obtain value for Q_{ps} actual.

8. Compute Q_{es} by subtracting actual flow carried by the pipe spillway from the total inflow, Q_T.

9. Use appropriate tables to obtain values of H_p, bottom width, and actual Q_{es}. If no emergency spillway is to be used, so state, giving reason.

10. Fill in design elevations. Emergency spillway crest must be set no lower than value of "h" which causes pipe spillway to carry the minimum required Q. The elevation difference between spillways shall be not less than 1 foot. Design high water is the elevation of the emergency spillway crest plus the value of H_p, or, if there is no emergency spillway, it is the elevation of the riser crest plus h required to handle the ten-year storm. Minimum top of dam elevation requires 1.0 feet of freeboard above design high water.

PIPE FLOW CHART (Full flow assumed)

For Corrugated Metal Pipe Inlet $K_e + K_b = 1.0$ and 70 feet of Corrugated Metal Pipe Conduit n = 0.025. Note correction factors for other pipe lengths.

Dia. / H	12"	15"	18"	21"	24"	30"	36"	42"
2	2.84	4.92	7.73	11.30	15.60	26.60	40.77	58.12
3	3.48	6.03	9.47	13.84	19.10	32.58	49.93	71.19
4	4.02	6.96	10.94	15.98	22.06	37.62	57.66	82.20
5	4.49	7.78	12.23	17.87	24.66	42.06	64.46	91.90
6	4.92	8.52	13.40	19.57	27.01	46.07	70.60	100.65
7	5.32	9.21	14.47	21.14	29.19	49.77	76.28	108.75
8	5.68	9.84	15.47	22.60	31.19	53.19	81.53	116.23
9	6.03	10.44	16.41	23.97	33.09	56.43	86.49	123.30
10	6.36	11.00	17.30	25.26	34.88	59.48	91.16	129.96
11	6.67	11.54	18.14	26.50	36.59	62.39	95.63	136.33
12	6.96	12.05	18.95	27.68	38.21	65.16	99.87	142.37
13	7.25	12.55	19.72	28.81	39.77	67.83	103.96	148.21
14	7.52	13.02	20.47	29.90	41.27	70.39	107.88	153.80
15	7.78	13.48	21.19	30.95	42.72	72.85	111.66	159.18
16	8.04	13.92	21.88	31.96	44.12	75.24	115.32	164.40
17	8.29	14.35	22.55	32.94	45.48	77.55	118.87	169.46
18	8.53	14.77	23.21	33.90	46.80	79.81	122.33	174.39
19	8.76	15.17	23.84	34.83	48.08	81.99	125.67	179.15
20	8.99	15.56	24.46	35.73	49.33	84.12	128.93	183.80
21	9.21	15.95	25.07	36.62	50.55	86.21	132.13	188.36
22	9.43	16.32	25.65	37.47	51.73	88.22	135.21	192.76
23	9.64	16.69	26.23	38.32	52.90	90.21	138.27	197.12
24	9.85	17.05	26.80	39.14	54.04	92.15	141.24	201.35
25	10.05	17.40	27.35	39.95	55.15	94.05	144.15	205.50
L	Correction Factors For Other Pipe Lengths							
40	1.23	1.22	1.20	1.19	1.16	1.14	1.13	1.11
50	1.14	1.13	1.12	1.11	1.10	1.09	1.08	1.07
60	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.03
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97
90	0.90	0.91	0.91	0.92	0.92	0.93	0.94	0.94
100	0.86	0.87	0.88	0.89	0.89	0.90	0.91	0.92

Pipe flow chart for corrugated metal pipe drop inlet spillway

Appendix B-4b

PIPE FLOW CHART (Full Pipe flow assumed)

For R/C Drop Inlet, $K_e + K_b = 0.65$ with 70 feet of R/C conduit, n = .013. Note correction factors for other pipe lengths.

Dia. / H	12"	15"	18"	21"	24"	30"	36"	42"
2	4.54	8.01	11.74	16.60	22.44	36.74	54.65	76.02
3	5.56	9.81	14.39	20.33	27.49	45.00	66.94	93.11
4	6.42	11.33	16.61	23.48	31.74	51.96	77.30	107.52
5	7.18	12.66	18.57	26.25	35.49	58.09	86.42	120.21
6	7.87	13.86	20.34	28.75	38.87	63.63	94.65	131.66
7	8.50	14.98	21.98	31.06	41.99	68.74	102.27	142.25
8	9.08	16.01	23.49	33.20	44.88	73.47	109.30	152.03
9	9.64	17.00	24.92	35.22	47.61	77.94	115.95	161.28
10	10.16	17.91	26.26	37.12	50.18	82.15	122.21	169.99
11	10.65	18.78	27.55	38.94	52.64	86.18	128.20	178.32
12	11.13	19.62	28.77	40.67	54.97	89.99	133.88	186.22
13	11.58	20.42	29.95	42.33	57.23	93.68	139.37	193.86
14	12.01	21.18	31.07	43.93	59.37	97.19	144.59	201.12
15	12.44	21.93	32.17	45.47	61.46	100.62	149.69	208.21
16	12.85	22.65	33.22	46.96	63.48	103.92	154.60	215.04
17	13.24	23.35	34.24	48.40	65.43	107.12	159.35	221.65
18	13.63	24.03	35.24	49.81	67.34	110.23	163.99	228.10
19	14.00	24.68	36.21	51.17	69.18	113.25	168.48	234.34
20	14.36	25.32	37.14	52.50	70.97	116.18	172.84	240.41
21	14.72	25.95	38.07	53.80	72.73	119.07	177.13	246.38
22	15.06	26.56	38.96	55.06	74.43	121.85	181.27	252.13
23	15.40	27.16	39.84	56.31	76.11	124.60	185.36	257.83
24	15.73	27.74	40.69	57.51	77.75	127.28	189.35	263.37
25	16.06	28.32	41.53	58.70	79.35	129.90	193.25	268.80
L	Correction Factors For Other Pipe Lengths							
40	1.15	1.13	1.11	1.09	1.08	1.06	1.06	1.05
50	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03
60	1.04	1.04	1.04	1.03	1.03	1.02	1.02	1.02
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.96	0.96	0.97	0.97	0.98	0.98	0.98	0.99
90	0.93	0.94	0.94	0.95	0.95	0.96	0.97	0.97
100	0.90	0.91	0.92	0.93	0.93	0.95	0.95	0.96

Pipe flow chart for concrete pipe drop inlet spillway

PIPE FLOW CHART FOR SMALL SIZE PIPES

Discharge in C.F.S.

For 70 Feet of Welded Steel Pipe:

Head \ Dia	4"	6"	8"
4	0.42	1.19	2.42
6	0.51	1.45	2.95
8	0.60	1.69	3.42
10	0.66	1.89	3.82
12	0.73	2.06	4.19
14	0.79	2.23	4.52
16	0.84	2.38	4.83
18	0.89	2.53	5.13
20	0.94	2.66	5.40

Correction for Other Pipe Lengths

L	4"	6"	8"
40	1.20	1.19	1.17
50	1.12	1.11	1.10
60	1.06	1.05	1.05
70	1.00	1.00	1.00
80	.94	.95	.95
90	.91	.92	.93
100	.86	.87	.88

For 70 Feet of Corrugated Metal Pipe:

Head \ Dia	4"	6"	8"
4	NOT AVAILABLE	0.67	1.41
6		0.82	1.72
8		0.95	2.00
10		1.06	2.23
12		1.16	2.44
14		1.25	2.64
16		1.33	2.82
18		1.42	3.00
20		1.50	3.16

Correction for Other Pipe Lengths

L	4"	6"	8"
40	NOT AVAILABLE	1.26	1.25
50		1.16	1.15
60		1.08	1.07
70		1.00	1.00
80		0.94	0.94
90		0.89	0.90
100		0.84	0.85

From: Erosion and Sediment Control Technical Handbook,
James River Soil and Water Conservation District

CIRCULAR RISERS WITH SPLITTER WALL

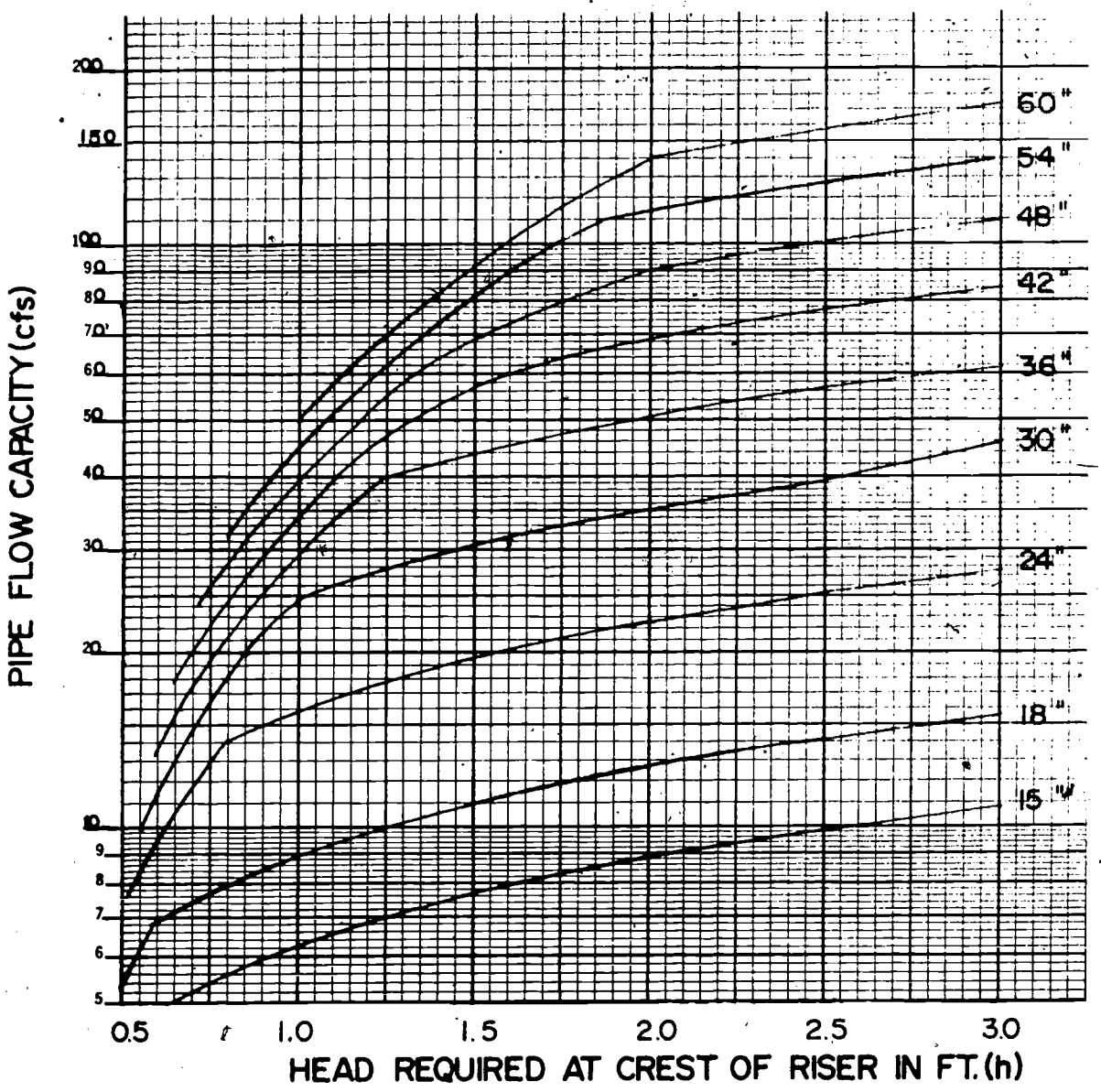
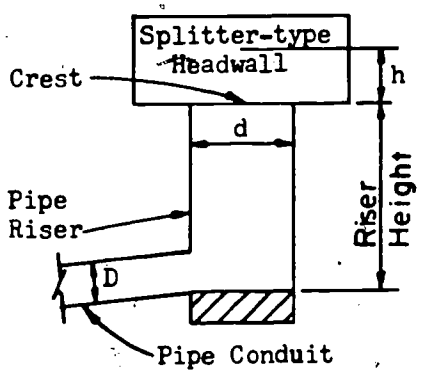
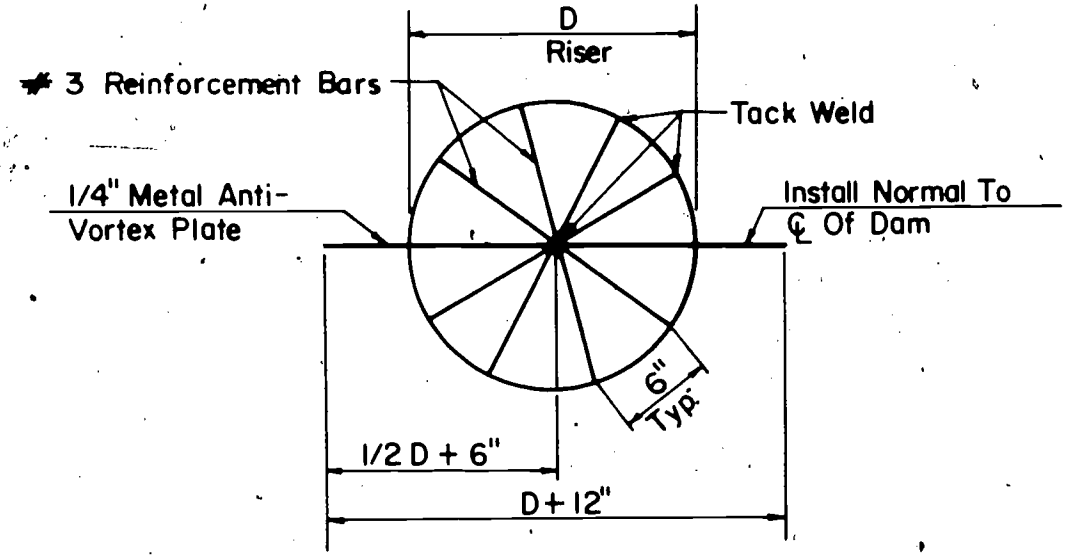


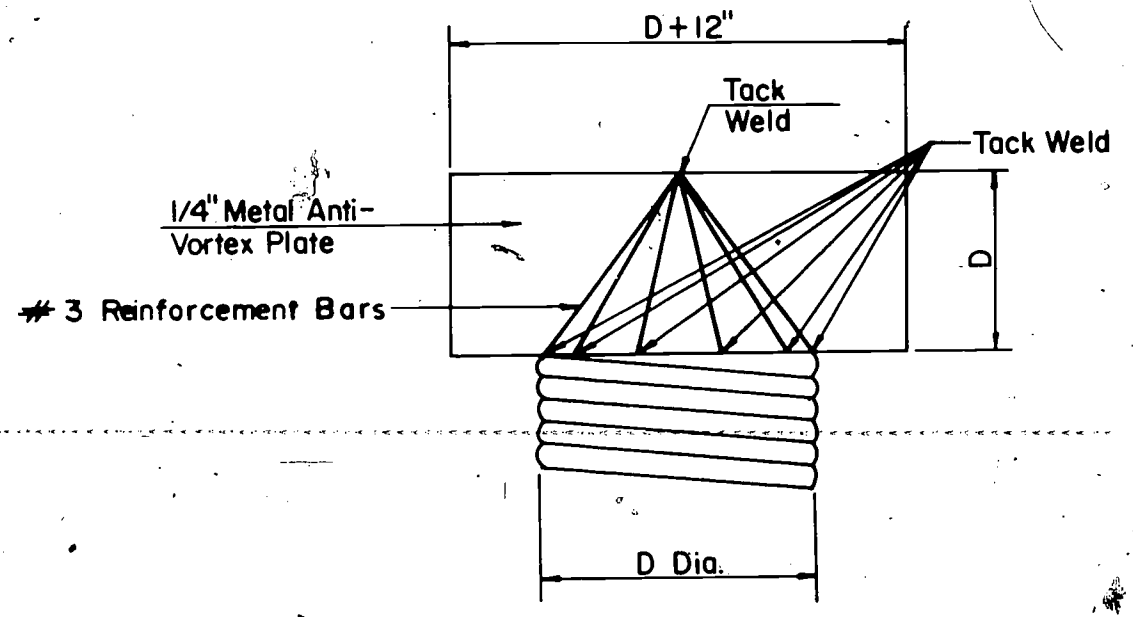
CHART FOR DETERMINING INLET PROPORTIONS

Suggested Inlet Proportions	
Pipe Conduit (D)-in.	Pipe Riser (d)-in.
8-12	15
15	18
18	21
21	24
24	30
30	36
36	48
42	54
48	60



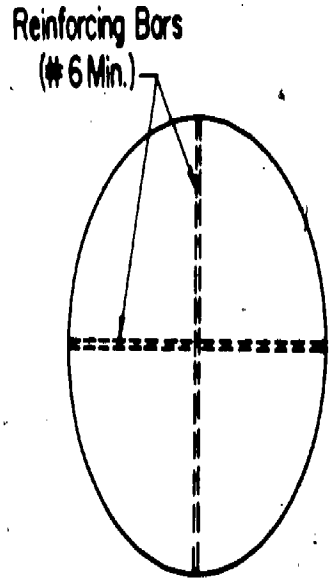


PLAN



SECTION

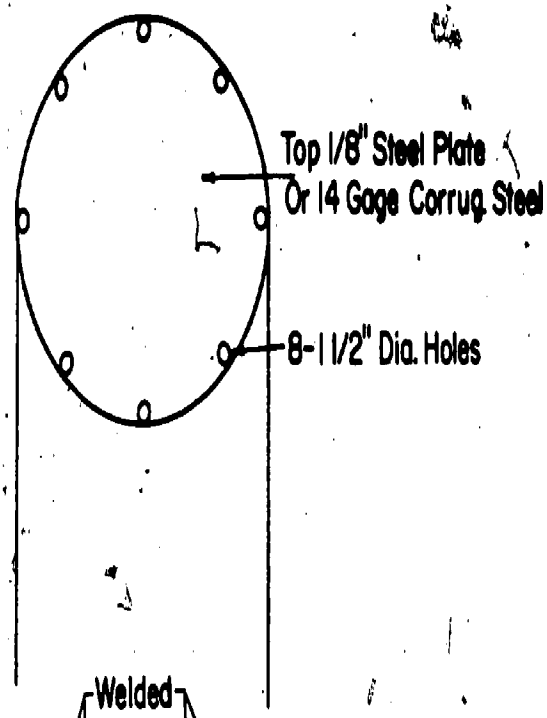
DETAIL OF TRASH RACK AND ANTI-VORTEX DEVICE

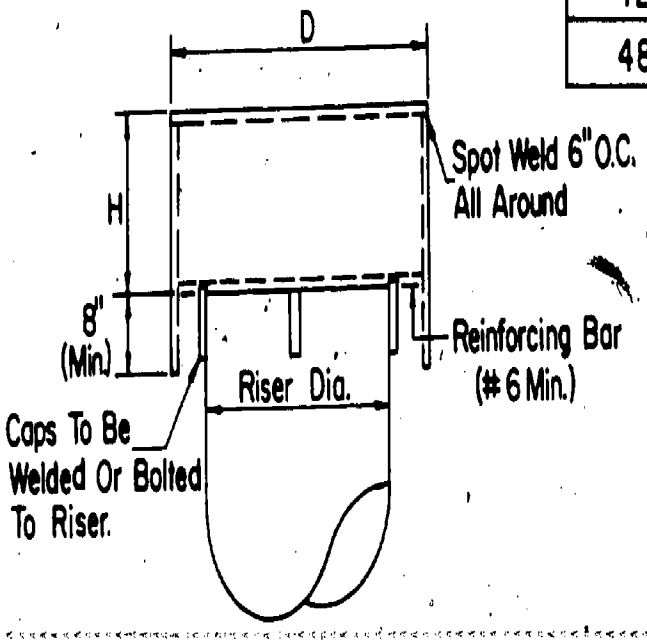


PLAN VIEW

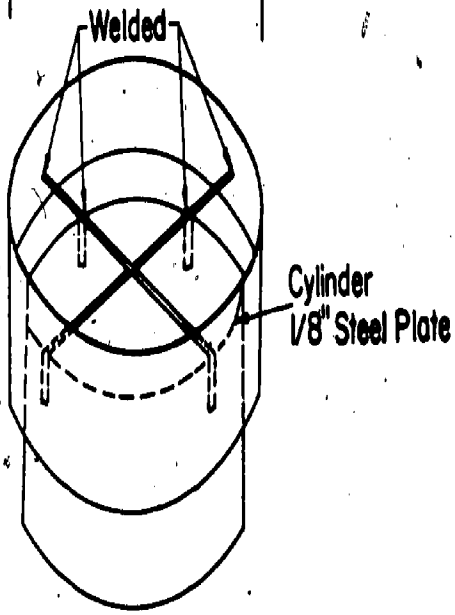
DESIGN TABLE

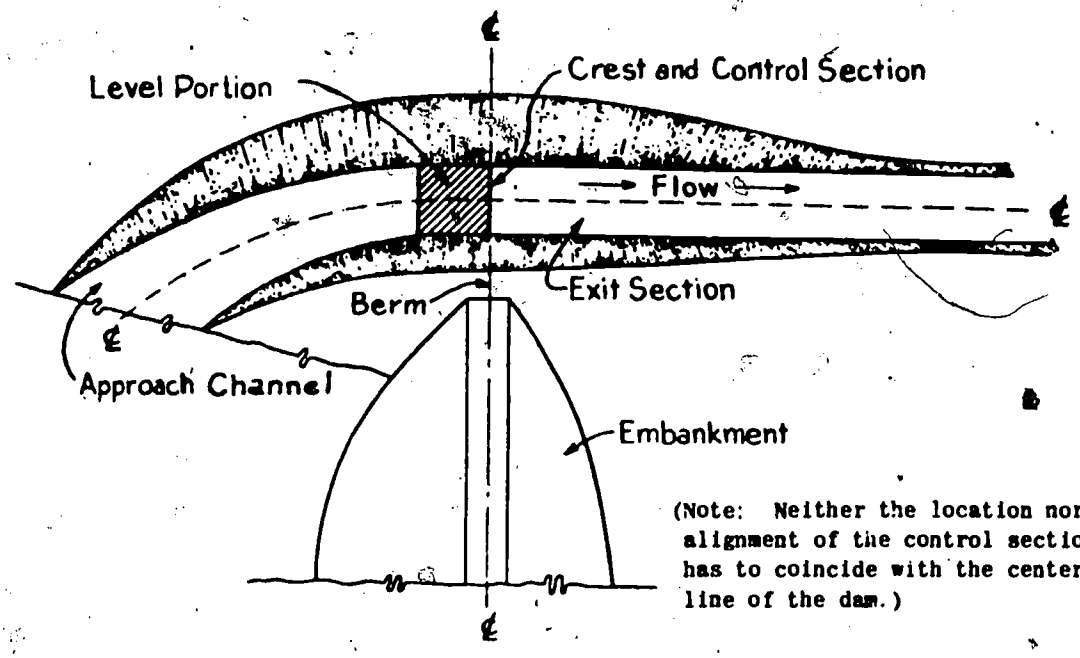
Riser Dia.	D Inch	H Inch
18	27	8
21	30	11
24	36	13
27	42	15
36	54	17
42	60	19
48	68	21



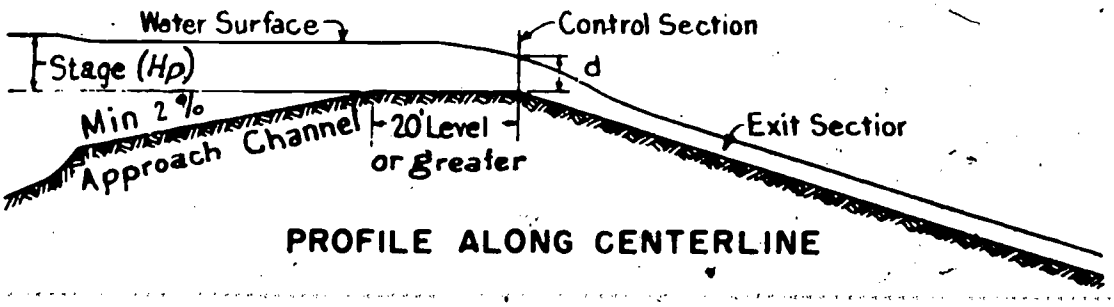


ELEVATION

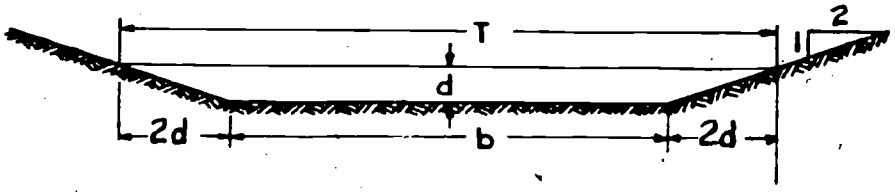




PLAN VIEW OF EXCAVATED EARTH SPILLWAY



PROFILE ALONG CENTERLINE



CROSS-SECTION AT CONTROL SECTION

Profile and cross section of excavated earth spillway.

EARTH SPILLWAY

Discharge Q CFS	Slope Range Minimum Percent	Slope Range Maximum Percent	Bottom Width Feet	Stage Feet
15	3.3	12.2	8	.83
	3.5	16.2	12	.69
20	3.1	8.9	8	.97
	3.2	13.0	12	.81
	3.3	17.3	16	.70
25	2.9	7.1	8	1.09
	3.2	9.9	12	.91
	3.3	13.2	16	.79
	3.3	17.2	20	.70
30	2.9	6.0	8	1.20
	3.0	8.2	12	1.01
	3.0	10.7	16	.88
	3.3	13.8	20	.78
35	2.8	5.1	8	1.30
	2.9	6.9	12	1.10
	3.1	9.0	16	.94
	3.1	11.3	20	.85
	3.2	14.1	24	.77
40	2.7	4.5	8	1.40
	2.9	6.0	12	1.18
	2.9	7.6	16	1.03
	3.1	9.7	20	.91
	3.1	11.9	24	.83
45	2.6	4.1	8	1.49
	2.8	5.3	12	1.25
	2.9	6.7	16	1.09
	3.0	8.4	20	.98
	3.0	10.4	24	.89
50	2.7	3.7	8	1.57
	2.8	4.7	12	1.33
	2.8	6.0	16	1.16
	2.9	7.3	20	1.03
	3.1	9.0	24	.94
60	2.6	3.1	8	1.73
	2.7	3.9	12	1.47
	2.7	4.8	16	1.28
	2.9	5.9	20	1.15
	2.9	7.3	24	1.05
	3.0	8.8	28	.97
70	2.5	2.8	8	1.88
	2.6	3.3	12	1.60
	2.6	4.1	16	1.40
	2.7	5.0	20	1.26
	2.8	6.1	24	1.15
	2.9	7.0	28	1.05
80	2.5	2.9	12	1.72
	2.6	3.6	16	1.51
	2.7	4.3	20	1.35

Discharge Q CFS	Slope Range Minimum Percent	Slope Range Maximum Percent	Bottom Width Feet	Stage Feet
80	2.8	5.2	24	1.24
	2.8	5.9	28	1.14
	2.9	7.0	32	1.06
90	2.5	2.6	12	1.84
	2.5	3.1	16	1.61
	2.6	3.8	20	1.45
	2.7	4.5	24	1.32
	2.8	5.3	28	1.22
	2.8	6.1	32	1.14
100	2.5	2.8	16	1.71
	2.6	3.3	20	1.54
	2.6	4.0	24	1.41
	2.7	4.8	28	1.30
	2.7	5.3	32	1.21
	2.8	6.1	36	1.13
120	2.5	2.8	20	1.71
	2.6	3.2	24	1.56
	2.7	3.8	28	1.44
	2.7	4.2	32	1.34
	2.7	4.8	36	1.26
140	2.5	2.7	24	1.71
	2.5	3.2	28	1.56
	2.6	3.6	32	1.47
	2.6	4.0	36	1.38
	2.7	4.5	40	1.30
160	2.5	2.7	28	1.70
	2.5	3.1	32	1.56
	2.6	3.4	36	1.49
	2.6	3.8	40	1.40
	2.7	4.3	44	1.33
180	2.4	2.7	32	1.72
	2.4	3.0	36	1.60
	2.5	3.4	40	1.51
	2.6	3.7	44	1.43
200	2.5	2.7	36	1.70
	2.5	2.9	40	1.60
	2.5	3.3	44	1.52
	2.6	3.6	48	1.45
220	2.4	2.6	40	1.70
	2.5	2.9	44	1.61
	2.5	3.2	48	1.53
240	2.5	2.6	44	1.70
	2.5	2.9	48	1.62
	2.6	3.2	52	1.54
260	2.4	2.6	48	1.70
	2.5	2.9	52	1.62
280	2.4	2.6	52	1.70
300	2.5	2.6	56	1.69

Example of Use

Given: Discharge, Q=87 c.f.s. Spillway Slope, Exit section (from profile)= 4%.

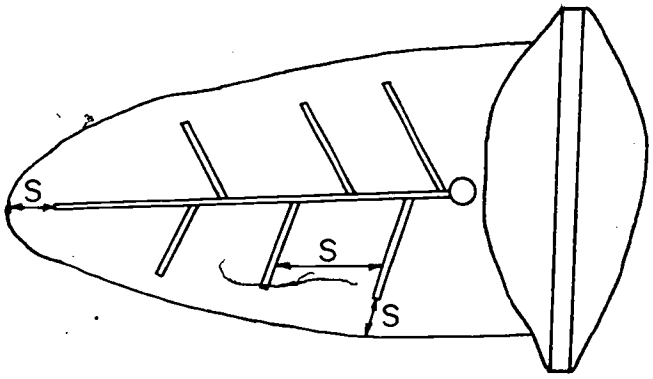
Find: Bottom Width and Stage in Reservoir.

Procedure: Enter table from left at 90 c.f.s. Note that spillway slope (4%) falls within slope ranges corresponding to bottom widths of 24, 28, and 32 feet. Use narrower bottom width, 24 feet, to minimize meandering. Stage in Reservoir will be 1.32 feet.

Note: Computations based on: Roughness coefficient, n=.040.
Maximum velocity=5.50 ft. per sec.

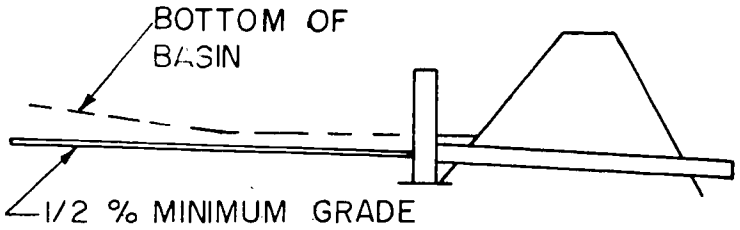
DESIGN TABLE FOR VEGETATED SPILLWAYS

PLAN VIEW

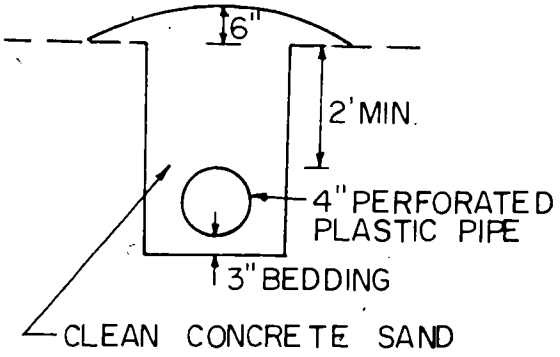


NOTE: MINIMUM S = 15'

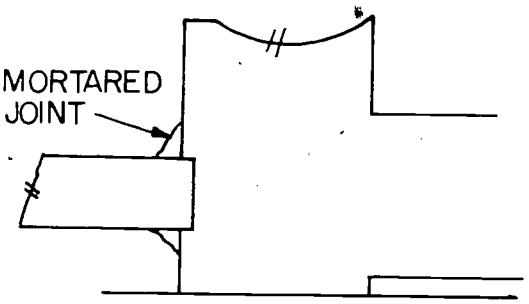
PROFILE



CROSS SECTION



RISER CONNECTION



VIRGINIA	DRAINING SEDIMENT WITH TILE	STANDARD DRAWING
		B - 10

APPENDIX C

DRAIN CHART - CORRUGATED PLASTIC DRAIN TUBING

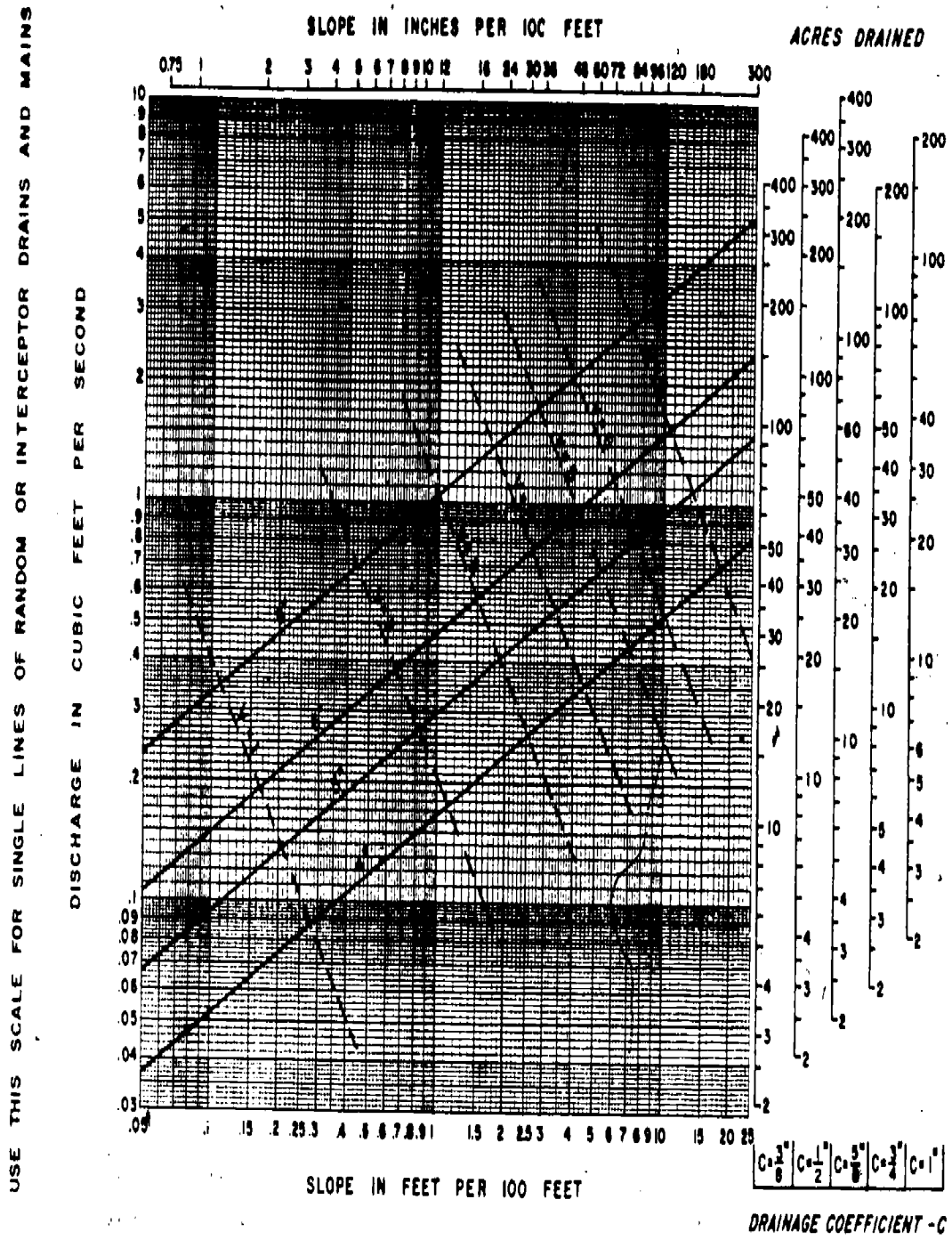


Exhibit 14-11.2

REFERENCE
DISCHARGE BASED ON
$V = 99 R^{2/3} s^{1/2}$
PIPE FLOWING FULL, MANNING N=0.015

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
VIRGINIA

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Appendix C-1

DRAIN CHART - CLAY, CONCRETE TILE AND BITUMINIZED FIBER PIPE

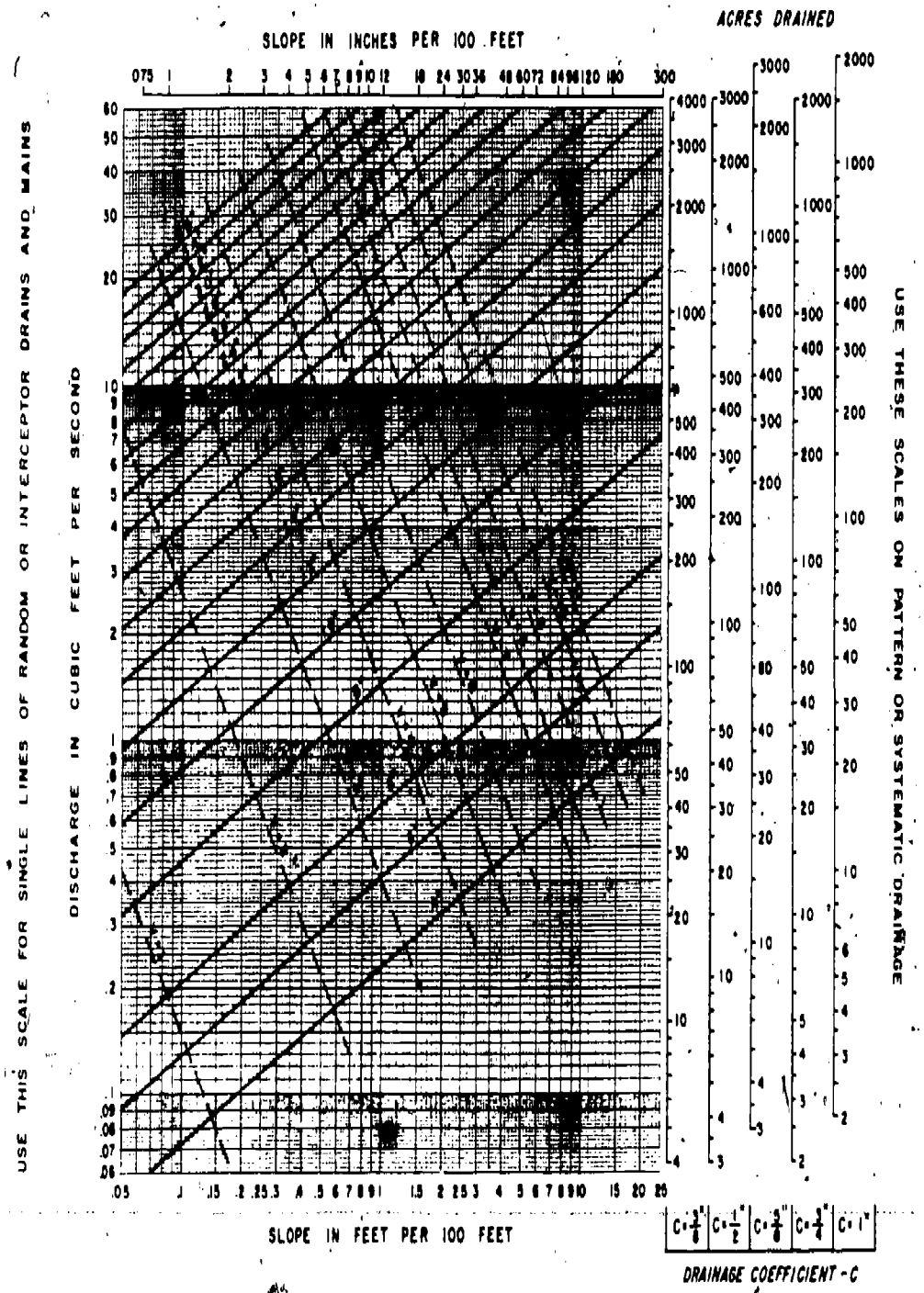


Exhibit 14-11.1

REFERENCE
DISCHARGE BASED ON
$V = 1.38 R^{2/3} S^{1/2}$
PIPE FLOWING FULL, MANNING N = 0.011

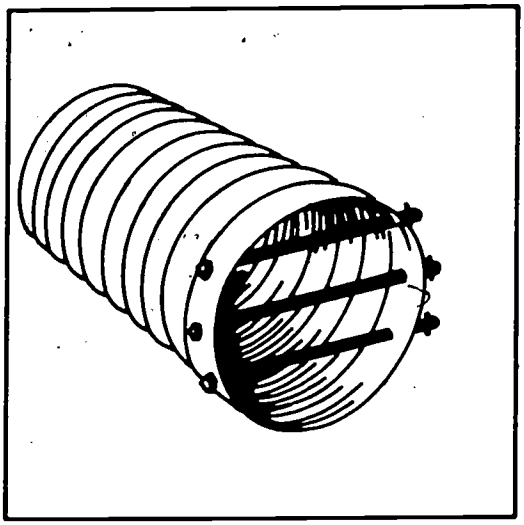
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
VIRGINIA

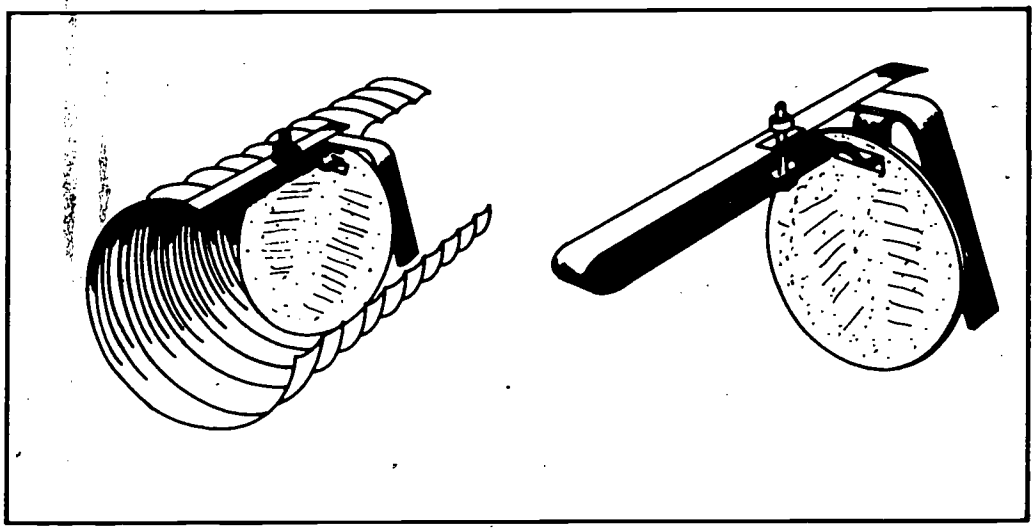
Size in.	Crushing Strength lbs/lin.ft	Width of Trench - Inches								
		14	16	18	20	22	24	26	28	30
4	800	*Inf.	13.5	10.5	10.5	10.5	10.5	10,5	10.5	10.5
	1100	"	Inf.	Inf.	12.5	12.5	12.5	12.5	12.5	12.5
5	800	"	16.5	8.5	7.5	7.5	7.5	7.5	7.5	7.5
	1100	"	Inf.	Inf.	12.0	9.5	9.5	9.5	9.5	9.5
6	800	"	"	8.5	6.5	6.5	6.5	6.5	6.5	6.5
	1100	"	"	Inf.	12.5	8.5	8.5	8.5	8.5	8.5
8	800	"	"	9.0	7.0	6.0	5.5	5.5	5.5	5.5
	1100	"	"	Inf.	12.5	9.0	7.5	7.0	7.0	7.0
10	800	"	"	9.0	7.0	6.0	5.5	5.0	5.0	5.0
	1100	"	"	Inf.	12.5	9.0	7.5	6.5	6.0	6.0
12	800	"	"	9.5	7.5	6.0	5.5	5.0	4.5	4.5
	1100	"	"	Inf.	13.0	9.0	7.5	7.0	6.0	5.5
15	870				8.5	7.0	6.5	6.0	5.0	5.0
	1100				13.0	9.5	8.0	7.0	6.5	6.0
18	930						7.0	6.5	6.0	5.5
	1200						9.5	8.5	7.5	7.0

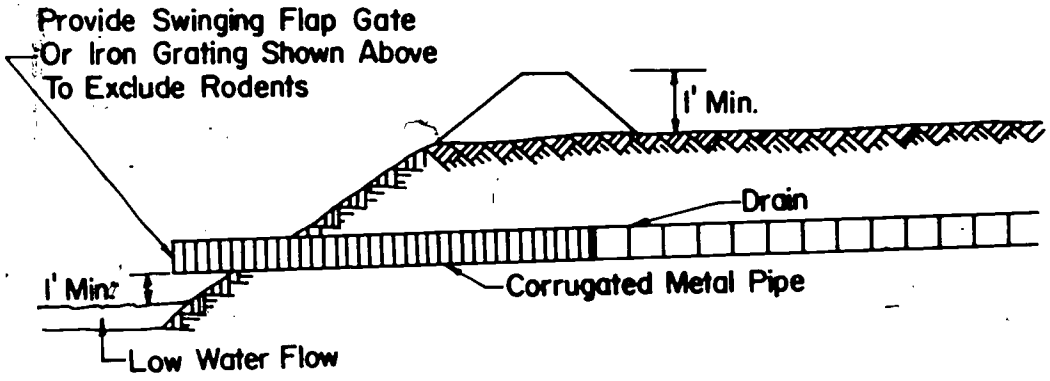
* Inf. = infinity

1/ Reference: Based on Marston's formula.
Soil - 120# w/ft.

Maximum Allowable Trench Depth in Feet for concrete or tile drains with varying widths of trench based on ordinary bedding 1/







CORRUGATED PIPE OUTLET

STANDARDS AND SPECIFICATIONS
FOR
VEGETATIVE PRACTICES

TABLE OF CONTENTS

STANDARD AND SPECIFICATIONS
FOR
DISTURBED AREA STABILIZATION
(With Mulching Only)

Definition

Applying plant residues or other suitable materials, not produced on the site, to the surface of the soil.

Purpose

To reduce runoff and erosion.

Conditions Where Practice Applies

On graded or cleared areas (not to finished condition) which are subject to erosion for 6 months or less; where seedings may not have a suitable growing season to produce an erosion retardant cover, but which can be stabilized with a mulch cover.

SPECIFICATIONS

Site Preparation

Prior to mulching, install needed erosion control practices such as diversions, grade stabilization structures, berms, dikes, level spreaders, sodded waterways, and debris basins.

Final grading is not required prior to mulching. However, mulching may be applied after final grade is reached.

Mulching

Mulching materials shall be unrotted small grain straw applied at the rate of 1 1/2 to 2 tons per acre, or 70 to 90 pounds per 1,000 sq. ft. Mulch materials shall be relatively free of all kinds of weeds and shall be free of prohibited noxious weeds. Other mulch materials may be used such as wood chips 3/4 - 1 1/2" in diameter, 50 to 70 cu. yds. per acre, or 1/2 to 1 1/2" deep.

Spread uniformly by hand or mechanically. For uniform distribution of hand spread mulch, divide area into approximately 1,000 sq. ft. sections and place 70-90 lbs. of mulch in each section.

Mulch anchoring shall be accomplished immediately after mulch placement to minimize loss by wind or water. This may be done by one of the following methods, depending upon size of area, erosion

hazard, and cost. On sloping land, practice No. 3 below should be done on the contour wherever possible.

1. Peg and Twine. Drive 8- to 10-inch wooden pegs to within 2 to 3 inches of the soil surface every 4 feet in all directions. Stakes may be driven before or after applying mulch. Secure mulch to soil surface by stretching twine between pegs in a criss-cross within a square pattern. Secure twine with two or more turns around each peg.

2. Mulch Nettings. Staple lightweight biodegradable paper, plastic or cotton nettings, over the mulch according to manufacturer's recommendations. Netting is usually available in rolls 4 feet wide and up to 300 feet long.

3. Mulch Anchoring Tool. This is a tractor-drawn implement designed to punch and anchor mulch into the surface 2 inches of soil. This practice affords maximum erosion control but is limited to flatter slopes where equipment can operate safely.

4. Liquid Mulch Binders

Applications of liquid binders should be heavier at edges where wind catches mulch in valleys and at crests of banks. Remainder of area should be uniform in appearance. Caution should be used with asphalt in residential and similar areas.

a. Cutback asphalt - rapid curing (RC-70, RC-250, RC-800) or medium curing (MC-250 or MC-800). Apply 5 gallons per 1,000 square feet, or 200 gallons per acre on flat areas and on slopes 1:1 to 2:1 and less than 8 feet high. On slopes 8 feet or more high, use 8 gallons per 1,000 sq. ft. or 348 gallons per acre.

b. Emulsified asphalt (SS1, CSS-1, CMS-2, MS-2, RS-1, RS-2 CRS-1, and CRS-2). Apply 5 gallons per 1,000 sq. ft. or 200 gallons per acre on flat areas and on slopes 1:1 to 2:1 and less than 8 feet high. On slopes 8 ft. or more high, use 8 gallons per 1,000 square feet or 348 gallons per acre.
All asphalt designations are from the Asphalt Institute Specifications.

c. Synthetic binders - Synthetic binders such as Curasol, DCA-70 Petroset and Terra Tack may be used at rates recommended by the manufacturer to anchor mulch material. Due to cost, these are usually used on small areas or in residential areas.

NOTE: All names given above are registered trade names. This does not constitute a recommendation of these products to the exclusion of other products.

****

STANDARD AND SPECIFICATIONS
FOR
DISTURBED AREA STABILIZATION
(With Temporary Seeding)

Definition

Planting short-term vegetation on disturbed areas.

Purpose

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

Conditions Where Practice Applies

On graded or cleared areas which are subject to erosion for a year or less; where permanent structures are to be installed or extensive grading of the area will be done prior to establishment of permanent vegetation.

SPECIFICATIONS

Site Preparation

Prior to seeding, install needed erosion control practices such as diversions, grade stabilization structures, berms, dikes, level spreaders, sodded waterways, and debris basins.

Final grading and shaping usually has not been completed prior to temporary seeding.

Soil Amendments

For temporary seedings, fertilizer shall be applied at the rate of 600 lbs/ac. (15 lbs/1000 sq. ft.), using 10-20-10 or equivalent. Soils which are highly acid should be limed according to soil tests. Work lime and fertilizer into soil during seedbed preparation.

Seedbed Preparation

When the area to be seeded has been recently loosened to the extent that an adequate seedbed exists, no additional treatment is required.

However, when the area to be seeded is packed, crusted, and hard, the top layer of soil shall be loosened by discing, raking, or other acceptable means before seeding.

Seeding

Select a mixture from Table 1.

Apply seed uniformly with a cyclone seeder, drill, cultipacker seeder or hydroseeder (slurry includes seed and fertilizer).

Mulching

When seedings are made on critical sites or adverse soil conditions, or other than optimum seeding dates (see table 1), mulch material will be applied immediately after seeding. Seedings made during optimum seeding dates and with favorable soils and site conditions will not need to be mulched. Existing conditions at each site will indicate mulching needs.

Mulch materials shall be unrotted small grain straw applied at the rate of 1 1/2 to 2 tons per acre, or 70 to 90 pounds per 1,000 sq. ft. Mulch materials will be relatively free of all kinds of weeds and shall be free of prohibited noxious weeds.

Other types of mulches may be used such as wood chips 3/4--1 1/2" in diameter at the rate of 50 to 70 cu. yds. per acre, or 1/2 to 1 1/2" deep.

Spread uniformly by hand or mechanically. For uniform distribution of hand spread mulch, divide area into approximately 1,000 sq. ft. sections and place 70-90 lbs. of mulch in each section.

Mulch anchoring shall be accomplished immediately after mulch placement to minimize loss by wind or water. This may be done by one of the following methods, depending upon size of area, erosion hazard, and cost. On sloping land, practice No. 3 below should be done on the contour whenever possible.

1. Peg and Twine. Drive 8- to 10-inch wooden pegs to within 2 to 3 inches of the soil surface every 4 feet in all directions. Stakes may be driven before or after applying mulch. Secure mulch to soil surface by stretching twine between pegs in a criss-cross within a square pattern. Secure twine with two or more turns around each peg.

2. Mulch Nettings. Staple lightweight biodegradable paper, plastic or cotton nettings over the mulch according to manufacturer's recommendations. Netting is usually available in rolls 4 feet wide and up to 300 feet long.

3. Mulch Anchoring Tool. A tractor-drawn implement designed to punch and anchor mulch into the surface 2 inches of soil.

This practice affords maximum erosion control, but its use is limited to slopes upon which the equipment can operate safely.

4. Liquid Mulch Binders. Use one of the following binders.

Applications of liquid binders should be heavier at edges, in valleys, and at crests of banks. Remainder of area should be uniform in appearance. Caution should be exercised in using asphalt in residential or similar areas.

a. Cutback asphalt - rapid curing (RC-70, RC-250 and RC-800) or medium curing (MC-250 or MC-800). Apply 5 gallons per 1,000 sq. ft. or 200 gallons per acre on flat areas and on slopes 1:1 to 2:1 and less than 8 feet high. On slopes 8 feet or more high, use 8 gallons per 1,000 square feet or 348 gallons per acre.

b. Emulsified asphalt (SS-1, CMS-2, MS-2, RS-1, RS-2, CRS-1 and CRS-2). Apply 5 gallons per 1,000 square feet or 200 gallons per acre on flat areas and on slopes 1:1 to 2:1 and less than 8 feet high. On slopes 8 feet or more high, use 8 gallons per 1,000 square feet or 348 gallons per acre.

All asphalt designations are from the Asphalt Institute specifications.

c. Synthetic binders. Synthetic binders such as Curasol, DCA-70, Petroset and Terra Tack may be used at rates recommended by the manufacturer to anchor mulch material.

Due to the expense involved, these binders are usually used on small areas or in residential areas where asphalt cannot be used.

NOTE: All names given above are registered trade names. This does not constitute a recommendation of these products to the exclusion of other products.

TABLE 1

TEMPORARY SEEDING BY RATES, DEPTHS AND DATES				NORTHERN PIEDMONT & MTNS. AND VALLEYS			SOUTHERN PIEDMONT & COASTAL PLAIN		
Species 3/	Seeding Rate Per Acre	Lbs./1000 Sq. Ft.	Planting Depth 2/ (Inches)	Seeding Dates 6/ Mar.1- Apr.30	May 1- Aug.14	Aug. 15- Nov. 1	Seeding Dates 6/ Feb.15- Apr.30	May 1- Sept.1	Sept.1- Nov. 15
CHOOSE ONE:									
Barley	72 lbs.	2 lbs. 13 oz.	1-2	X5/	-	By 10/15	X	-	By 11/1
Oats	96 lbs.	2 lbs. 2 oz.		X	-	-	X	-	-
Rye 1/	140 lbs.	3 lbs. 5 oz.		X	-	X	X	-	X
Italian ryegrass 1/	40 lbs.	13 oz.	1/4 - 1/2	X5/	-	By 11/1	X	-	By 11/15
Millet	40 lbs.	13 oz.	1-2	-	X	-	-	X	-
Weeping lovegrass	3 lbs.	1 oz.	1/4 - 1/2	-	Begin June 1 X	-	-	Begin May 15 X	-
Sudangrass	30 lbs.	11 oz.	1-2	-	X	-	-	X	-

1/ Use only on areas where seed stalks and volunteer growth are acceptable.
2/ Applicable on slopes 3:1 or less.
3/ Use varieties currently recommended for Virginia. Use certified seed when available.
4/ Use common sudangrass varieties only. Do not use hybrids.
5/ Twenty pounds per acre of annual lespedeza may be substituted for 1/2 the seeding rate of any species used for spring seedings.
6/ From November 15 to March 1, use only mulching or sodding practices.

X Applicable during entire period.

- Not applicable in period.

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STANDARD AND SPECIFICATIONS
FOR
TOPSOILING
DISTURBED AREAS

Definition

Obtaining topsoil from other places and spreading it over the area to be stabilized.

Purpose

To provide a suitable soil medium for vegetative growth on areas where other measures will not produce or maintain a stand of desirable vegetation.

Conditions Where Practice Applies

This practice is recommended for sites of 2:1 or flatter slopes where:

- The texture of the exposed subsoil or parent material is not suitable to produce adequate vegetative growth.
- The soil material is so shallow that the rooting zone is not deep enough to support plants and furnish continuing supplies of moisture and plant food.
- The soil to be vegetated contains material toxic to plant growth.

SPECIFICATIONS

Site Preparation (Where topsoil is to be added)

- Topsoiling. When topsoiling, maintain needed erosion control practices such as diversions, grade stabilization structures, berms, dikes, level spreaders, waterways and sediment basins.
- Grading. Grades on the areas to be topsoiled which have been previously established shall be maintained.
- Liming. Where the pH of the subsoil is 5.0 or less or composed of heavy clays, agricultural limestone shall be spread at the rate of 100 pounds per 1,000 square feet. Lime shall be distributed uniformly over designated areas and worked into the soil in conjunction with tillage operations as described in the following procedure.
- Bonding. Use one of the following methods to insure bonding of topsoil and subsoil:

  1. Tilling. After the areas to be topsoiled have been brought to grade, and immediately prior to dumping and spreading the topsoil, the subgrade shall be loosened by discing or by scarifying to

a depth of at least 2 inches to permit bonding of the topsoil to the subsoil.

2. Tracking. Is the passing of bulldozer tracks vertically or diagonally over the entire surface area of a slope.

Topsoil Material and Application

Note: Topsoil salvaged from the existing site may often be used but it should meet the same standards as set forth in these specifications. Field analysis for textural classification of topsoil will normally be acceptable unless other means of analysis is required by the appropriate plan approving authority.

Materials. Topsoil may be stockpiled. Topsoil may be salvaged from the project area or it may be furnished from sources outside the project area. Topsoil shall be the original top layer of a soil profile formed under natural conditions, technically defined as the "A" horizon by the Soil Conservation Society of America. It shall consist of a natural friable loam, sandy loam, silt loam, sandy clay loam or other soil texture (see chart 2) as approved. It shall be reasonably free of refuse, noxious weeds, subsoil, stiff clay, hard lumps, stumps, roots, brush, stones or other litter or similar objects larger than 1 1/2 inches in diameter. It shall have demonstrated by evidence of healthy vegetation growing or having grown on it, prior to stripping, that it is reasonably well-drained and does not contain substances toxic to plant life.

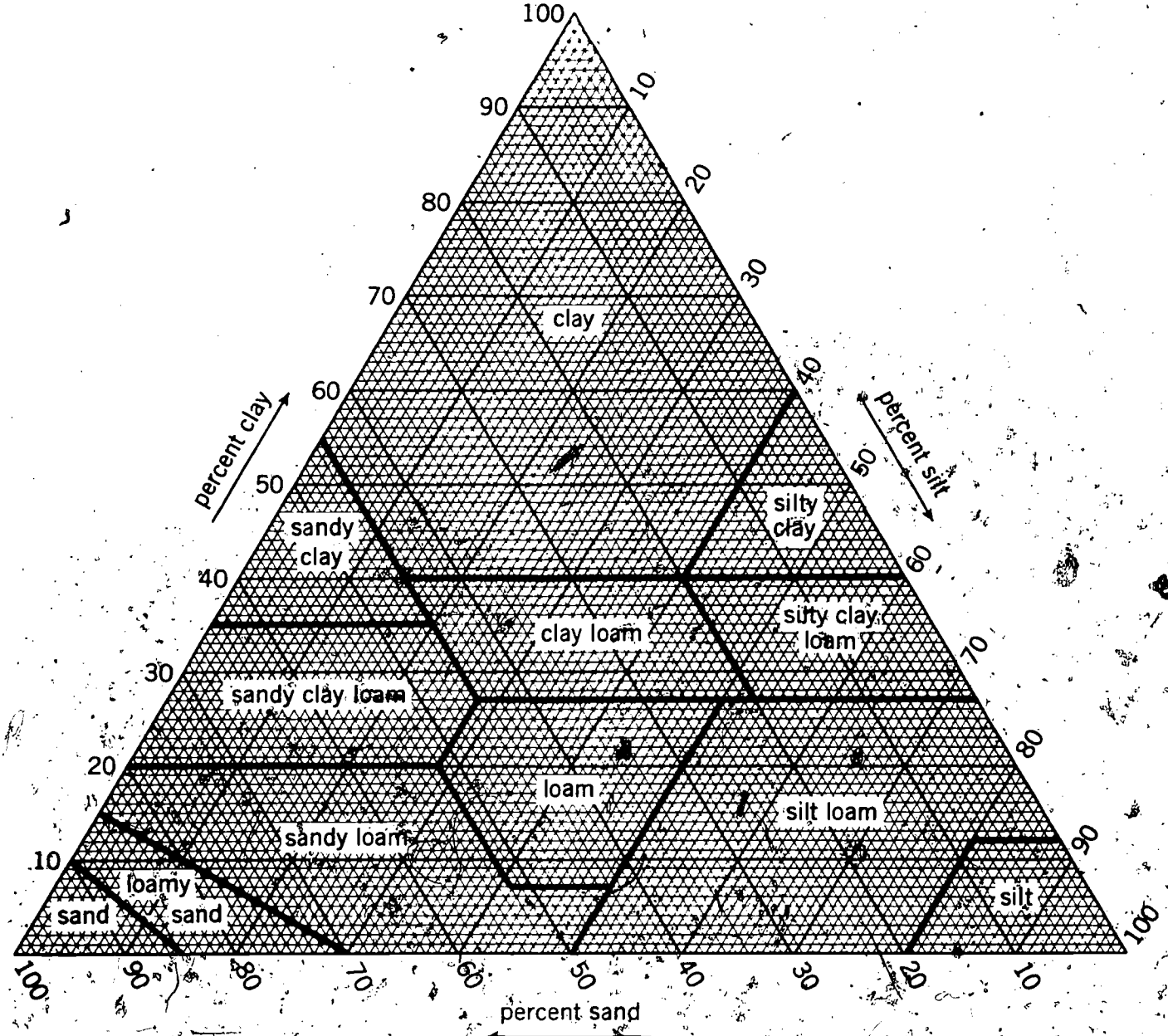
Testing of topsoil that is from an unknown or questionable source by a recognized laboratory for residual organic content of not less than 1.5 percent by weight is required. If pH value is less than 6.0, lime shall be applied and incorporated with the topsoil to adjust the pH to 6.5 or higher. Topsoil containing soluble salts greater than 500 parts per million shall not be used.

No sod or seed shall be placed on soil which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials.

Grading. The topsoil shall be evenly distributed and shall be a minimum depth of 2 inches on 3:1 or steeper slopes and 4 inches on flatter slopes. Spreading shall be performed in such a manner that sodding or seeding can proceed with a minimum of additional soil preparation and tillage. Any irregularities in the surface resulting from topsoiling or other operations shall be corrected in order to prevent the formation of depressions or water pockets. Topsoil shall not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or in a condition that may otherwise be detrimental to proper grading, proposed sodding or seeding.

GUIDE FOR TEXTURAL CLASSIFICATION

May 1, 1950



STANDARD AND SPECIFICATIONS
FOR
DISTURBED AREA STABILIZATION
(With Permanent Seedings)

Definition

Planting vegetation such as grasses and legumes on disturbed areas.

Purpose

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

Conditions Where Practice Applies

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

SPECIFICATIONS

Vegetation cannot be expected to provide an erosion control cover and prevent soil slippage on a soil that is not stable due to its texture, structure, water movement or excessive slope.

Minimum soil conditions needed for the establishment and maintenance of a long-lived vegetative cover:

1. Enough fine-grained materials to provide the capacity to hold at least a moderate amount of available moisture. Excessively porous sands which have moisture supplies consistently too low for growth of plants cannot be maintained in good cover regardless of other soil factors.
2. Sufficient pore space to permit adequate root penetration.
3. The soil shall be free from any material harmful to plant growth.
4. If these minimum conditions cannot be met, see standard and specifications for topsoiling disturbed areas.

Site Preparation

Install needed erosion control practices such as interceptor ditches, berms and terraces, contour ripping, erosion stops, channel liners and debris basins.

Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, seeding, mulch application, anchoring and maintenance.

Seedbed Preparation

Flat areas and slopes up to 3 to 1 grade shall be loose and friable to a depth of at least (3) inches. The top layer of soil shall be loosened by raking, discing or other acceptable means before seeding.

Slopes of greater than 3 to 1 grade shall have the top 1-3 inches of soil loose and friable before seeding.

Soil Amendments

Apply lime and fertilize according to soil tests.

In lieu of soil test results, apply (2) tons ground agricultural limestone and 600 pounds 0-20-20, or equivalent per acre before seeding. Harrow or disc lime and 0-20-20, or equivalent fertilizer, uniformly into the soil to minimum depth of (3) inches on slopes less than 3 to 1. On slopes of greater than 3 to 1 grade, the lime and fertilizer shall be worked in as directed. On sloping land, final tillage operations should be on the contour wherever feasible. No attempt should be made to drag any disced area to make the soil surface very smooth after discing. At time of seeding apply 400 pounds 38-0-0 ureaform fertilizer and 500 pounds 10-20-20, or equivalent fertilizer per acre. Incorporate into soil on slopes less than 3:1.

Seeding

Select a mixture from table 1.

Apply seed uniformly on seedbed with a cyclone seeder, drill, cultipacker seeder or hydroseeder (slurry includes seed and fertilizer) on a firm, moist seedbed. Maximum seeding depth should be 1/4 inch on clayey soils and 1/2 inch on sandy soils, when using other than hydroseeder method of application.

Mulching

Mulch materials shall be applied immediately after seeding. They shall be unrotted small grain straw applied at the rate of 1 1/2 to 2 tons per acre (70 to 90 pounds per 1,000 sq. ft.). Mulch materials shall be relatively free of all kinds of weeds and shall be free of prohibited noxious weeds. Other mulch materials may be used, i.e. -- wood chips 3/4 to 1 1/2" in diameter at the rate of 50 to 70 cu. yds. per acre or 1/2 to 1 1/2 inches deep.

Spread uniformly by hand or mechanically. For uniform distribution of hand spread mulch, divide area into approximately 1,000 sq. ft. sections and place 70 to 90 pounds of mulch in each section.

Mulch anchoring shall be accomplished immediately after mulch placement to minimize loss by wind or water. This may be done by one of the following methods, depending upon size of area, erosion hazard, and cost. On sloping land, practice Number 3 below should be done on the contour wherever possible. Use one of the following:

1. Peg and Twine. Drive 8- to 10-inch wooden pegs into within 2 to 3 inches of the soil surface every (4) feet in all directions. Stakes may be driven before or after applying mulch. Secure mulch to soil surface by stretching twine between pegs in a criss-cross within a square pattern.

2. Mulch Netting. Staple lightweight biodegradable paper, plastic or cotton nettings, over the mulch according to manufacturer's recommendations. Netting is usually available in rolls 4 feet wide and up to 300 feet long.

3. Mulch Anchoring Tool. A tractor-drawn implement designed to punch and anchor mulch into the surface (2) inches of soil. This practice affords mulch erosion control, but its use is limited to slopes upon which the equipment can operate safely.

4. Liquid Mulch Binders. Applications of liquid binders should be heavier at edges, in valleys, and at crests of banks. Remainder of area should be uniform in appearance. Caution should be exercised in using asphalt in residential or similar areas. Use one of the following:

   a. Cutback asphalt - rapid curing (RC-70, RC-250 and RC-800) or medium curing (MC-250 or MC-800). Apply 5 gallons per 1,000 sq. ft. or 200 gallons per acre on flat areas, and on slopes 1:1 to 2:1 and less than 8 feet high. On slopes 8 feet or more high, use 8 gallons per 1,000 square feet or 348 gallons per acre.

   b. Emulsified asphalt (SS-1, CSS-1, CMS-2, MS-2, RS-1, RS-2, CRS-1 and CRS-2). Apply 5 gallons per 1,000 square feet or 200 gallons per acre on flat areas and on slopes 1:1 to 2:1 and less than 8 feet high. On slopes 8 feet or more high, use 8 gallons per 1,000 square feet or 348 gallons per acre.

   All asphalt designations are from the Asphalt Institute specifications.

c. Synthetic binders. Synthetic binders such as Curasol, DCA-70, Petroset and Terra Tack may be used at rates recommended by the manufacturer to anchor mulch material. Due to the expense, these binders are usually used on small areas or in residential areas where asphalt cannot be used.

NOTE: All names given above are registered trade names. This does not constitute a recommendation of these products to the exclusion of other products.

Maintenance

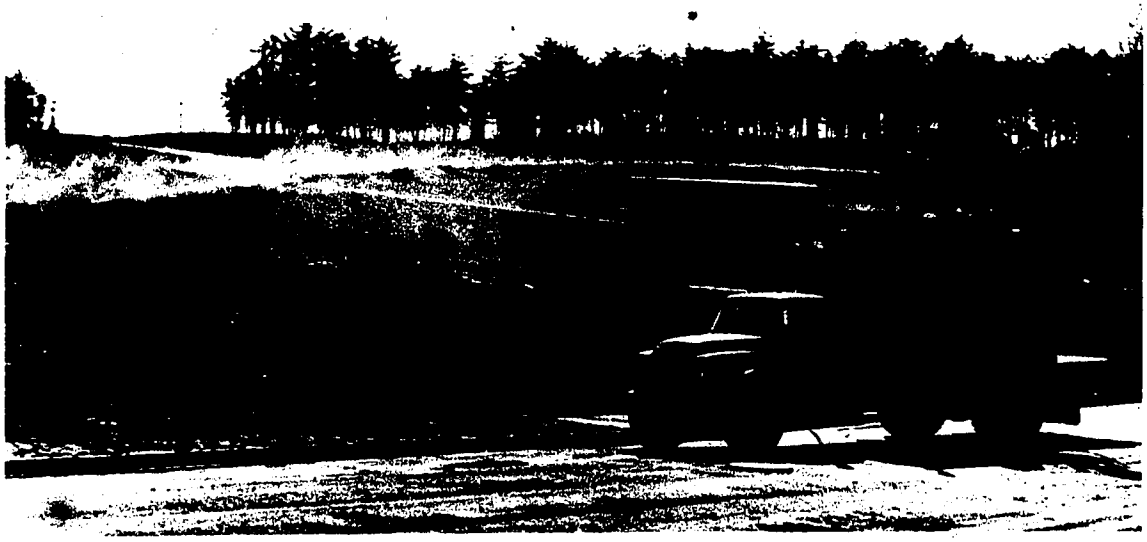
Maintenance is a vital factor in maintaining an adequate vegetative erosion control cover. See Table 2.

Irrigation. If soil moisture is deficient, supply new seedings with adequate water for plant growth when they are made late in the planting season, in abnormally dry or hot seasons, or on adverse sites.

Repairs. Inspect all seeded areas for failure and make necessary repairs, replacements, and reseedings within the planting season, if possible.

1. If stand is inadequate for erosion control, overseed and fertilize at half of the rate originally applied.

2. If stand is less than 40%, reestablish following original lime, fertilizer, seedbed preparation and seeding recommendations.



Hydroseeding allows the seed, fertilizer and mulch to be applied in one operation.

TABLE 1

PERMANENT SEEDING BY RATES, DEPTH AND DATES			NORTHERN PIEDMONT MTNS. & VALLEYS			SOUTHERN PIEDMONT & COASTAL PLAIN		
Seeding Mixtures (Use Certified Seed)	Seeding Rate Lbs. Acre	Lbs./1000 Sq. Ft.	Seeding Dates (e) Mar. 15- Apr. 15	May 1- Aug. 1	Aug. 15- Sept. 15	Seeding Dates (e) Mar. 1- Apr. 1	May 1- Aug. 15	Sept. 1 Oct. 1
1. Kentucky 31 Tall Fescue	60	1 lb. 6 oz.	x	-	x	x	-	x
2. Kentucky 31 Tall Fescue	60	1 lb. 6 oz.	-	x	-	-	x	-
Weeping lovegrass (a)	2	0.8 oz.						
3. Kentucky 31 Tall Fescue	50	1 lb. 2 1/2 oz.	x	x	-	x	x	-
Korean lespedeza (b)	15	5 1/2 oz.						
4. Kentucky 31 Tall Fescue	40	15 oz.	x	x	-	x	x	-
Sericea lespedeza (b)	20	7 1/2 oz.						
5. Crownvetch (b)	15	5 1/2 oz.	x	-	x	x	-	x
Redtop	3	1 oz.						
6. Crownvetch (b)	15	5 1/2 oz.	x	-	x	x	-	x
Kentucky 31 Tall Fescue	40	15 oz.						
DROUGHTY AREAS								
7. Kentucky 31 Tall Fescue	30	11 oz.	x	-	x	x	-	x
Redtop	5	1 3/4 oz.						
8. Weeping lovegrass	2	0.8 oz.	x	x	-	x	x	-
Sericea lespedeza (b)	20	7 1/2 oz.						

- CONTINUED ON NEXT PAGE -

TABLE 1 (continued)

PERMANENT SEEDING BY RATES, DEPTH AND DATES			NORTHERN PIEDMONT MTNS. & VALLEYS			SOUTHERN PIEDMONT & COASTAL PLAIN		
Seeding Mixtures (Use Certified Seed)	Seeding Rate Lbs./ Acre	Lbs./1000 Sq. Ft.	Seeding Dates Mar. 15- Apr. 15	May 1- Aug.1	Aug.15- Sept.15	Seeding Dates Mar. 1- Apr. 1	May 1- Aug. 15	Sept. 1 Oct. 1
POORLY DRAINED AREAS								
9. Kentucky 31 Tall Fescue	30	11 oz.	x	-	x	x	-	x
Reed canarygrass (c)	10	3 3/4 oz.						
SHADED AREAS								
10. Kentucky 31 Tall Fescue	60	1 lb. 6 oz.	x	-	x	x	-	x
11. Red Fescue, Jamestown or Pennlawn	40	15 oz.	x	-		(i)	(i)	(i)
LAWNS & HIGH MAINTENANCE AREAS								
12. Merion Kentucky Bluegrass	40	15 oz.						
Common Kentucky Bluegrass (d)	40	15 oz.	x	-	x	(i)	(i)	(i)
Red Fescue, Pennlawn or Jamestown	20	7 1/2 oz.						
13. Kentucky 31 Tall Fescue (g)	220-260	5-6 lbs.	x	x (f)	x	x	x (f)	x
14. Bermudagrass (j)	80	2 lbs.	-	x	-	-	x	-
15. [illegible]a (k)			-	x	-	-	x	-

FOOTNOTES TABLE 1

x Applicable during entire period:

- Not applicable during period.

(a) Use weeping lovegrass to provide a stand of grass for erosion control during summer.

(b) Use scarified, inoculated seed.

(c) Preferable to seed in fall with seed from current year's crop.

(d) "South Dakota" certified or "Kenblue" Kentucky bluegrass are the only acceptable varieties for use on these areas.

(e) Mixtures 1,3,4,5,6,7,9,10,11,12, and 13 may be seeded during winter months in an emergency if (2) tons per acre of a well-anchored mulch are used. These are optimum seeding dates and may be usually extended 15 days before and after with a reasonable degree of success.

(f) Can be seeded during this period of irrigation water is used. Use (2) tons per acre of mulch.

(g) Can use 10 percent Kentucky bluegrass. Varieties shown in (d) above.

(i) Not recommended

(j) Common Bermudagrass may be seeded, sodded, sprigged, plugged or established from runners. Tufcote Bermuda should be used only in Piedmont and Coastal Plain and must be plugged, sprigged, sodded or established from runners. Refer to standards and specifications for disturbed area stabilization with Bermudagrass.

(k) Zoysia must be plugged or sprigged. For establishment, follow standards and specifications for disturbed area stabilization with Bermudagrass.

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TABLE 2

MAINTENANCE FERTILIZATION FOR PERMANENT SEEDINGS
(Use Soil Test Recommendations or Rates Shown Below)

Mixture No.	Seeding Mixtures	Formulation	Lbs./Acre	Lbs./1000 Sq.Ft.	Time	Mowing
1,2,3,6,7,8, 9,10,11	Tall Fescue makes up 70% or more of cover.	10-10-10 or	500	11.5	Fall. Yearly, or as needed.	*Not closer than 4" if occasional mowing is desired.
		38-0-0+	400	9.2	Fall.	
		0-20-20	250	5.8	Yearly, or as needed.	
4,5,6	Crownvetch Sericea lespedeza	0-20-20	400	9.2	Spring. Year following establishment and every 4 to 5 years thereafter.	Do not mow crownvetch.
4	Fairly uniform stand of tall fescue and sericea lespedeza.	5-10-10	500	11.5	Fall. Year following establishment and every 4 to 5 years thereafter	Not required. Not closer than 4" if occasional mowing is desired, and then in fall after sericea seed has matured.
8	Weeping lovegrass and sericea lespedeza. Fairly uniform plant distribution	5- -10	500	11.5	Spring. Year following establishment and every 3 to 4 years thereafter.	Not required. Closer than 4" if occasional mowing is desired, and then in fall after sericea seed has matured.
12, 13	Kentucky bluegrass-red fescue mixture, Ky-31 tall fescue.	20-10-10	250	6.75	September	Mow no closer than 3 inches.
		20-10-10	250	6.75	30 days later.	
		20-10-10	250	6.75	December	
		20-10-10	85	2.23	May 20-June 30 if needed.	
14, 15	Bermudagrass Zoysia	20-10-10	200	5	May 1, July 1, August 15	Mow Tufcote and Zoysia at 1" common at 2"

STANDARD AND SPECIFICATIONS
FOR
DISTURBED AREA STABILIZATION
(With Sod)

Definition

Stabilizing silt-producing areas by establishing long-term stand of grass with sod.

Purpose

To stabilize the soil; reduce damage from sediment and runoff to downstream areas.

Conditions Where Practice Applies

On exposed soils that have a potential for causing off-site environmental damage where a quick vegetative cover is desired.

SPECIFICATIONS

Methods and Materials

1. Class of turfgrass sod shall be Virginia State Certified, or State approved sod.

2. Sod shall be machine cut at a uniform soil thickness of 3/4 inch, plus or minus 1/4 inch, at the time of cutting. Measurement for thickness shall exclude top growth and thatch.

3. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10% of the section.

4. Individual pieces of sod shall be cut to the supplier's width and length. Maximum allowable deviation from standard widths and lengths shall be 5%. Broken pads and torn or uneven ends will not be acceptable.

5. Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its survival.

6. Sod shall be harvested, delivered and installed within a period of 36 hours. Sod not transplanted within this period shall be inspected for approval prior to its installation.

Site Preparation

Fertilizer and lime application rates shall be determined by soil tests. Under unusual circumstances where there is insufficient time for a complete soil test, fertilizer and lime materials may be applied in amounts shown under 2 and 3 below.

1. Prior to sodding, the surface shall be cleared of all vegetation, trash, debris, and of all roots, brush, wire, grade stakes and other objects that would interfere with planting, fertilizing or maintenance operations.

2. Where the soil is acid or composed of heavy clays, ground agricultural limestone shall be spread at the rate of 100 pounds per 1,000 square feet. In all soils the required lime and 30 pounds of 5-10-5, or equivalent fertilizer per 1,000 square feet shall be uniformly applied and mixed into the top 3 inches of soil during final tillage operations.

3. Slow release nitrogen at the rate of 3.5 lbs. N/1000 square feet shall be applied to the prepared soil just prior to sod installation. This material shall be approximately 1/3 immediately available and 2/3 water insoluble nitrogen. Urea formaldehyde (UF) and isobutylidene urea (IBDU) meet these standards.

Sod Installation

1. During periods of excessively high temperature, the soil shall be lightly irrigated immediately prior to laying the sod.

2. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and tightly wedged against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Insure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause air drying of the roots.

3. On sloping areas where erosion may be a problem, sod shall be laid with the long edges parallel to the contour and with staggered joints. Secure the sod by tamping and pegging or other approved methods.

4. As sodding is completed in any one section, the entire area shall be rolled or tamped to insure solid contact of roots with the soil surface. Sod shall be watered immediately after rolling or tamping until the underside of the new sod pad and soil surface below the sod are thoroughly wet. The operations of laying, tamping and irrigating for any piece of sod shall be completed within eight hours.

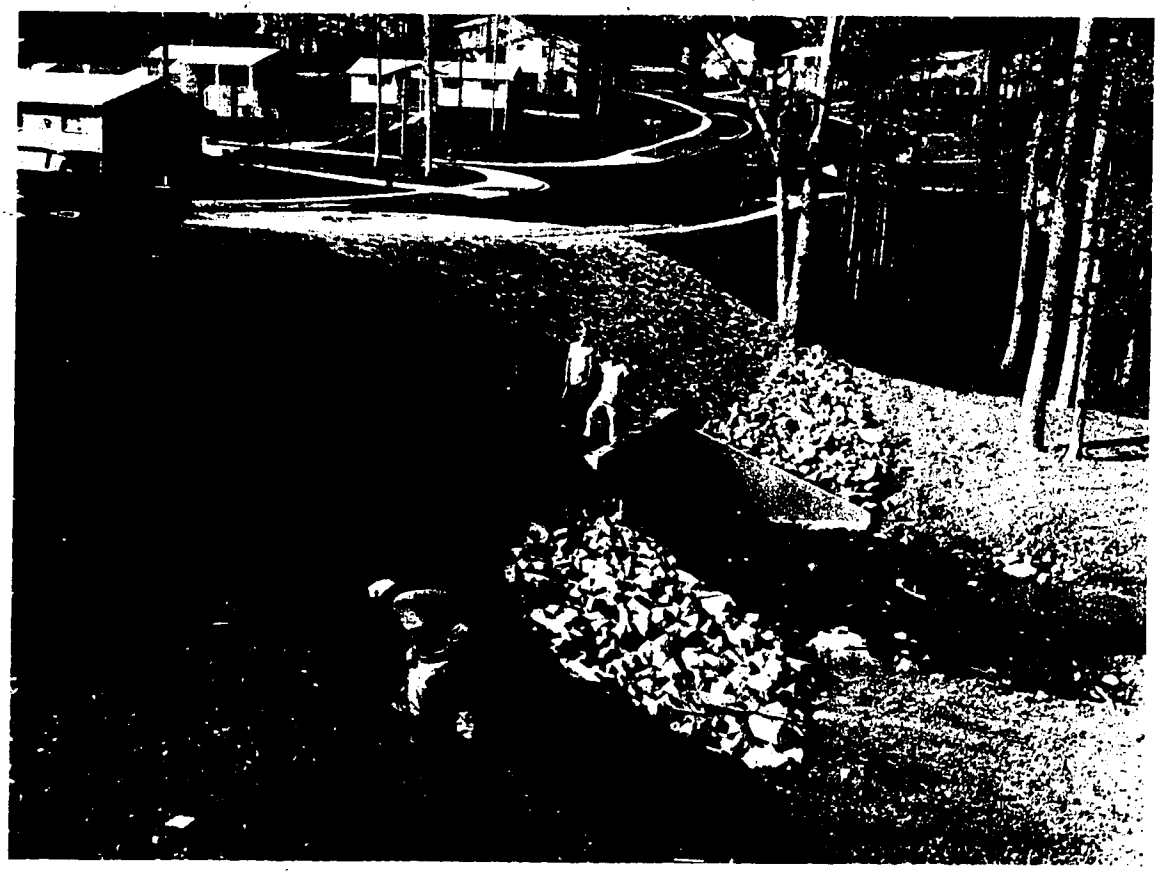
Sod Maintenance

1. In the absence of adequate rainfall, watering shall be performed daily or as often as deemed necessary during the first week and in sufficient quantities to maintain moist soil to a depth of 4 inches. Watering should be done during the heat of the day to help prevent wilting.

2. After the first week, sod shall be watered as necessary to maintain adequate moisture and insure establishment.

3. First mowing should not be attempted until sod is firmly rooted. No more than 1/3 of the grass leaf shall be removed by the initial cutting or subsequent cuttings. Grass height shall be maintained between 2 and 3 inches unless otherwise specified.

4. Maintenance of established sod should follow specifications outlined in table 15.



Stabilization of road banks with sod and riprap prevents erosion damage to structures and reduces pollution of streams by sediment.

TABLE 1

Maintenance Fertilization for Permanent Sod
Use Soil Test Recommendations or Rates Shown Below

Seeding Mixtures	Formulation *	Lbs./Ac.	Lbs./1000 sq.ft.	Time	Mowing
Ky-31 tall fescue and	20-10-10	250	6.75	Sept. 1 - Oct. 1	Mow no closer
Kentucky bluegrass-	20-10-10	250	6.75	30 days later	than 2 inches
red fescue mixture	20-10-10	250	6.75	December	for bluegrass
	20-10-10	85	2.25	May 20 - June 30 if needed	and 3 inches for fescue.
Bermudagrass, 'Tufcote'	20-10-10	200	5.00	May 1, July 1, August 15	1-2"

* Equivalent amounts of plant food may be applied with other formulations.

STANDARD AND SPECIFICATIONS
FOR
DISTURBED AREA STABILIZATION
(With Bermudagrass)

Definition

Stabilizing silt-producing areas by establishing long-term stands of Bermudagrass.

Purpose

To stabilize the soil; to reduce damage from sediment and runoff to downstream areas; to enhance natural beauty.

Conditions Where Practice Applies

On hot, droughty, graded areas which are subject to erosion or traffic, and where a long-lived, warm-season grass cover is desired.

SPECIFICATIONS

Vegetation cannot be expected to provide an erosion control cover and prevent soil slippage on a soil that is not stable due to its structure, texture, water movement or excessive slope.

Minimum Soil Conditions Needed for the Establishment and Maintenance of a Long-Lived Vegetative Cover are:

1. Enough fine-grained materials to provide the capacity to hold at least a moderate amount of available moisture. Excessively porous sands which have moisture supplies consistently too low for growth of plants cannot be maintained in good cover regardless of other soil factors.

2. Sufficient pore space to permit adequate root penetration.

3. The soil shall be free from any material harmful to plant growth.

4. If these minimum conditions cannot be met, see standard and specifications for topsoiling disturbed

Site-Preparation

- Install needed erosion control practices such as sod waterways, interceptor ditches, berms and terraces, contour ripping, erosion stops, channel liners and sediment basins.

- Grade as needed and feasible to permit the use of conventional equipment for seedbed preparation, planting, and maintenance.

Seedbed Preparation

'Tufcote', 'Midland', and common Bermudagrass varieties can be established by planting sprigs, plugs or stolons (runners). The seedbed will have to be loose enough to enable proper placement and firming of plants in the soil.

The seedbed must be free of weeds and other plants. Tillage to remove weeds and to work in lime and fertilizer will usually be sufficient for seedbed preparation.

Soil Amendments

Apply lime and fertilize according to soil tests.

In lieu of soil test results, apply 2 tons ground agricultural limestone, 400 pounds 38-0-0, Ureaform fertilizer, and 600 pounds 0-20-20 fertilizer, or equivalent, per acre. Harrow or disc lime and fertilizer uniformly into the soil to a minimum depth of 3 inches on slopes less than 3 to 1. On slopes of greater than 3 to 1 grade, the lime and fertilizer shall be worked in as directed. On sloping land, final tillage operations should be on the contour wherever feasible. No attempt should be made to drag any disced area to make the soil surface very smooth after discing. At time of planting apply 500 pounds 10-20-20 fertilizer, or equivalent, per acre. Incorporate into soil on slopes less than 3 to 1.

Adaptation

Bermudagrass is a warm-season grass which grows well in hot, droughty areas, but Tufcote is susceptible to winterkill in the Piedmont region. Midland and local strains of common are more winter hardy.

Three varieties are recommended: Tufcote, local strains of common, and Midland. Tufcote is a low-growing, turf-type variety. It should be used on sites which will be maintained as turf (with frequent, close mowings). Midland and common are taller growing types. They require less frequent mowing.

Planting Methods

These Bermudagrasses may be planted as stolons (runners), plugged or sprigged. Tufcote may be sodded. (If established as sod, follow standard and specifications for disturbed area stabilization with sod).

The seedbed should be moist at planting time and soil temperature should be at least 50° F. The optimum period for establishment is from May 15 - July 15 for all types of plantings. Plugs may be planted from April 15 to August 15.

Good soil moisture must be maintained for the first two weeks following planting, thus, supplemental irrigation may be required. Competitive weed growth during the first season must be controlled by mowing or herbicide. 2,4-D at the rate of 3/4 pounds/A will help control broadleafed weeds. For best results, apply herbicide when weeds are 4-6 inches high.

CAUTION: Herbicides can be injurious to humans, domestic animals, beneficial insects, desirable plants, and fish or other wildlife--if not handled or applied properly. Use all herbicides selectively and according to manufacturer's recommendations. Follow recommended practices for the disposal of surplus herbicides and herbicide containers.

Sprigging

A Bermudagrass sprig is a small section of underground stem (rhizome) from the plant, 3 to 5 inches long with at least one node. Sprigs are planted deep with the node about 2 inches below the ground. If leaves are present, best results are obtained if leaf tips are above ground. They may be planted by hand or with a transplanter. Most planting material may consist of both rhizomes (sprigs) and stolons (runners).

The recommended spacing of sprigs is 18"x24" (about 30 bu/A) on gentle slopes and 18"x18" (40 bu/A) where erosion hazard is greater. During a normal growing season, both spacings will provide a complete cover by the end of the first growing season. The closer spacing not only helps control erosion but will give more rapid cover.

Stolons (Runners)

Stolons or runners are above ground stems that spread by covering the soil surface. These may be harvested and used as planting material. They should be planted 2-4 inches deep with the leaf tips left above ground. They should be planted at a rate of 2-7 bushels per 1000 square feet with a maximum spacing of 18"x24". Closer spacing will give faster coverage.

Plugging

Using 4" diameter plugs from established stands is also a good method of planting. One square foot of grass will plug one square yard on 12" centers. Use 540 square yards for an acre. Use 180 square yards per acre for an 18"x24" spacing. Plant plugs 2" deep with topgrowth flush with the surface and leaves exposed. They should be firmed with the heel of a shoe, a press wheel or a tractor wheel.

Maintenance

Irrigation. For maximum growth and spread, provide supplemental water as needed during the establishment year. From then on, little or no irrigation will be required.

Mowing. For turf-type maintenance, Tufcote may be mowed to a 1-inch height although normal mowing height is 2 inches. For low maintenance areas, Midland and common are well-adapted but Tufcote may be used. One mowing is recommended when the grass becomes 12 to 18 inches tall or when the lower growing variety reaches 6 inches tall. Weeds should be mowed when they become a problem and shade the Bermudagrass.

Fertilization. For turf-type management, higher rates of nitrogen are required. Apply 200 lbs. ~~per~~ acre (5 lbs. per 1000 sq. ft.) of 20-10-10 or equivalent fertilizer May 1, July 1, and August 15.

For low maintenance programs, apply 400 lbs. of 20-10-10 in late May. This is applicable only to Midland and common Bermuda.

STANDARD AND SPECIFICATIONS
FOR
DISTURBED AREA STABILIZATION
(With Ground Covers, Vines, Shrubs and Trees)

Definition

Planting vegetation such as trees, shrubs, vines, and ground covers on disturbed areas.

Purpose

To stabilize area; to reduce damages from sediment and runoff to downstream areas; to enhance natural beauty.

Conditions Where Practice Applies

Graded or cleared areas subject to erosion where a permanent, long-lived vegetative cover other than turf is desired.

SPECIFICATIONS

An attempt has been made to list some plants known to be suitable for erosion control and to possess aesthetic value. This list is neither inclusive or exclusive. The list includes plants which establish easily on difficult sites as well as plants which will require some site improvement before they will grow satisfactorily. See Appendix D-8.

These plants cannot be expected to provide an erosion control cover and prevent soil slippage on a soil that is not stable due to its texture structure, water movement or excessive slope.

Ground covers are not necessarily low-maintenance plants. In general, they are more difficult to establish than turf. Plants included in this list respond favorably to careful treatment during establishment.

Planting Time

Early spring. This allows for the maximum root and top development to check erosion and allow the plant to become established before winter. Woody plants may be planted during the fall of year, if given special care during the winter.

Soil Preparation

For short slopes, small areas, and mass plantings with close spacings, apply a commercial granular fertilizer such as 5-10-10 and organic

supplement such as composted cow manure, peat or well-rotted sawdust, and work into the soil prior to planting. Fertilizer rate - 3 to 5 lbs. per 100 sq. ft. The organic material needed will depend upon the soil and plant being used. Plants such as pachysandra require a high rate of organic material, about a 2-inch layer worked into the root zone. Depending on the soil type and steepness of slope, the depth of soil working will vary from 4 to 6 inches.

For steep slopes and large area plantings, working up the entire planting area would be impractical and would probably induce erosion. Center hole planting, a hole dug for each plant, would be more desirable. If the soil on the slope is poorly suited to the species being planted, incorporate organic material into the planting hole. Whether organic material is needed or not, apply fertilizer for each plant at the rate of one ounce per plant of some complete fertilizer such as 10-10-10. Mix fertilizer with soil below the roots of the plants.

Another alternative is to add to the planting hole a sandy loam soil mixed with peat, composted cow manure and cocoa shells, or well-rotted sawdust at a rate of 1:1 or 2:1.

The entire planted slope will be covered with a protective mulch such as excelsior, wood chips, straw or wood pulp fiber to conserve moisture and control erosion. Weeds shall be controlled by pulling or other acceptable means. Where fresh wood chips, wood shavings or sawdust are used as mulches or as organic material to planting bed, a slow release fertilizer such as 7-40-6, 38-0-0 or organic forms should be used.

Where erosion hazard is very high, heavy jute matting stapled to the slope will provide excellent erosion control, as will landscape mats of excelsior or fiber glass.

Where individual plants are planted, a temporary cover crop of annuals will be used for erosion control until planted materials offer protective cover. (See standards and specifications for disturbed area stabilization with temporary seeding).

Maintenance

Some watering, remulching and fertilizing may be required of a new planting during the period of establishment. Cultivation is not recommended. This will encourage erosion and cause root injury. Competing weeds will be controlled.

If a controlled release fertilizer was used at time of planting, additional fertilizing may not be necessary for several years. Otherwise, fertilize plantings during the spring of the second growing season and thereafter as needed, using 2 to 3 pounds of a granulated commercial fertilizer such as 5-10-10 per 100 square feet.

STANDARD AND SPECIFICATIONS
FOR
TIDAL BANK STABILIZATION
(Vegetative)

Definition

Stabilizing tidal banks or slopes adjacent thereto with adequate plants in conjunction with designed structures as needed.

Purposes

To control undesirable soil movement and loss from tidal banks and from higher adjacent slopes.

Conditions Where Practice Applies:

1. Where eroding tidal banks and adjacent slopes can normally be stabilized without structures.

2. Where erosion needs to be controlled on tidal banks and adjoining slopes in support of tidal bank protection structures.

PLANNING CONSIDERATIONS

The critical area for stabilizing eroding tidal banks is to control erosion at the toe of the slope. Once this is done, the upper slope can be vegetated. Toe stabilization is usually accomplished through the use of structures such as bulkheads and revetments, or groins, or a combination of these practices. These structures are designed to protect the shore from loss of soil by wind and current action, and in the case of groins, some sand can be trapped which gives a stabilizing affect to the immediate area. The design of structures is a specialized field in which the services of an experienced engineer should be obtained.

There are sites with characteristics which permit use of economical measures such as sloping the bank and stabilizing it with vegetation. These site conditions include:

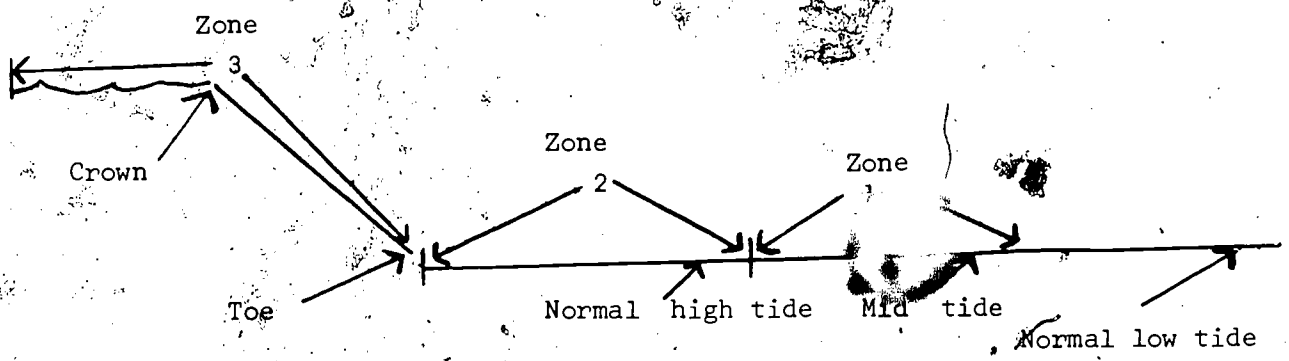
1. Evidence that at least one of the cordgrasses is invading the bank area.

2. Evidence that littoral drift is being transported by the location being planted. (IMPORTANT)

3. Exposure to waves and currents is not severe.

4. Bank height does not exceed 10 feet.

VEGETATIVE ZONES
(Areas of Plant Adaptation)



Vegetative Zone 1

That area extending from mid tide to normal high tide.
This zone is submerged during normal high tides.
Soil composition may vary from coarse sand to compacted silt or clay.

Vegetative Zone 2

That area extending from normal high tide to toe of bank, or graded slope, or to the base of bulkhead or slope revetment, if an along-shore structure is employed.

This zone is subject to spray and periodic inundation.

Soil composition may vary from rather stable sandy material to shifting sands, and in some cases, silt or clay strata may be on or near the surface.

Vegetative Zone 3

That area extending from toe to bank or graded slope or from top of bulkhead, or slope revetment, if an along-shore structure is employed, to the crown and beyond.

This zone is subject to spray but seldom to flooding. Soils may vary from droughty sands to heavy impervious clay materials. There may be seepage spots, and in some cases, poor natural soil drainage.

SPECIFICATIONS

(See specifications on plants and their establishment and maintenance requirements).

VEGETATIVE ZONE 1

This is the most difficult area in which to establish plants, due to wave and tidal action which tends to lift the new plantings before they become established. Planting in this area is usually restricted to fortifying and tying together existing vegetation, if present, into a continuous uniform stand.

Planting must be done during periods of low tide in trenches parallel to the shoreline. The trenches should be approximately 6 inches wide and 8 inches deep (use square pointed shovel) with not over 2 feet between trenches. Sods of planting stock should be approximately 6 inches square and placed in a continuous tight band in the trench and securely tamped until they are lower than the existing soil surface. Use care in tamping sod so as not to injure top growth. A capping of jute netting can be used to anchor plants in place.

Plant Materials

1. Brackish to saline sites (5,000 to 42,000 parts per million): Spartina alternaflora Loisel, (smooth cordgrass). A long-lived erect-stemmed perennial with a heavy mat of cordlike rhizomes which form an excellent erosion resistant cover. Average height 2 to 3 feet. Plant between April 1 and June 30. Grows best on organic or firm mineral soils. At higher elevations, Distichlis spicata (L.) Greene, seashore saltgrass may be used on saline sands to clays.

2. Brackish Sites: Juncus roemerianus Scheele (needlegrass rush). A smooth upright perennial with creeping root stocks. Average height 2 to 3 feet. Plant between April 1 and June 30.

3. Fresh to Brackish Sites: Scirpus americanus Pers. (three-square or American bulrush). A perennial with triangular stems. Spreads by rhizomes. Average height 2 to 3 feet. Plant between March 1 and May 1.

The above plants are not available commercially. It is best to secure them from natural sources as close to the planting site as possible, since they are dug in sod pieces approximately 6 inches square and considerable weight is involved. Water transportation may be easier than overland transfer. If possible, dig sod with shallow (6 to 8 inches) root system. The sod will lift easier and contain a more compact root system than if dug from deeply rooted plants.

Fertilization

Commercial fertilization is impractical. Daily inundation supplies sufficient nutrients for plants in this zone.

Maintenance

Since this is the first line of defense against tidal and wave action on the shore, it is imperative that repairs be made promptly to prevent damaging washouts.

VEGETATIVE ZONE 2

This area may vary in width from a few feet to 50 or more feet. Often groins are needed to provide, or widen, a protective beach by trapping littoral drift or retarding loss of an existing beach. It is desirable to have a distance of at least 15 feet between the normal high tide and the toe of the slope or base of along-shore structures before starting vegetative stabilization.

Along "starved" shorelines (where there is little or no littoral transplant) this zone or area is nonexistent. The most difficult area to vegetatively stabilize is where a light sand capping is deposited over layers of ferruginous sandstone or dense, slick blue clay. There is little or no root penetration into these materials to form a bond against erosion.

Plant Materials and Establishment Techniques

Brackish and saline soils are usually found along the lower section of this zone, but may compose the entire zone.

Spartina patens (Att.) Muhl (Saltmeadow cordgrass). Grows best on firm mineral soils. A perennial with erect slender stems, 2 to 3 feet in height, and aggressive, stout, cordlike, scaly rhizomes. Forms dense erosion resistant cover. Will tolerate salt content between 2,000 and 39,000 p.p.m.

Plant not available commercially. Should be dug locally. The best planting stock can be secured from moist, sandy shoreline areas where the root mass is no deeper than 6 to 8 inches. Bundle bare-rooted plants in moist burlap. Plant as soon after digging as possible between April 1 and June 30.

Planting

Pull clumps apart so as to have 3 to 5 stems per plant. Plant in rows parallel to the shoreline with not over 2 feet spacing between plants and between rows. Use a staggered planting pattern. Planting depth should be about 8 inches, approximately 2 inches deeper than original soil line. Fertilize at time of planting with a controlled release fertilizer such as magnesium ammonium phosphate fertilizer (7-40-6). Place 1 to 1 1/2 oz. of fertilizer in bottom of each plainting hole. Compact soil firmly around each plant.

Saltmeadow cordgrass can be planted either on heavier textured soils from the

normal high tide line to an elevation of about 3 feet, or on sandy saline soils to an elevation of about 10 feet. For fresh or moderately brackish moist sands to clays, seashore saltgrass may be substituted for saltmeadow cordgrass. Sandy soil and shifting maritime sands are usually found along the upper section of this zone, especially between groins, and in some cases may comprise the entire zone.

Amophila breviligulata Fernald (American beachgrass). An aggressive perennial with deep, strong, extensively-creeping rhizomes. Culms (stems) grow in tufts commonly between 2 and 4 feet tall.

This plant is unexcelled for stilling sand and stabilization. It spreads rapidly through its underground stems (rhizomes) to form an erosion resistant cover. The foliage traps sand to build up the shoreline, yet as the sand deposits accumulate, this grass has the remarkable ability to grow up through over 2 feet of sand deposition during a single growing season and reestablish itself.

This plant is available from commercial producers and it is shipped to users ready to plant. It can also be dug from native stands. Here again, be sure to secure young plants with vigorous root systems that are between 6 and 8 inches deep.

Shade the sand from the roots and cut back tops so that the planting stock is approximately 15 inches long. Dip the plants in a clay slurry to coat roots to prevent desiccation. Bundle in moist burlap and keep cool until planted. Planting period - October 1 through April 30.

Planting

Separate the clumps so as to have 3 or more culms (stems) per plant. Plant in rows parallel to the shoreline with not over 2 feet spacing between plants and between rows. Use a staggered planting pattern. Planting depth should be between 8 and 10 inches (tiling spade best tool for hand planting).

Fertilize at time of planting with a controlled release fertilizer such as magnesium ammonium phosphate fertilizer (7-40-6). Plant 1 to 1 1/2 oz. of fertilizer in bottom of each planting hole. Compact soil firmly around each plant.

Maintenance

Apply 400 lbs. per acre of 10-10-10 fertilizer in May and July to maintain plant vigor. Prune or remove trees and brush piles etc. that shade the area and prevent plant growth.

VEGETATIVE ZONE 3

Particular attention should be given to the planting of the toe of the slope, if a graded slope, and to the area immediately above the bulkhead or

slope revetment, if an along-shore structure is employed, as these areas are vulnerable to erosion. For this reason, it is best to establish a band of Bermudagrass approximately 15 feet wide along these areas to provide maximum soil binding against erosion. The remainder of the upper slope may be planted to Bermudagrass or tall fescue (Ky-31).

Site Preparation

Grade as needed and feasible to permit the use of conventional equipment for soil preparation, sprigging or seeding (slope not to exceed 3 feet horizontal to 1 foot vertical). Save topsoil for use on drastically disturbed slopes. Remove problem trees from face of slope to prevent windthrow damage and shading of grasses. Intercept over-bank flow of surface water and divert down through structures. If there is seepage on face of slope, bench slope and drain with tile as needed and feasible.

Soil Preparation

If soils are reasonably uniform, lime and fertilize according to soil test. In absence of soil test, apply 2,000 pounds of pulverized dolomitic limestone and 1,000 pounds of granulated 10-10-10 fertilizer into the soil to a depth of 3 to 4 inches. Make sure last tillage operation is on the contour.

Plant Materials

All species listed below are adapted to a droughty sand to heavy impervious clay materials.

Cynodon dactylon, var. (L.) Pers. (Tufcote Bermudagrass).
A long-lived, low-growing perennial that forms a dense sod which is both drought and salt tolerant. Bermudagrass, being a warm season grass, grows during the hot summer months and is dormant during the winter. It thrives on close mowing. Planting stock is available commercially.

Cynodon dactylon, var. (L.) Pers. ("Midland" or common Bermudagrass).
These grasses are available commercially and may be substituted for "Tufcote". They are taller growing, more haylike, and do not form as dense a turf as that formed by Tufcote.

Planting

Bermudagrass is established by planting sprigs (small section of plant 3 to 4 inches long with at least one node or joint with leaves) by hand or with a transplanter in a firm, moist seedbed to a depth of 2 to 3 inches.

Compaction of soil around the sprig is a must for survival. Planting period - April 15 to August 15. Recommended spacing - 18"x18". (This will require approximately 40 bu. of sprigs per acre. One square yard of sod or bushel of Bermudagrass sprigs will yield approximately 500 plantable pieces).

Good soil moisture must be maintained the first two weeks following planting, thus supplemental irrigation may be necessary.

Maintenance After Planting

To maintain a vigorous, weed-free cover, annual applications of nitrogen during the warm months are important. Depending upon the soil type, exposure and usage, the total amount of nitrogen may vary from 50 to 200 pounds per acre per year. A complete fertilizer such as 5-10-10 (500 pounds per acre) should be applied during August or September to condition Bermudagrass for winter on medium to heavy texture soils. Prune or remove trees and brush piles, etc. that shade the area and prevent plant growth.

Festuca arundinacea, var. Schreb. "Ky-31" tall fescue.
A cool season, salt tolerant, grass which forms a heavy turf and persists longer on the heavier textured soils. "Ky-31" tall fescue seed is available commercially.

Seeding

Apply seed uniformly at the rate of 40 to 60 pounds per acre with a cyclone seeder, drill, cultipacker seeder, or hydro-seeder on a firm moist seedbed.

Where feasible, except when a cultipacker type seeder is used, the seedbed should be firmed following seeding operations to cover seed to a depth of 1/2 inch. Seeding periods - February 15 to April 15 and August 15 to October 15. Mulch slope with straw immediately after seeding (1 1/2 to 2 tons per acre). Apply and anchor mulch as outlined in Standard and specification for mulching. Inspect seeded areas and make necessary repairs, replacements, and reseedings within the planting season, if possible.

Maintenance After Seeding

Apply fertilizer annually, or as needed in the fall with 500 pounds per acre of 5-10-10 or its equivalent. Do not mow closer than 4 inches. Other maintenance necessary except for weed control. Remove brush piles etc. that shade the area and prevent plant growth.

Other

Vines such as Virginia creeper and honeysuckle may be used on some of the steeper, unsloped banks.

Vegetation is not a cure-all nor can it be expected to provide an erosion control cover on a soil that is not inherently stable due to its structure, texture, water movement or excessive slope. However, vegetation performs an important function in complementing and prolonging the useful life of most tidal bank structures.

STANDARD AND SPECIFICATIONS FOR DUNE STABILIZATION

Definition

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

Purpose

To stabilize frontal dunes and reduce soil movement and the encroachment of shifting sands on valuable property; to provide a barrier against tide water; and to make the areas useful for other purposes.

Conditions Where Practice Applies

On seashore, tidal rivers and bays where blowing sands, tide and storm water may cause damage.

Site Conditions

Land adjoining the ocean, tidal rivers and bays is usually sandy in nature and is composed of a line of primary dunes which are discontinuous in nature. These dunes are naturally rather bare on the ocean side making them vulnerable to wind and water action. Without man's help, the frontal dunes are not a dependable protective barrier to protect the back-dune area.

Man's constructive activities in dune building and stabilization consist of building dunes to an elevation of 12 feet with side slopes of 5:1. This is accomplished by erecting stilling barriers of slat (snow) fences or plastic fencing and planting of vegetation at desired locations to catch sand and help keep it in place. Tests have proved American beachgrass to be the most reliable grass to plant for primary dune stabilization. In some cases, it is best to start a dune where none exists by erecting a trainer dike which can then be given adequate height and cross-section by the above-mentioned techniques. Planting is delayed on hydraulic fill until salt has been leached to a low level. Sand placed by earth-moving equipment is allowed to be compacted by rains prior to dune planting. Dunes built with the aid of mechanical barriers are planted when the dune is near top of fences and elevation is near desired height.

SPECIFICATIONS

Building Dunes by Mechanical Methods

In frontal areas, dunes may be created by erection of snow fences, brush or plastic fences, or Christmas trees set in parallel rows 20 to 30 feet apart, parallel to the beach, and well back from the mean high water line. Barriers are added until the desired height and width of the dune is obtained. The frontal dune should be about 120 feet wide at the base and 12 feet high.

If brush is used, it is lashed to horizontal rails nailed to a line of posts.

If Christmas trees are used, they are anchored well in the sand spaced to touch each other in the row.

Short term fencing requires more maintenance and does not stand up well under severe conditions.

Dunes are stabilized as in B below with American beachgrass.

Where foot or vehicular traffic is appreciable over frontal dunes, it is advisable to direct the traffic over paths or roads of gravel or boards to prevent dune blow-out.

Vegetative

Amphila breviligulata Frenald, American beachgrass, which can be bought from commercial nurseries, is best planted between October 1 and April 30 when sand is not frozen. Planting can be done by hand or by mechanical planters.

Three to five culms (stems) with roots, which may be joined, are placed in a hole approximately 8 to 9 inches deep.

It is recommended that planting stock be cut back to approximately 15 inches high. Roots should be dipped in a mud slurry to prevent them from drying during planting.

Plants are spaced 18" x 18"; where erosion is severe, 12" x 12". Plants should be staggered in alternate rows.

A common grade of mineral fertilizer equivalent to 600 lbs. per acre of 10-10-10 or a slow-release fertilizer such as 7-40-6 (magnesium ammonium phosphate) is applied at the rate of 1 oz. per hill. Mineral fertilizer, when used, is applied as a top-dressing. When a slow-release fertilizer is used, it is placed in the holes with plants being planted. The slow-release fertilizer will usually be adequate to maintain fertility for

(3) growing seasons.

The sand is packed firmly around the roots to eliminate air pockets.

When plants are used to build dunes, the plantings should consist of at least 10 rows paralleling the shoreline to trap the sand and form a continuous band. Rows should be closer together at the center of the dune and wider apart at the edges.

Trees, brush piles, etc. that shade the area and prevent grass growth should be pruned or removed.

Fertilizer should be added when plant vigor starts declining after establishment. Apply a complete granular fertilizer such as 10-10-10 at rate of 400 pounds per acre in April or May and again in July.

STANDARD AND SPECIFICATIONS
FOR
DUST CONTROL ON DISTURBED AREAS

Definition

Controlling surface and air movement of dust on construction sites, roads, and demolition sites.

Purpose

To prevent surface and air movement of dust from exposed soil surfaces and reduce the presence of airborne substances which may be harmful or injurious to human health, welfare, or safety, or to animals or plant life.

Conditions Where Practice Applies

This practice is applicable to areas subject to surface and air movement of dust where on-and off-site damage is likely without treatment.

METHOD AND MATERIALS

Temporary methods

Mulches. See standards for disturbed area stabilization with mulches only. Synthetic resins may be used instead of asphalt to bind mulch material. Resins such as Curasol or Terratack should be used according to manufacturer's recommendations.

Vegetative Cover. See standards for temporary seeding.

Spray-on Adhesives. These are used on mineral soils (not effective on muck soils). Keep traffic off these areas.

	Water Dilution	Type of Nozzle	Apply- Gallons/Ac.
Anionic Asphalt emulsion	7:1	Coarse Spray	1,200
Latex emulsion	12 1/2:1	Fine Spray	235
Resin-in-water emulsion	4:1	Fine Spray	300

Tillage. This practice is designed to roughen and bring clods to the surface. It is an emergency measure which should be used before wind erosion starts. Begin plowing on windward side of site. Chisel-type plows spaced about 12 inches apart, spring-toothed harrows, and similar plows are examples of equipment which may produce the desired effect.

Irrigation. This is generally done as an emergency treatment. Site

is sprinkled with water until the surface is wet. Repeat as needed.

Barriers. Solid board fences, snow fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and soil blowing. Barriers placed at right angles to prevailing currents at intervals of about 15 times their height are effective in controlling wind erosion.

Calcium Cloride. Apply at rate that will keep surface moist. May need retreatment.

Permanent Methods

Permanent Vegetation. See standards for permanent seeding, and permanent stabilization with sod. Existing trees and large shrubs may afford valuable protection if left in place.

Topsoiling. This entails covering the surface with less erosive soil material. See standards for topsoiling.

Stone. Cover surface with crushed stone or coarse gravel.

GUIDE
FOR
PROTECTION OF TREES ON DISTURBED AREAS

Definition

Protection of desirable trees from mechanical and other injury while the land is being converted from forest to urban and related use.

Purpose

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

Condition Where Practice Applies

On areas now occupied by single specimen trees or groups of trees.

Criteria for Selecting Trees to Leave on Site

Esthetic Values. Consideration should be given to autumn foliage, flowering habits, bark and crown characteristics, and type of fruit.

Disease and Rot. There shall be no evidence of disease or rot on the trees to be left. Trees that are known to be resistant from attack by insects or disease should be given preference over those known to be susceptible to attack. Example: sugar maple - good; American elm - poor.

Life Span. Preference should be given to trees with a long life span. Example: oak - good; gray birch - poor.

Wind Firmness. Trees with a strong tap or fibrous root system should be given priority over those with a weak root system. Example: oak or hickory - good; thinned Virginia pine - poor.

Wildlife Values. Leave trees which provide a good source of food, cover and nesting sites. Example: oaks, hickories and dogwoods have a high food value.

Comfort Index. Consider the location of the trees to be left in relation to the planned use of the site. Summer temperatures are generally 10° cooler under stands of hardwoods than under pines or cedars.

Sudden Exposure. Consider the tolerance of the tree to increased direct sunlight and the increased radiated heat generated from the proposed buildings or pavement.

Space Needed. Consider the mature height and spread of the trees to insure they will not interfere with structures, overhead or utility lines. Also consider root development characteristics of the species to insure that they will not affect water and sewer lines, septic systems, underground drainage systems or paved areas such as sidewalks, roads, or driveways.

Adaptability to Proposed Use. Consider resistance to air pollution in parking lots and other urban developments.

Outstanding Specimen. Consider trees of impressive size or shape, or of rare species.

Criteria for Protecting Remaining Trees

Where existing ground levels are raised, drainage tiles will be placed at the old soil level and open into a well built around the base of the tree. This well can be left open or can be filled with coarse stones or gravel. Tiles may be installed in a radiating pattern or laid in parallel lines. The size of the well should be in proportion to the diameter of the tree allowing sufficient room for growth. The diameter of the radiating tiles should extend to the drip-line of the tree. See Plate Nos. 1 and 2.

Trees within 25 feet of buildings will be protected by a fence. The fence will be placed to protect the root system as well as the trunk. See Plate Nos. 3 and 4.

Boards will not be nailed to trees during building operations.

Heavy equipment operators will be cautioned to avoid damage to existing tree trunks and roots during land leveling operations. Cutting or filling should not extend inside the drip line of trees.

Tree trunks and exposed roots damaged during equipment operations will be properly trimmed, cut out, and treated to prevent water from being trapped and also, to eliminate harboring places for insects and disease. The wounds will be painted immediately with a good grade "tree paint." Care for serious injury should be prescribed by a forester or a licensed tree specialist.

All tree limbs damaged during building or land leveling, or removed for any other reason, will be sawed flush with tree trunks and painted with a "tree paint".

The use of heavy equipment on root systems of desirable trees should be avoided as much as possible to minimize soil compaction.

Broad leaf trees should receive a heavy application of complete fertilizer to aid their recovery from possible damage caused by construction operations. Fertilization should be done during winter and/or early spring following completion of construction. It should be applied at the following rate: 2 to 4 lbs. of 10-6-4 for each diameter inch of trunk measured at 4 1/2 feet above ground line. Fertilizer should be applied in holes 1" or greater in diameter 18" deep, spaced about 2' apart at the drip line of the tree.

During the first two summers following construction, it is desirable that the trees receive adequate amounts of water. Do not over-water.

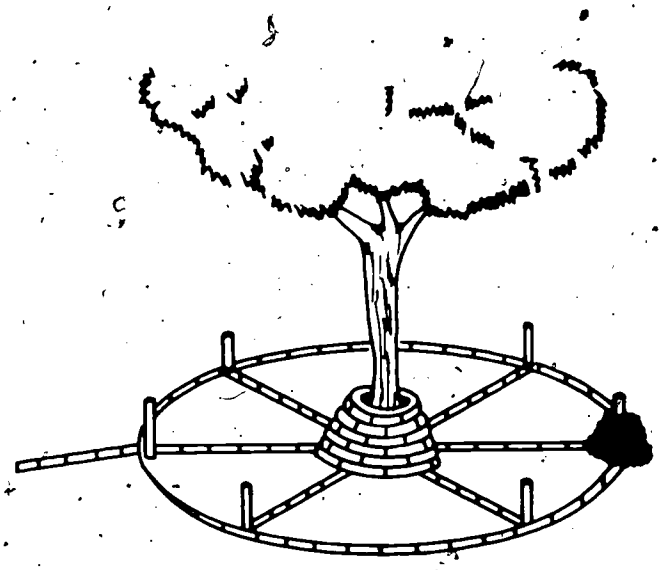
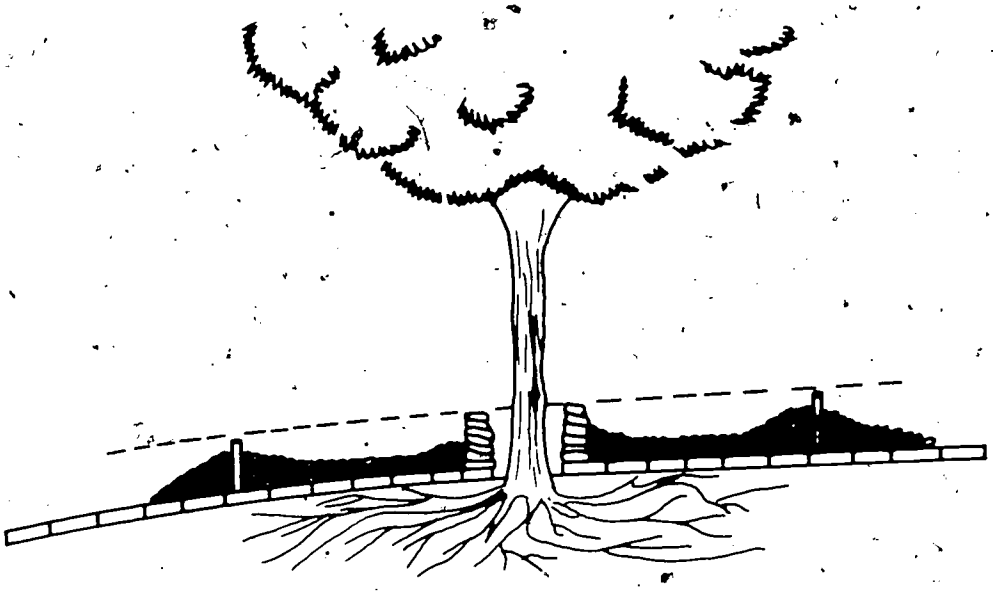


PLATE NO. 1



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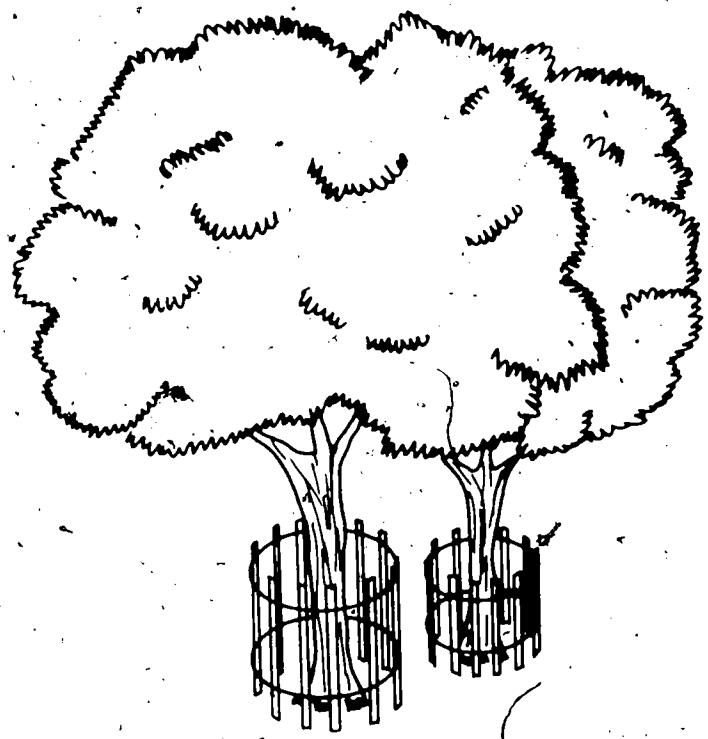

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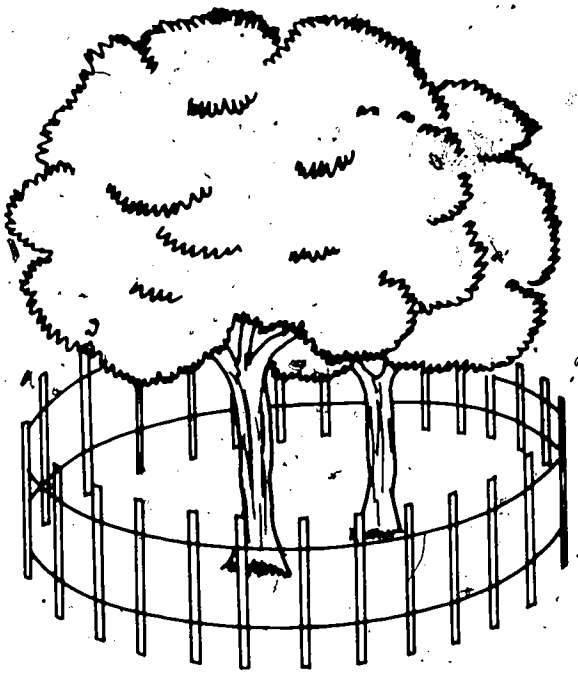


PLATE NO. 4

GUIDE
FOR
TREE PLANTING ON DISTURBED AREAS

Definition

Planting trees on construction sites and disturbed areas.

Purpose

To establish a stand of trees for erosion and sediment control, landscape beautification, watershed protection, dust control, and dune stabilization.

Conditions Where Practice Applies

On disturbed areas and similar sites where erosion and sediment control, watershed protection, dust control and dune stabilization require permanent vegetative cover with low maintenance cost for adequate stabilization.

Specifications

Species: The tree species to be planted must be adapted to the site.

Quality: Planting stock must be healthy and free of insect and disease pests. The tree seedlings must be at least 5 inches tall above the root collar, and with a single leader. The root system is to be well developed, fibrous, and kept moist until planted.

Number: On exposed and unprotected areas no less than 800 well spaced trees per acre must be planted to insure an adequate stocking (about 7'x8'). On steep slopes and other disturbed areas the number should be increased. Seedling requirements for various spacings are listed below.

4 x 4 feet	2723 trees	6 x 9 feet	807 trees
5 x 5 feet	1742 trees	6 x 10 feet	726 trees
6 x 6 feet	1210 trees	7 x 8 feet	778 trees
6 x 8 feet	907 trees		

Time of Planting: Trees are to be planted between December 1st and May 15th.

Site Preparation: Competing vegetation must be suppressed or removed.

Method of Planting: Any method may be used that will assure -

- The seedlings are planted as shown on the plan.
- The seedlings are kept moist, fresh, and protected from wind and sun to prevent mortality before planting. Seedlings shall be carried in a pail or bucket filled with sufficient mud and/or water to puddle the roots until actual planting unless the seedling roots have been clay dipped for moisture protection in which case the seedling roots may be wrapped in wet burlap until planted instead of being carried in a bucket.
- The seedlings are planted at approximately the same depth as they were growing in the nursery; i.e., the root collar should be at ground level.
- The seedlings are planted erect.
- The seedling roots are spread carefully in a natural position in the planting hole.
- The seedling roots are completely covered with soil.
- The seedling is securely planted with the soil firmly packed around the roots.
- On planting areas of one acre or less, the seedlings are to be thoroughly watered the day they are planted. All excess material excavated during planting shall be used as a cup for water retention.
- The seedlings are provided with an appropriate mulch or the establishment of grasses and legumes for temporary erosion and sedimentation control until the trees can become established. (See specifications for disturbed area stabilization with ground covers, vines, shrubs and trees).
- The seedlings are protected from future fire and equipment damage. Domestic animal grazing is prohibited in the planted area.
- The seedlings not planted 24 hours after delivery shall be "heeled in" in a moist earth trench. Seedling bundles shall be opened and trees separated. Seedlings shall be placed singly in the trench with the roots spread in a natural position. Seedlings may be layered in the trench, but the roots of each layer of seedlings must be immediately covered with moist, pulverized earth or moist sawdust. Trees in the heel-in trench should be watered at intervals to prevent drying until they are planted. Unopened, clay-dipped bundles from the Division of Forestry may be stored in cold storage units until needed.

Maintenance. Some watering, remulching, and fertilizing may be required on a new planting during the period of establishment. Cultivation is not recommended since this would encourage erosion and cause root injury. Competing weeds and brush should be controlled. Seedling mortality should be assessed after the first growing season. Plantings failing to accomplish their purpose will be restocked.

Other Considerations. To make trees more aesthetically pleasing, plant occasional trees or clumps of trees of species other than those used for the main body of the plantation. Include trees having contrasting bark, form or foliage, or which have attractive flowers or fruits beneficial to wildlife.

Plant slower growing trees and shrubs or those which are smaller at maturity on the outside of the planting.

Plant conifers, for views pleasing to the eye, as a backdrop for cultivated fields, meadows, pastures, farmsteads, ponds and buildings.

Plant deep-rooted species for free standing specimen trees. Group shallow-rooted species for accent plantings.

Provide open space at the borders of large plantation areas by selecting a contour outside of which no planting will be done, or where only lower growing trees and shrubs will be established. On uniform slopes, make borders irregular.

Shrubs and trees may be the best means of permanently stabilizing many disturbed areas.

APPENDIX FOR VEGETATIVE PRACTICES

TABLE OF CONTENTS

Appendix D:

APPENDIX D

GRASS AND LEGUME PLANT CHARACTERISTICS

Common Name	Botanical Name	1/ Germ. Time Days	Growth Habit 2/	Season	Drainage Class						Annual Cover		pH Range	Flooding Tolerance	Erodible Areas	Waterways & Channels	Shade Tolerance	Foot Traffic	Playgrounds, Lawns Athletic Fields	Beautification	Levels of 3/ Maintenance		
				Cool	Warm	Dry, (Not Drought)	Well Drained	Mod, Well Drained	Somewhat Poorly Drained	Poorly Drained	Winter	Summer									High	Medium	Low
Barley	Hordeum vulgare	7	A	X	-	-	X	X	-	-	X	-	5.5 -7.8	-	X	-	-	-	-	-	-	X	-
Bermudagrass	Cynodon dactylon	Plant Veg.	PL RS	-	X	X	X	X	X	-	-	-	4.5 -7.5	X	X	X	-	X	X	X	X	X	X
Bluegrass, Kentucky	Poa pratensis	10-28	PL R	X	-	-	X	X	X	-	-	-	5.5 -7.0	X	X	X	-	X	X	X	X	X	X
Canarygrass, Reed	Phalaria arundinacea	5-21	PL R	X	-	X	X	X	X	X	-	-	5.0 7.5	X	X	X	-	-	-	-	X	X	X
Fescue, creeping red	Festuca rubra	7-21	PL R	X	-	X	X	X	X	-	-	-	4.5 -7.5		X	X	X	X	X	X	X	X	X
Fescue, Chewings red	Festuca comutata	7-14	PL	X	-	X	X	X	X	-	-	-	4.5 -7.5	X	X	X	X	X	X	X	X	X	X
Fescue, tall (Ky-31)	Festuca arundinacea	5-14	PL BR	X	-	-	X	X	X	-	-	-	5.0 -8.0	X	X	X	X	X	X	X	X	X	-
Lovegrass, weeping	Eragrostis curvula	5-14	Ps B	-	X	X	X	X	X	-	-	-	4.5 -8.0	-	X	-	-	-	-	-	X	X	X
Millet	Setaria & Pennisetum spp.	4-14	A	-	X	X	X	X	X	-	-	X	4.5 -7.0	-	X	-	-	-	-	-	-	-	X
Oats	Avena sativa	5-10	A	X	-	-	X	X	-	-	X	-	5.5 -7	-	X	-	-	-	-	-	-	X	-

Redtop	Agrostis alba	5-10	Ps B	X	-	X	X	X	X	X	-	-	4.0-7.5	X	X	X	-	X	X	-	-	X	X
Rye	Secale cereale	4-7	A	X	-	X	X	X	-	-	X	-	5.5-7	-	X	-	-	-	-	-	-	X	X
Ryegrass, annual	Lolium multiflorum	5-14	A	X	-	-	X	X	X	-	X	-	5.5-7.5	X	X	-	X	-	-	-	-	X	X
Ryegrass, perennial	Lolium perenne	5-14	Ps B	X	-	-	X	X	X	-	-	-	5.5-7.5	X	X	-	X	X	X	X	X	X	-
Sundangrass	Sorghum sundanense	4-10	A	-	X	X	X	X	X	-	-	X	4.5-7.5	-	X	-	-	-	-	-	-	X	X
Crownvetch	Coronilla varia	14-21	PL R	X	X	X	X	X	-	-	-	-	5.5-7.5	-	X	-	X	-	-	X	-	X	X
Lespedeza, Korean	Lespedeza stipulacea	5-14	A	-	X	X	X	X	X	-	-	X	5.5-7.0	-	X	-	-	-	-	-	-	-	X
Lespedeza, sericea	Lespedeza cuneata	7-28	PL B	-	X	X	X	X	X	-	-	-	5.5-7.0	-	X	-	-	-	-	-	-	X	X

Notes: 1/ Germination time Days - No. of days required for majority of seeds to germinate and emerge under favorable conditions.

2/ Growth Habit: A - annual; Bi - biennial; P - perennial; L - long-lived; s - short-lived
R - rhizomatous or spreads by rootstocks; S - stoloniferous; B - bunch

3/ Amount of fertilization and mowing tolerated.

EXPLANATION OF COMPOSITION OF TURFGRASS SOD

The following mixtures of species and varieties are eligible for the State "Certified" and State "Approved" classes of sod.

NO. 1 Sunny Turf Areas

a. Kentucky Bluegrasses

20-60% Certified Merion

20-40% Certified Kenblue (Ky. origin), or South Dakota Certified

0-40% Certified Fylking, Certified Pennstar or Certified Adelphi

b. 'Tufcote' bermudagrass 100% 2/

NO. 2 General Purpose Turf Areas (Droughty or Shaded Areas)

a. Kentucky Bluegrasses

20-60% Certified Merion
20-40% Certified Kenblue (Ky. origin) or South Dakota Certified

0-40% Certified Fylking, Certified Pennstar or Certified Adelphi 1/

Red Fescue

10-50% Certified Pennlawn or Certified Jamestown

b. 'Tufcote' bermudagrass 100% (Not in shade) 2/

NO. 3 Multi-use Turf Areas (Athletic fields, lawns, parks, playgrounds)

a. Tall Fescue

90-100% Certified Kentucky 31

Kentucky Bluegrass

0-10% Certified Kenblue (Ky. origin), South Dakota Certified, or Certified Merion

b. 'Tufcote' bermudagrass 2/

1/ If the lawn is under heavy shade, use the higher percentage of red fescue.

2/ Sod is expensive - Use of stolons may be more practical.

Appendix D-3

EXPLANATION OF CLASSES OF TURFGRASS SOD

1. State "Certified Sod"

"Certified" turfgrass sod is superior sod grown from "Certified" seed. It is inspected and certified by the State Certifying Agency to insure genetic purity, overall high quality and freedom from noxious weeds as well as excessive amounts of other crop and weed plants at the time of harvest. It may be composed of a mixture of two or more varieties or species. The sod must meet published state standards and bear an official Virginia or other state "Certified Sod" label on the bill of lading. The purchaser should require such labels when sod is delivered.

Specimen "Certified" Labels for Virginia

VIRGINIA CROP IMPROVEMENT ASSOCIATION
BLACKSBURG, VIRGINIA

Certified Turf

The turf accompanying this invoice is represented by the producer to be a part of the lot that has been officially field inspected and has met the requirements for "Certified Turf" under the rules and regulations of the Virginia Crop Improvement Association.

No. 3765

2. State "Approved Sod"

"Approved" turfgrass sod is inspected and approved by the State Certifying Agency to insure overall high quality and freedom from noxious weeds and excessive amounts of other crop and weed plants at the time of harvest. It may be composed of a mixture of two or more varieties or species. The sod must meet published state standards and bear an official Virginia "Approved Sod" label on the bill of lading. The purchaser should require such labels when sod is delivered.

Specimen "Approved" Labels for Virginia

VIRGINIA CROP IMPROVEMENT ASSOCIATION
BLACKSBURG, VIRGINIA

APPROVED TURF

The sod accompanying this invoice is represented by the producer to be a part of the lot that has been officially field inspected and has met the requirements for **Approved Turf** under the rules and regulations of the Virginia Crop Improvement Association.

0916

3. Other Sod

The architect should provide detailed quality specifications for all sod other than State "Certified" or "Approved" classes. Such specifications should include species and/or varieties and the following quality standards: weed content, other crop contaminants, thatch, diseases, insects, mowing height, uniformity and overall quality. These quality standards are automatically covered in the State "Certified" and "Approved" classes. If assistance is needed in developing quality standards for other sod, contact the Extension Agent in the county or city where the work is to be performed.

Appendix D-4

EXAMPLE SEED SPECIFICATIONS

A. The seed mixtures and specifications shall meet the minimum requirements as specified below.

1. Furnish the kinds and amounts of seed as indicated below to be seeded.

   (List mixtures and amounts of each species here).

2. The minimum requirements for grass and legume seed used in the vegetative work are as follows:

   a. All seed shall be labeled to meet the requirements of the Va. Seed Law.

   b. All seed shall be subject to re-testing by a recognized seed laboratory.

   c. All seed used shall have been tested within the six (6) months immediately preceding the date of sowing.

   d. Inoculant - The inoculant for treating legume seed in the seed mixtures shall be a pure culture of nitrogen-fixing bacteria prepared for the species. Inoculants shall not be used later than the date indicated on the container. Twice the supplier's recommended rate of inoculant will be used on dry seedings; four times the recommended rate if hydroseeded.

   e. The quality of the seed used shall conform to the following guidelines as shown on the next page. Labels will be the source of this quality and testing information.

Quality of Seed*

	Minimum Seed purity Per cent	Minimum Germination Per cent	Weed Seed (Not Over) Per cent
LEGUMES			
Crownvetch[1]	98	60	.50
Korean Lespedeza[2]	98	80	1.00
Sericea Lespedeza[3,2]	98	75	.75
GRASSES			
Kentucky Bluegrass[4]	85	80	.75
Red Fescue[5]	98	85	.50
Tall Fescue, Ky-31[6]	98	85	.50
Redtop	92	85	1.00
Reed Canary grass	96	80	.50
"Ryegrass"	96	90	.50
Weeping Lovegrass	98	70	.50
OTHER ANNUALS			
Barley	98	90	
German Foxtail Millet	98	80	
Oats	98	[illegible]	
Abruzzi Rye	98	85	
Piper Sweet Sundangrass		80	

*Seed containing prohibited noxious weeds should not be accepted.

Seeds should not contain weed seed in excess of the specified amount.

To calculate percent pure live seed, multiply germination times purity and divide by 100.

Example: Ky-31 Tall Fescue with a germination of 85 percent and a purity of 97 percent. 97 X 85 = 8245. 8245 divided by 100 = 82.45 percent pure live seed.

(1) Crownvetch should be certified and scarified.
(2) Permit one dodder per ounce.
(3) To be scarified.
(4) To be of South Dakota or Kentucky origin or be the variety Fylking, Pennstar, Adelphi.
(5) To be "Penlawn" or "Jamestown" variety.
(6) Must be grown in Virginia, Kentucky, Missouri, Tennessee, Arkansas, North Carolina, or South Carolina. Not to contain in excess 1% other crop seed and shall not contain more than .6% wild onion bublets per ounce.

GUIDE FOR INSTALLING JUTE AND EXCELSIOR MATTING (THATCHING)

Jute and excelsior matting is used as a mechanical aid to protect the soil from erosion during the critical period of vegetative establishment. It is easier to lay and hold in place against wind. It has the tensile strength and weight to resist water flow and erosion.

MATERIALS

Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 inches in width plus or minus 1 inch and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of plus or minus 5 per cent, with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth. This yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one-half its normal diameter.

Excelsior mat shall be wood excelsior, 48 inches in width plus or minus 1 inch and weighing 0.8 pounds per square yard plus or minus 10 per cent. The excelsior material shall be covered with a netting to facilitate handling and to increase strength.

Staples for anchoring soil stabilization matting shall be made of 6 to 10 inch lengths of No. 8 plain iron wire.

INSTALLATION REQUIREMENTS

Site Preparation. Shape and grade the waterway, channel or area to be protected as required.

Remove rocks, clods over 1 1/2 inches in diameter, sticks and other material that will prevent contact of the mat with the soil surface.

Seeding. Lime, fertilize and seed in accordance with the applicable seeding standard except that for jute matting, one-half the seed may be applied prior to laying the mat and the remaining seed applied after laying the mat.

Do not cultipack.

Laying the Matting. Lay matting on loose soil. Start laying the matting from the top of the channel or slope and unroll downgrade so that one edge of the strip coincides with the channel center.

Lay a second strip parallel to the first on the other side of the channel and allow at least a 2-inch overlap for jute matting. Excelsior matting may be butted. If one roll of matting does not extend the length of the channel, continue downhill with additional rolls.

Securing the Matting. Bury the top end of jute strips in a trench 4 inches or more deep. Tamp the trench full of soil. Reinforce with a row of staples driven through the jute about 4 inches downhill from the trench. These staples should be about 10 inches apart. Then staple the overlap in the channel center. These staples should be 3 to 4 feet apart. The outside edges may be stapled similarly at any time after the center has been stapled.

Succeeding strips of matting, farther down the channel or slope, are secured in a similar manner. Where one roll of jute matting ends and another roll bgeins, the end of the top strip over laps the trench where the upper end of the lower strip is buried. Make the overlap at least 4 inches and staple securely. Rolls of excelsior matting may be butted at the ends and securely stapled.

Erosion Stops. At any point jute matting may be folded for burying in slit trenches and secured as were the upper ends. This checks water flow and erosion that may begin under the matting. It also gives improved tie-down. The procedure is recommended on the steeper slopes of sandy soil and gentler slopes subject to seepage. Spacings vary from 25 to 100 feet.

Diversions. Where diversions outlet into the waterway, the outlet should be protected with matting used in the same manner as in the main channel. The matting for the outlet is laid first so that matting in the main channel will overlap the outlet strip.

Matting Soil Contact. Get contact between matting and soil by rolling after laying, stapling and seeding is complete to assure good contact with soil. Perfect contact is vital to keep water flow over - not under the matting.

Inspection. After job completion, make sure the matting is in contact with the soil at all places and that critical areas are securely stapled down.

Additional Suggestion. When used for stabilization of steep slopes, the area can be hydroseeded after the jute is anchored in place. Seeding should be done before placing the excelsior blanket.

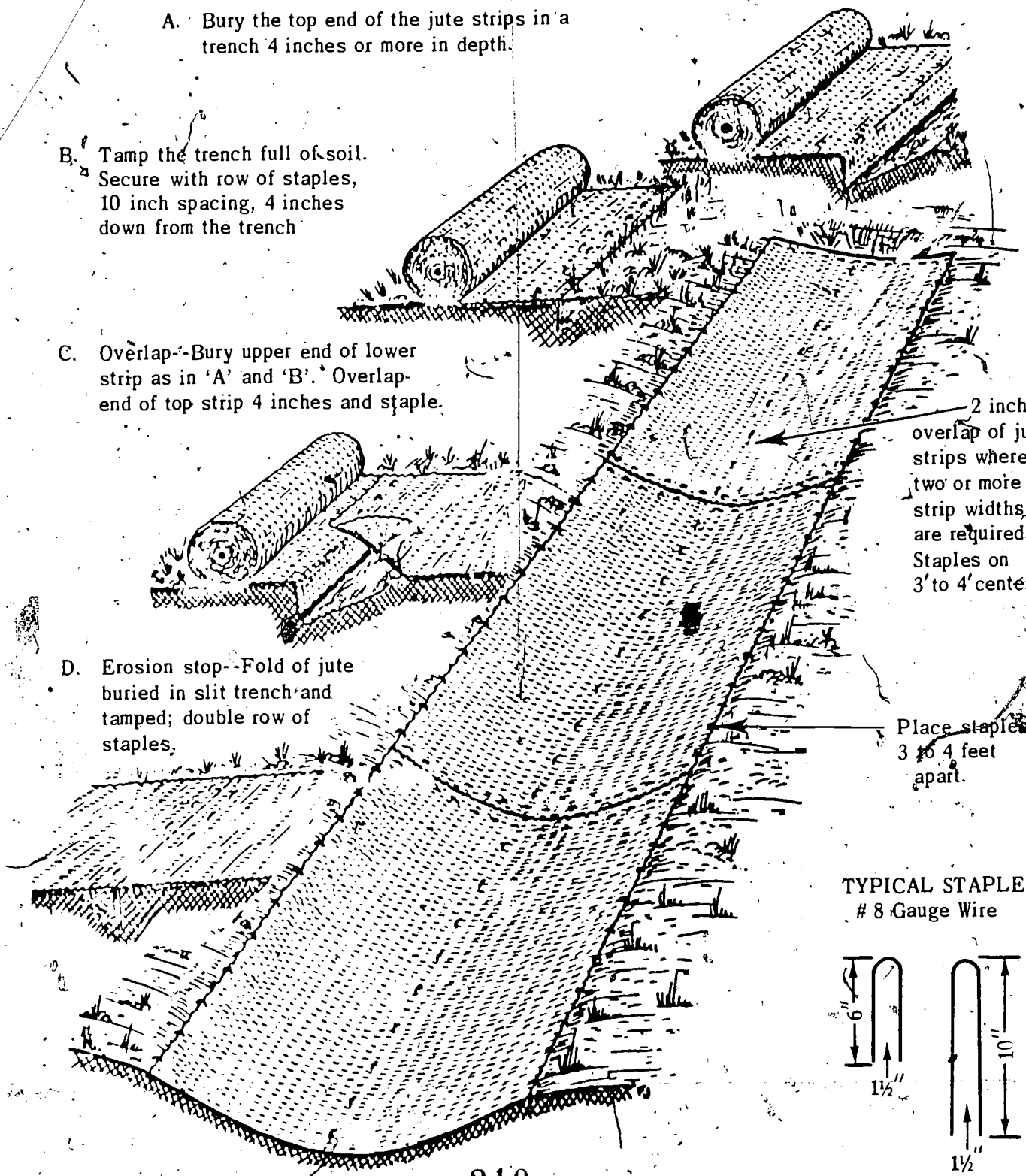
DETAIL FOR STABILIZING WATERWAYS WITH JUTE THATCHING

A. Bury the top end of the jute strips in a trench 4 inches or more in depth.

B. Tamp the trench full of soil. Secure with row of staples, 10 inch spacing, 4 inches down from the trench

C. Overlap--Bury upper end of lower strip as in 'A' and 'B'. Overlap end of top strip 4 inches and staple.

D. Erosion stop--Fold of jute buried in slit trench and tamped; double row of staples.



TYPICAL STAPLES
8 Gauge Wire

EFFECTIVENESS OF GROUND COVER ON EROSION AND SEDIMENT CONTROL ON CONSTRUCTION SITES

Kinds of Ground Cover	Soil Loss Reductions Related to Bare Surfaces
Seedings 1/	
Permanent grasses	99
Ryegrass (perennials)	95
Ryegrass (annuals)	90
Small grain	95
Millet or sudangrass	95
Grass sod	99
Hay (2 tons/acre)	98
Small grain straw (2 tons/acre)	98
Corn stalks (4 tons/acre)	98
Woodchips (6 tons/acre) 2/	94
Wood cellulose fiber (1-3/4 tons/acre) 2/	90
Fiberglass (1000 lbs/acre) 2/	95
Asphalt emulsion (1250 gal/acre)	98

Other kinds of mulches that may be used are gravel, stones, fiber matting and excelsior.

1/ Values of seeded vegetation are based upon a fully established stand.

2/ Based on research in progress. In-Service use only.

Reference: USDA, Agricultural Research Service.

DISTURBE
(With Ground Cove

GROUND COVER PLANTS	Winter Aspect Evergreen Semievergreen Herbaceous	Major Resource Areas*	Site Conditions Required	Light Prefers	Light Tolerates	Range of Height (Inches)	Spread Rapid Medium Slow	Spacin Betwee Plants (Inches
Bugle Weed (Ajuga reptans)	S	All	Pref. mod. moist soils. Tolerates wet soils.	T	P	4-8	R	9-12
Lilyturf (Liriope muscari)	E	All	All but droughty soils.	T	P	10-15	M	10-12
Tawny daylily (Hemerocallis fulva)	H	All	Pref. moist soils, seepage areas. Tolerates all but droughty soils.	P	T	18-24	S	12-24
Lily-of-the-valley (Convallaria majalis)	H	All	Pref. rich moist soils. Tolerates acid soils.	-	P	6-8	M	6-8
Dwarf polygonum (Polygonum reynowtria)	H	All	Pref. moist soils. Tolerates droughty acid soils, rocky slopes.	P	-	12-15	R	18
Canby Pachistima (Pachistima canbyi)	E	All	Pref. slightly acid, moist, fertile soils.	P	T	8-12	M	12-18
Creeping Thyme (Thymus serpyllum)	E	All	Pref. well-drained soils. Tolerates poor drought soils.	P	T	2-4	M	8-10
Wineleaf Cinquefoil (Potentilla tridentata)	S-E	All	Pref. well-drained soils. Tol. acid moist soils to dry poor soils.	P	T	6-12	R	12-18
Japanese Spurge (Pachysandra terminalis)	E	All	Pref. moist soils with high organic matter.	-	P	6-8	M	6-8
Baltic English Ivy (Hedera helix baltica)	E	All	Pref. moist soils with high organic matter.	T	P	6-12	M-R	18-24
Common Periwinkle (Vinca minor)	E	All	Pref. moist fertile soils. Tolerates acid moist soils.	T	P	6-8	R	12-18
Bearberry (Arctostaphylos uva-ursi)	E	All	Pref. droughty acid sands.	P	T	4-8	S	12-24
Littleleaf cotoneaster (Cotoneaster dammeri radicans)	E	All	All but droughty and wet soils.	P	-	10-15	M	12-18
Crownvetch (Coronilla varia)	H	All	All well-drained soils except coarse sands; drought-tolerant.	P	T (med.)	12-24	S	12-18 (usuall sceded

*MAJOR LAND RESOURCE AREAS:

Coastal Plain Physiographic Area
Piedmont Physiographic Area
Mountain and Valleys Physiographic Area

:D AREA STABILIZATION
ers, Vines, Shrubs and Trees)

ıg n)	Time to Form Cover (Years)	Area (size) Limitations Large -over 500 sq.ft.	Bloom Distinct Indistinct Color	Notes
	1-2	None	D Blue.Purp.	Compact ground cover. Thrives in light shade and northerly exposure Dark green or purple foliage with attractive spring flowers. a/
	2	None	I White	Forms dense deep green grasslike turf. Withstands occasional mowing but limited foot traffic. Provides good erosion control with little maint. a/
	2-3	None	D Orange	Excellent for erosion control contour bands on steep slopes. Mass plantings need companion cover crop. Long-lived. b/
	2	None	D White	Forms long-lived dense green erosion control mat, with fragrant spring flowers. Dormant in winter. c/
	1	Large	D Pink-Red	Very aggressive, long-lived plant. Underground runners may invade border areas. Red autumn foliage. Dies to ground in winter. a/
	2	None	I Red	A prostrate shrub with branches often rooting to form solid mass of fine foliage. Very hardy, requiring minimum maintenance. d/
	2	None	D Rose	Forms low mass of fragrant, tiny gray foliage. Above ground spreader. Thrives in rocky areas. c/
	2	None	I White	An attractive evergreen species which forms a thick mat. Branches erect, spreading c/ f/
	2	None	I White	Forms thick carpet of yellow-green foliage, even under pines. On open locations, leaves may burn in winter. Spreads by underground stems. a/
	2	Large	I White	Forms dense green mat with trailing root stems. Stands severe cold. Better than English ivy. Easy to cultivate. d/
	1-2	None	D Blu.to Wh.	Forms glossy green long-lived cover requiring little maintenance. Easy to establish. Excellent soil stabilizer. c/ d/
	2-3	None	I Wh.-Pink	Forms attractive thick prostrate mat of trailing stems. Established from potted plant only. Salt tolerant. Excellent sand stabilizer. d/
	2	None	I White	A prostrate shrub with long, trailing, often rooting branches. Forms tough cover. Will cover rocky slopes. d/ e/ f/ g/
y)	2-3	None	D Wh.-Purple	Straggling or ascending smooth herb. South or north exposures. c/ f/

Propagated by: a/ stolons b/ tubers c/ plant division d/ cuttings
e/ layering f/ seed g/ grafting

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VINES	Winter Aspect Evergreen Semievergreen Deciduous	Major Land Resource Areas*	Site Conditions Required	Light Prefers	Light Tolerates Sun	Light Tolerates Shade	Range of Height (ins.) Spread (ft.)
Wintercreeper (Euonymus fortunei) colorata reticulatus and minimus	S-E	All	Pref. well drained soils. Tol. acid, moist soils.		T	P	6-12 / 10+
Fiveleaf Akebia (Akebia quinata)	S-E	All	Moderately moist soils with high organic matter.		P	T	6-8 / 15+
Halls Japanese Honeysuckle (Lonicera Japonica halliana)	S-E	All	Nearly all soils - stony rough slopes. Tol. moist acid soils.		P	T	12-18 / 25+
Henry Honeysuckle (Lonicera henryi)	S-E	All	Nearly all soils - stony rough slopes. Tol. moist acid soils.		P	T	12-18 / 25+
Memorial Rose (Rosa wichuraiana)	S	All	All but poorly drained soils Tol. stony, rough slopes.		P	-	12-24 / 20+
Max Graf Rose (Rosa wichuraiana, Max Graf)	S	All	All but poorly drained soils. Tol. stony, rough slopes.		P	-	12-24 / 20+
Virginia Creeper (Parthenocissus quinquefolia)	D	All	Pref. medium to well drained soils. Tol. dry soils, rough slopes.		P	T	10-20 / 15
Korean Bittersweet (Celastrus flagellaris)	D	All	Pref. heavy moist soils. Tol. dry soils, rocky slopes.		P	T	24-48 / 20+
Oriental Bittersweet (Celastrus orbiculata)	D	All	Pref. heavy moist soils. Tol. dry soils, rocky slopes.		P	T	24-48 / 20+
Common Moonseed (Menispermum canadense)	D	All	Pref. well drained soils. Tolerates moist to wet soils.		P	T	12-18 / 12+

*See bottom of first page of table.

DISTURBED AREA STABILIZATION
ound Covers, Vines, Shrubs and Trees)

Spread Rapid Medium Slow	Spacing Between Plants (ft.)	Time to Form Cover (years)	Area (size) Limitations Large Cover 500 sq.ft.	Bloom Distinct Indistinct Color	Notes
M-R	1-2	2-3	Large areas	I Green	Forms weed free mat, tacking at nodes. Less subject to scale than other euonymuses. Frost turns foliage reddish purple. Covers steep slopes. d/
R	2-3	2	Large areas	D Red	A vigorously growing twiner with rich dark green, clean foliage, somewhat like honeysuckle. Covers steep slopes. Will climb. d/ f/
R	2-3	2	Large areas	D Wh.-Yel.	A rampant grower requiring some control shearing. Long lived with fragrant bloom. Do not plant near trees; will climb. Covers steep slopes. c/ d/
R	2-3	2	Large areas	D Reddish	Similar in many ways to L. japonica halliana, may be more hardy with showy green winter foliage; not as vig. c/ d/
R	2-3	2	Large areas	D White	A strong grower that forms a prostrate tangled thorny traffic resistant cover. Requires occasional clipping and dead cane removal. Covers steep slopes. d/
R	2-3	2	Large areas	D Pink	A prostrate, strong growing vine similar to R. wichuriana, but with bright pink flowers. d/
R	2-3	2	Large areas	I Greenish	A vigorous clinging vine of loose habit. Showy scarlet fall foliage, black berries. Will climb. d/ e/ f/
R	2-3	2	Large areas	I Greenish	A twining vine with spines which make it a good barrier plant. Fruit smaller than other bittersweets. (Male and female plants.) c/ e/ f/
R	2-3	2	Large areas	I Greenish	A scrambling type vine with branched woody stems. Showy yellowish orange autumn fruit (male & female plts.) c/ e/ f/
R	2-3	1	Large areas	I Greenish	A rampant ground cover of ivy-like foliage usually killed to the ground in winter, but quickly grows back in spring. Very aggressive. d/ f/ g/

Propagated by: c/ plant division; d/ cuttings; e/ layering; f/ seed; g/ transplants

DISTURBED
(With Ground Covers

DECIDUOUS SHRUBS	Major Land Resource Areas*	Site Conditions Required	Light: Prefers Sun	Light: Tolerates Shade	Growth: Rapid / Medium / Slow	Spac Betw Plan (ft.
Up to 3 ft.						
Arnold Dwarf Forsythia (Forsythia arnoldi)	All	Any well drained soils.	P	-	R	2-3
Fragrant sumac (Rhus aromatica)	All	Any well drained soil. Tolerates acid soils.	P	-	R	2-3
Hardhack Spirea (Spirea tomentosa)	All	Well to imperfectly drained poor soils. Tol. droughty soils.	P	-	R	2-3
Black Chokeberry (Aronia melanocarpa)	All	Pref. moist soils Tol. poorly drained acid soils.	T	T	M	2-3
Scotch Rose (Rosa spinosissima)	All	Pref. rich loamy sand. Tolerates droughty sand.	P	T	R	2-3
Dwarf Pussy Willow (Salix tristis)	All	Any well drained soil. Tolerates poorly drained soils.	T	T	M	2
Blue Artic Willow (Salix purpurea nana)	All	Any well drained soil. Tolerates poorly drained soils.	P	T	R	3
4 to 6 ft.						
Siebold Forsythia (Forsythia suspensa sieboldi)	All	Any well drained soil. Tolerates stony, rough slopes.	P	-	R	3-4
Bristly locust (Robinia fertilis)	All	Any well drained soil. Excellent for droughty soils, rocky slopes.	P	-	R	3-4
Virginia Rose (Rosa virginiana fertilis)	All	Pref. well-drained heavy soils. Tolerates droughty soils.	P	T	R	3-4
Snowberry (Symphoricarpos albus)	All	Well drained to imperfectly drained soils.	T	P	R	2-3
Coralberry (Symphoricarpos orbiculatus)	All	Well drained to imperfectly drained soils.	T	T	R	2-3
Billiard Spirea (Spirea billiardi)	All	Any well drained soil.	T	T	R	2-3
Red-osier dogwood (Cornus stolonifera)	All	Moist to poorly drained soils	P	T	R	2-3
Bayberry (Myrica pensylvanica)	All	Prefers poor, acid sandy soils. Tol. well drained to imperfectly drained soils.	P	T	S	3

*See bottom of first page of table.

REA STABILIZATION
Vines, Shrubs and Trees)

ing Between Plants)	Time to Form Cover (yrs.)	Bloom — Distinct Indistinct Color	Notes
	2	I Yellow	A true dwarf shrub with drooping branches that root as they touch the ground.
	2	I Yellow	A low dense irregular spreading shrub. Forms colonies. Brilliant autumn foliage and fruit.
	2	D Rose	An upright clump-type shrub with rooting branches. Good for naturalizing and clump plantings.
	2-3	D White	A suckering shrub of loose habit with upright stems. Good woodland border plant. Black berries and red foliage in autumn.
	2	D Pink	A low, dense, freely suckering, roundlike shrub. Thicket former. Profuse bloomer.
	2	-	A low shrub with slender clustered stems and gray foliage, and long, deep-set root.
	3	-	Dense twigs; can be sheared. Foliage has blue cast.
	2	D Yellow	A vigorous shrub with pendulous, spreading, rooting branches.
	2	D Purple	A much branched thicket forming shrub. Spreads vigorously by underground suckers. Give plenty of space. Excellent soil stabilizer.
	2	D White	Forms dense mat of erect stems. Foliage, fruit and stems scarlet in autumn. Spreads by underground stems. Clump or contour row plantings.
	2	I Pink	A slender, loosely ascending shrub with showy white autumn fruit.
	2	I White	A low, freely suckering shrub with slender upright, spreading branches. A clump former. Showy coral fruit. Excellent soil stabilizer.
	2	D Rose	A erect shrub which increases by underground stems to form a dense mass.
	2	D White	A rather open-branched, somewhat spreading yet upright shrub. Forms thickets by stoloning. The branches, especially the new ones, are bright red. The pith is white.
	3	I -	A symmetrical spreading shrub with aromatic deciduous to sub-persistent leaves and trailing, rooting branches. Show, waxy-gray berries. Male and female plants.

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EVERGREEN SHRUBS	Major Land Resource Areas*	Site Conditions Required
Needle Evergreen - up to 3 ft.		
Creeping Juniper (Juniperus horizontalis)	All	Pref. moist, slightly acid sandy soils. Tolerates droughty banks.
Sargent Juniper (Juniperus chinensis sargenti)	All	Pref. moist, slightly acid sandy soils. Tolerates dry soils
Shore Juniper (Juniperus conferta)	Coastal Plain and Piedmont	Sand dunes and seashore Tolerates inland droughty sand.
Japanese Juniper (Juniperus procumbens)	All but Mountains	Sandy and loamy moderately moist soil.
Canada Yew (Taxus canadensis)	All	Pref. moist acid soils.
Broadleaf Evergreen - up to 3 ft.		
Prostrate Cotoneaster (Cotoneaster horizontalis)	All but Mountains	Pref. well drained soils. Tolerates poor, dry soils.
Bearberry Cotoneaster (Cotoneaster dammeri)	All but Mountains	Pref. well drained soils. Tolerates dry, rocky slopes.
Needle Evergreen - 4 to 6 ft.		
Pfitzer's Juniper (Juniperus chinensis pfitzeriana)	All	Prefers well drained soils. Tolerates droughty soils.
Japanese Yew (Taxus cuspidata)	All	Moist well drained soils with moderate organic matter.

*See bottom of first page of table.

STURBED AREA STABILIZATION
d Covers, Vines, Shrubs and Trees)

Light Prefers Sun	Tolerates Shade	Growth Rapid	Medium	Slow	Spacing Between Plants (ft.)	Time to Form Cover (yrs.)	Notes
P	T		M		3-4	2-3	A low creeping very hardy shrub with attractive trailing branches of dark green to blue-gray foliage. Covers steep sunny slopes.
P	-		M		3-4	2-3	A low prostrate, creeping shrub with steel-blue foliage. Forms dense mat. Tolerates salt spray.
P	-		M		3-4	2-3	A procumbent shrub especially adapted for seashore planting; salt tolerate; requires organic supplement for establishment.
P	-		R		3-4	2	A handsome hardy low spreading shrub with ascending branches, Free from disease and insect problems.
T	P		S		2-3	2-3	A very hardy low spreading, straggling, long-lived shrub. Showy autumn scarlet fruit.
P	T		M		2-3	2-3	An attractive shrub with flat horizontal branches. Bright red autumn foliage and berries. Excellent for short, steep, rocky slopes. Do not use bare root stock.
P	T		M		2-3	2-3	A prostrate shrub with long, trailing, often rooting, branches. Red berries. Covers steep rocky slopes. Susceptible to fire blight. Do not use bare root stock.
P	T		R		3-4	2	A broad, often flat-topped, wide-spreading shrub. Long-lived, and very hardy.
T	P		M		3	2-3	A handsome, compact, low shrub with dark green foliage and red fleshy berries in autumn. Long lived.

DISTURBED AR
(With Ground Covers,

DECIDUOUS SHRUBS	Major Land Resource Areas*	Site Conditions Required	Light: Prefers Sun	Light: Tolerates Shade	Growth: Rapid / Medium / Slow	Sp Be Pl (1
7 to 10 ft.						
Gray Dogwood (Cornus racemosa)	All	Nearly all soils. Tolerates wet soils.	P	T	R	1
Japanese Barberry (Berberis thunbergi)	All	Pref. medium to well drained soils. Tol. sandy soils.	P	T	S	2
Red Chokeberry (Aronia arbutifolia)	All	Tol. dry to somewhat poorly drained soils.	P	T	M	3
Ninebark (Physocarpus opulifolius)	All	Prefers well drained soils. Tolerates dry rocky soils.	P	-	R	3
Regels Border Privet (Ligustrum obtrusifolium regelianum)	All	Tolerates dry to medium well drained soils.	P	-	M	3
11 to 15+ ft.						
Tatarian Honeysuckle (Lonicera tatarica)	All	Any well drained soil.	P	T	R	3
Staghorn Sumac (Rhus typhina)	All	Any well drained soil. Tolerates droughty soils	P	-	M	A
Shining Sumac (Rhus copallina)	All	Any well drained soil. Tolerates droughty soils.	P	-	M	A
Cardinal Autumn Olive (Elaeagnus umbellata)	All	Dry to moderately well drained soils. Excellent for dry slopes.	P	-	R	A
Amur Privet (Ligustrum amurense)	All	Moderately well drained to well drained soils.	P	-	R	A
Arrow-Wood (Viburnum dentatum)	All	Prefers well drained to moist soils.	P	T	R	A

*See bottom of first page of table.

EA STABILIZATION
Vines, Shrubs and Trees)

)acing tween ants t.)	Time to Form Cover (yrs.)	Bloom Distinct Indistinct Color	Notes
-4	2	I White	Bushy, spreading, stoloniferous shrub. Suckers freely. Colony former.
-3	2-3	I Yellow	A very twiggy, compact shrub with red autumn foliage and berries. Forms a deterrent to traffic. Thorns toxic to some people.
-4	2-3	D White	A dependable shrub, open branched and suckering. Showy red fruit and foliage in autumn.
-4	2	D White	A vigorous shrub with coarse twiggy recurving branches. Very hardy. Use in large plantings.
-4	2-3	I White	A low growing hardy shrub with distinctive horizontal branching. Make attractive contour row plantings.
-4	2	D White	A refined upright shrub free of disease and insects. Good for clump or contour row plantings.
-5	2-3	I Yellow	A straggling shrub with a flattish crown. Brilliant scarlet autumn foliage and fruit. Colony former for large areas.
-5	2-3	I Yellow	One of the most ornamental sumacs with brilliant red fall color. Colony former for large areas.
-5	2	I Yellow	A very hardy spreading shrub with silvery foliage and abundant red fruit. For large areas.
-5	2	I White	A dense, pyramidal, upright shrub with stiffly upright, lateral twigs. Considerably hardier than California privet. Large areas.
-5	2	D White	A vigorous bush, upright shrub which spreads from numerous basal shoots. Large areas - mass plantings.

TREES	Winter Aspect Evergreen Deciduous	Major Land Resource Areas*	Site Conditions Required
Ash, Green (Fraxinus pennsylvanica)	D	All	Moist to Wet Soils
Ash, White (Fraxinus americana)	D	All	Moist to Wet Soils
Hemlock, Eastern (Tsuga canadensis)	E	Mt. & Valleys and Piedmont	Moist Soils
Maple, Red (Acer, rubrum)	D	All	Wide Range of Dry to Wet Soils
Maple, Sugar (Acer saccharum)	D	Piedmont and Mt. & Valleys	Moist Soils
Oak, Black (Quercus velutina)	D	All	Dry to Moist Soils
Oak, Chestnut (Quercus prinus)	D	All	Dry to Moist Soils
Oak, Live (Quercus virginiana	D	Coastal Plain	Dry to Moist Soils
Oak, Northern Red (Quercus rubra)	D	All	Dry to Moist Soils
Oak, Pin (Quercus palustris)	D	All	Dry to Wet Soils
Oak, Scarlet (Quercus coccinea)	D	All	Dry to Moist Soils
Oak, Southern Red (Quercus falcata)	D	All	Dry to Moist Soils
Oak, Swamp White (Quercus bicolor)	D	All	Wet Soils
Oak, Water (Quercus nigra)	D	Piedmont Coastal Plain	Dry to-Wet Soils
Oak, White (Quercus alba)	D	All	Dry to Moist Soils
Oak, Willow (Quercus phellos)	D	Piedmont Coastal Plain	Dry to Wet Soils
Pine, Shortleaf (pinus ecninata)	E	All	Dry to Moist Soils
Spruce, Norway (Picea abies)	E	Mt. and Valleys	Moist Soils
Sycamore (Platanus occidentalis)	D	All	Moist to Wet Soils
Willow, Black (Salix nigra)	D	All	Moist to Wet Soils
Poplar, Yellow (Liriodenoron tulipifera)	D	All	Moist

*See bottom of first page of table.

Growth Rapid Medium Slow	Spacing Between Plants (Ft.)	Height Range (Ft.)	Notes
R	3-10	70	Full Sunlight Best, Fruit is Samara, Liked By Birds, Autum Color Pale Yellow to Purple
R	8-10	70	Required full sunlight, Fruit is Samara Liked by Birds, Autum color Pale Yellow to Purple
M	6-8	60	Grows in Shade to Full Sunlight, Drooping Branches Good Bird and Squirrel Food in cones
M	8-10	60	Likes Partial Shade to Full Sunlight, Yellow to Red Autumn Color, Fruit - Samara
M	8-10	60	Likes Shade to Full Sunlight, Yellow to Red Autumn Color, Fruit - Samara
M	8-10	60	Good Squirrel Habitat Part Shade to Full Sunlight, Fruit - Acorn,
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
S	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	60	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	60	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	8-10	70	Part Shade to Full Sunlight, Fruit - Acorn, Good Squirrel Habitat
M	6-8	70	Full Sunlight Best, Fruit - Cone
R	6-8	60	Full Sunlight Best, Fruit - Cone Drooping Branches
R	8-10	80	Full Sunlight Best, Fruit - Seed Ball
R	8-10	65	Full Sunlight Best, Fruit - Capsule Drooping Branches
R	8-10	70	Full Sunlight Best, Attractive Flowers, Autumn Color - Yellow

DISTURBED AREA S
(With Ground Covers, Vin

Tree	Winter Aspect Evergreen Deciduous	Major Land Resource Areas*	Site Conditions Required
Washington Hawthorn (Crataegus phaenopyrum)	D	All	Well drained to moderately well drained soils.
European Black Alder (Alnus glutinosa)	D	All	Dry to poorly drained soils.
Japanese Zelkova (Zelkova serrata)	D	All	Well drained to moderately well drained soils.
Scotch Pine (Pinus sylvestris)	E	All	Dry to somewhat poorly drained soils.
Virginia Pine (Pinus virginiana)	E	All	Dry to moderately well drained soils.
Common Juniper (Juniperus communis)	E	All	Prefers limestone soils. Dry to moderately well drained soils.
Eastern Red Cedar (Juniperus virginiana)	E	All	Prefers limestone soils. Dry to moderately well drained soils.
Black Locust (Robinia pseudoacacia)	D	All	Wide range from rich, well drained to acid soils.
Loblolly Pine (Pinus taeda)	E	Coastal Plain and Piedmont	Moist to somewhat poorly drained flat soils. Useful on disturbed or dredged areas, especially where slight to moderate salinity is present.
White Pine (Pinus strobus)	E	Piedmont, Mts. and Valleys	Prefers rich, moist soils, especially heavy soils.

*See bottom of first page of table.

rowth apid edium low	Spacing Between Plants (ft.)	Height Range (ft.)	Notes
M	5-9	30	Dense twiggy upright growth. Profuse red flowers. Brilliant autumn foliage. Red fruit lasts all winter.
R	5-9	50+	A small tree with spreading branches and a symmetrical ovoid to oblong top.
R	5-9	50+	A graceful deciduous conifer with short horizontal branches. Quickly lays down a ground cover of needles.
R	5-9	50+	Pyramidal when young, irregular shape when older. A very rugged conifer.
R	5-9	50+	A rugged conifer of open habit and sparse branching. A good litter producer on poor soils.
S	4-6	25+	A small conifer of pyramidal habit. A variable species.
S	5-7	50+	A densely pyramidal, often columnar conifer with scalelike foliage, Female plant bears blue fruit. A long lived tree in full sun.
R	8-10	50+	Black locust is a widely used tree for covering large areas to be vegetated. It is not desirable to use close to homes, etc.
R	5-9	50+	Has spreading branches, the upper ascending, forming a compact round-topped head; branchlets yellowish brown, sometimes slightly bloomy. Develops a straight, clean trunk in stands.
R	5-9	50+	One of best pines for ornamental purposes. Must have plenty of room for growth. Also used for screens and windbreaks.

TREES	Winter Aspect Evergreen Deciduous	Land Resource Areas*	Site Condition Required	Growt Rapid Mediu Slow
Dogwood, Flowering ✿ (Cornus florida)	D	All	Moist Soils	S
Holly, American ✿ (Ilex opaca)	E	All	Moist Soils	S
Magnolia, Evergreen ✿ (Magnolia grandiflora)	E	Piedmont Coastal Plain	Dry to Moist Soils	M
Redbud, Eastern ✿ (Cercis canadensis)	D	All	Moist Soils	R
Sassafras ✿ (sassafras albidum)	D	All	Dry to Moist Soils	S
Sourwood ✿ (Oxydendrum arboreum)	D	All	Moist Soils	M

✿ Ornamental

* See bottom of first page of table.

th / m	Spacing Between Plants	Height Range Ft.)	Notes
	6	30	Shade to Full Sun, Attractive Flowers and Red Berries, Autumn Color - Red
	6	40	Shade to Full Sun, Attractive Red Berries, Good Landscape Screen
	6	60	Part Shade to Full Sunlight, Attractive White Flowers and Red Berries, Good Screen
	6	30	Full Sunlight Best, Attractive Purple Flowers, Fruit - Pod
	6	40	Part Shade to Full Sunlight, Yellow Flowers
	6	35	Part Shade to Full Sunlight, Attractive White Flowers

EROSION AND SEDIMENT CONTROL HANDBOOK

PART IV

COMMISSION INVOLVEMENT

APRIL 1974

COMMISSION REQUIREMENTS FOR STATE AGENCY PROJECTS

The Erosion and Sediment Control Law states that "any State agency that undertakes a project involving a land disturbing activity shall file specifications or a conservation plan with the Commission for review and written comments. The Commission shall have sixty days in which to comment and such comment shall be binding on the State agency or private business hired by the State agency. Individual approval of separate projects is not necessary when approved specifications are followed".

I. Submission of Standards and Specifications (Generally confined to highway projects).

State agencies that have expertise in erosion and sediment control work shall submit standards and specifications for Commission approval.

Such standards and specifications shall be at least as stringent as those contained in the Virginia Erosion and Sediment Control Handbook.

State agencies shall submit standards and specifications at least annually for the Commission's review. Such standards and specifications shall be submitted by October 1 of each year. Any subsequent changes in the approved standards and specifications shall be submitted for review by the Commission as they occur. The Commission shall promptly review these standards and specifications and notify the agency of its approval or disapproval within 60 days of submission.

II. Submission of Erosion and Sediment Control Plan(s) (Generally required for non-highway projects).

State agencies that have not adopted standards and specifications which have been approved by the Commission shall submit conservation plans and specifications for each project involving land disturbing activities. To implement this provision the following shall apply:

A. Preliminary Submission

When preliminary plans have been prepared in accordance with the criteria outlined in paragraph 43.03 of the Manual for the Planning and Execution of Capital Outlays, 3 copies of the site plan showing grading and first floor and basement floor elevations of buildings shall be submitted to the Commission. In addition, preliminary erosion and sedimentation control measures shall be indicated.

Concurrence with the plan or required change shall be conveyed promptly to the agency and in no case later than 60 days after receipt.

B. Working Drawing Submission

When working drawings have been prepared in accordance with the criteria outlined in paragraph 43.04 of the Manual for the Planning and Execution of Capital Outlays, 3 copies of the site plan showing grading and first floor and basement floor elevations and erosion and sedimentation control measures shall be submitted to the Commission.

The plan shall conform to the Virginia Erosion and Sediment Control Handbook requirements.

C. Approval or Disapproval of Plan

The Commission shall promptly review such plans submitted to it and will notify the state agency of its approval or disapproval within 60 days of date of submission. If the plan is disapproved, the Commission will provide the agency with written comments specifying such modification, terms and conditions as will permit approval of the plan.

The Commission shall provide the Division of Engineering and Buildings with copies of their correspondence and comments dealing with capital outlay projects at both stages of review.

D. Modification of Approved Plan

An approved erosion and sediment control plan may be changed when:

1. Inspection has revealed the inadequacy of the plan to accomplish the erosion and sediment control objectives of the plan, and appropriate modifications to correct the deficiencies of the plan are agreed upon by the Commission and the agency responsible for carrying out the plan;

or

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

proposed amendments to the plan, consistent with the requirements of the control program, are agreed to by the Commission and the agency responsible for carrying out the plan.

III. Inspection

Each state agency engaged in land disturbing activities shall be responsible for conducting a diligent inspection program on all projects on which erosion and sediment control plans are required.

IV. Commission Assistance

When needed and requested, the Commission will assist state agencies in formulating and implementing erosion and sediment control plans on capital improvement programs. The Commission will make available its personnel and other resources for carrying out inspection and enforcement activities, conducting conservation training workshops, research and evaluation activities on state projects as appropriate and needed.

V. Appeals

Appeals may be registered with the Commission when disagreements on project erosion and sediment control plans or specifications have developed. Such appeals must be filed with the Commission within fifteen days and the Commission's decision will be subject to appeal as provided in Section 21-89.10(c) of the Code of Virginia.

MULTI-JURISDICTIONAL LAND DISTURBING ACTIVITIES

When the applicant for land disturbing activities that will take place in more than one local control program chooses to submit his plan to the Commission for review and approval rather than submission to each jurisdiction concerned, the following provisions shall apply:

1. The applicant shall submit to the Commission--

   (a) Three copies of the plan plus one copy for each county, city or town in which the land disturbing activity lies.

   (b) The name, address and phone number of the owner of record.

   (c) The name, address and phone number of the person to be responsible for carrying out the plan.

   (d) The name, address and phone number of the permit issuing authority in each county, city or town, who is to be notified of the Commission's action.

2. The plan--

   (a) Shall be in accordance with the "Guidelines for Erosion and Sediment Control Planning" and "Guidelines for Erosion and Sediment Control Plans" as contained in the local Erosion and Sediment Control Handbook. The conservation practices contained in the plan shall meet or exceed the standards and specifications set forth in the local handbook.

   (b) Shall be approved within 45 days from receipt of the plan if it is adequate. If the plan is disapproved, within 45 days from receipt thereof, the Commission shall specify in writing such modifications, terms, and conditions as will permit approval of the plan and communicate these requirements to the applicant. In the absence of receiving a certification from the person responsible for carrying out the plan that he will properly perform the control measures included in the plan, the Commission may approve the plan contingent upon receipt of such certification. The Commission shall notify the permit issuing authority in each county, city or town in which the project lies of its action.

An approved plan may be changed---

(i) Where inspection has revealed the inadequacy of the plan to accomplish the erosion and sediment control objectives of the plan, and appropriate modifications to correct the deficiencies of the plan are agreed upon by the Commission and by the person responsible for carrying out the plan;

or

(ii) Where the person responsible for carrying out the approved plan finds that, because of changed circumstances ~~or for~~ other reasons, the approved plan can not be effectively carried out, and proposed amendments to the plan, consistent with the requirements of the control program, are agreed to by the Commission and by the person responsible for carrying out the plan.

3. Performance bond, cash escrow, letter of credit, any combination thereof--

(a) Such a requirement shall be the responsibility of the permit issuing authority in each county, city or town in which the project lies consistent with the requirements of the local jurisdiction for similar type projects.

(b) The Commission shall advise on the cost of installing emergency conservation measures as such cost relates to each county, city or town in which the project lies.

4. The person responsible for carrying out the plan shall, on the date the land disturbing activities commences, notify the Commission of this fact.

5. Inspection--

(a) The Commission shall coordinate its inspections with the local jurisdictions in the project area.

6. Enforcement--

(a) On projects for which a performance bond, cash escrow, letter of credit or some other legal arrangement has been required by a permit issuing authority, enforcement is vested with the appropriate county, city or town.

(b) Where (a) above does not apply, enforcement is vested with the Commission.

7. Appeals by the applicant or person responsible for carrying out the plan--

   (a) Appeals on the requirements of or the use of performance bond, cash escrow, letter of credit, etc., shall be to the governing body of the appropriate county, city or town, within the time limit specified by each county, city or town in their local control program. Final appeal is subject to review by the circuit court(s) having jurisdiction in the project area, provided an appeal is filed within thirty days from the date of any written decision by the county, city or town.

   (b) Appeals on the requirements of the plan or other action or proposed action by the Commission shall be to the Circuit Court of the city of Richmond, provided an appeal is filed within thirty days from the date of the written decision of the Commission.

DEVELOPMENT AND ADOPTION OF LOCAL SEDIMENT CONTROL PROGRAMS WHEN LOCALITIES FAIL TO ACT

The Erosion and Sediment Control Law provides that "If a district, or county, city, or town not in a district, fails to submit a program to the Commission within the period specified herein, the Commission shall, after such hearings or consultations as it deems appropriate with the various local interests involved, develop and adopt an appropriate program to be carried out by such district, county, city, or town. The Commission shall do likewise with respect to any town lying within a county which adopts its own erosion and sediment control program and such town does not provide for land disturbing activities within the town to be covered by a local control program".

The "period specified herein" is as follows:

(a) For a district, or the county or city not within a district, when a program has not been developed, adopted, and submitted by January 1, 1976.

(b) For a town when a program has not been developed, adopted and submitted by January 1, 1976 (applies when the county in which the town lies has adopted its approved program by July 1, 1975 and the town has not adopted its own program, adopted jointly with the county a program or authorized the county to adopt the program for the town).

While it is the hope of the Commission that it not become involved in the development and adoption of local erosion and sediment control programs, should such become necessary, the Commission shall discharge its responsibilities as provided under law.

EROSION AND SEDIMENT CONTROL HANDBOOK

PART V

GUIDELINES, CRITERIA, AND REQUIREMENTS FOR LOCALITIES

APRIL 1974

ELEMENTS OF AN EFFECTIVE EROSION AND SEDIMENT CONTROL PROGRAM

The Elements

- The ordinance(s) to provide the legal authority and adequate technical standards and specifications for control measures must be specific, concise and workable.

- The necessary preplanning should be done to fit the development to the natural terrain. Local government should provide flexibility in its requirements (such as variance in lot size and population density) so that the overall objective of good conservation and land use can be achieved.

- The program must be completely integrated with other functions of local government so that cost will be minimized and unnecessary delays in construction may be prevented by conducting simultaneously the review and approval process for erosion and sediment control plans with the review and approval process for other requirements relating to construction.

- Assistance should be available to landowners and others involved in plan development both on a direct basis and in the nature of referral to other agencies having technical expertise.

- The development of high quality conservation plans that entail the latest conservation planning procedures and techniques for erosion and sediment control and environmental protection is very important.

- It should be understood by all parties involved in plan development and implementation that, almost without exception, there is more than one approach to the solution of minimizing erosion and sedimentation. Consequently, there is a time to be flexible without compromising the conservation objectives and there is a time to be firm.

- The individuals involved in the program at all levels of operation must be competent, committed, and persons of integrity.

- There must be commitment of resources to provide adequate plan development, plan review, support services and, particularly, on-site inspections and enforcement.

- A performance bond, cash escrow or letter of credit must be required to provide the resources to apply the necessary conservation measures when violations occur.

- Positive enforcement based on program administration which is fair and equitable cannot be over emphasized.

- The most important element stems not from legislation or regulation but from a conservation ethic. Therefore, an education-information program to gain an understanding and acceptance of the program by developers, equipment operators, planners, designers, landscape architects and the public at large is paramount. One should develop the realization that, almost without exception, conservation does not cost; it pays.

Determining the Effectiveness

- It is important to schedule a comprehensive review and evaluation of the overall erosion and sediment program at least once every three years. Such evaluations should identify any factors contributing to weaknesses of the program. Positive action should be taken to alleviate such weaknesses.

- In order to review and evaluate the effectiveness of an erosion and sediment control program, a benchmark should be established, preferably, prior to the enactment of the control program. This benchmark would be established by the identification and evaluation of the nature and magnitude of erosion and sediment problems. Then, the problems of erosion and sedimentation after the control program has been in effect could be measured against this benchmark.

STATE REQUIREMENTS FOR LOCAL EROSION AND SEDIMENT CONTROL PROGRAMS

The Erosion and Sediment Control Law provides that the Virginia Soil and Water Conservation Commission shall approve each local control program. To assist localities in developing a local Erosion and Sediment Control Handbook, one of the requirements for a local program, the Commission shall make available, upon request, and at cost, the following pages of the Virginia Erosion and Sediment Control Handbook:

1. All of Part I, "Introduction".

2. Sections of Part II, "Erosion and Sediment Control Planning and Plans", covering "Guidelines for Erosion and Sediment Control Planning", "Guidelines for Erosion and Sediment Control Plans", and Submission of Erosion and Sediment Control Plans".

3. All of Part III, "Erosion and Sediment Control Practices".

The Commission's approval of the local control program shall be conditioned on the following:

I. A Local *Erosion and Sediment Control Handbook* Applicable to the Area to be Encompassed by the Local Control Program. The handbook shall contain--

A. An Erosion and Sediment Control Ordinance. If some or all of the provisions for erosion and sediment control are contained in other ordinances such as subdivision, grading, zoning, etc., include copies of each ordinance with the sections concerning erosion and sediment control designated by a mark in the margin. The proposed ordinances or amendments to existing ordinances shall be approved as to legal form and sufficiency prior to submittal.

B. Guidelines for Erosion and Sediment Control Planning and Guidelines for Erosion and Sediment Control Plans from Part II of the State Handbook.

If adopted verbatim from the state handbook, a certified statement to this effect by the county administrator, chairman of the board of supervisors, town or city manager, or town or city mayor or chairman of the soil and water conservation district will suffice. Localities may develop their own approach in utilizing these guidelines, provided that the minimum state guidelines are met and detailed information and requirements that will be utilized are submitted for review.

C. Submission of Erosion and Sediment Control Plans from Part II of the State Handbook. If adopted verbatim from the state handbook, a certification will suffice. If this item is adequately covered in the plan submission as developed by the locality in their procedure for "Plan Submission and Review, On-Site Inspection, and Ordinance Enforcement" (from Part V of the state handbook), it need not be duplicated as a separate section of the local handbook. Therefore, submit either (1) a certification, or (2) a statement that this item is adequately covered elsewhere in the local handbook and indicate by reference where it is covered.

D. Procedures for Plan Submission and Review, On-Site Inspection, and Ordinance Enforcement. See guidelines for development of these procedures in Part V of the state handbook.

E. Standards and Specifications for Mechanical and Vegetative Practices. The minimum standards and specifications contained in Part III of the state handbook must be met in the local control program or more stringent standards and specifications may be adopted. If the standards and specifications contained in the state handbook are to be adopted verbatim, a certification will suffice. Where the minimum standards and specifications are to be exceeded, copies of those standards and specifications more stringent shall be submitted. (To facilitate review by the Commission, any standard or specification not adopted verbatim from the state handbook, must be identified by a mark on the margin of the page to delineate the deviation and cross-referenced by page number to the state handbook on one of the submitted copies.)

II. A Plan for an Education-Information Program and a Plan for Technical Training. For assistance, see information contained in the "Guidelines for Developing Procedures for Plan Submission and Review, On-Site Inspection, and Ordinance Enforcement" (Part V of the state handbook).

III. The Estimated Program Cost and Sources of Funding. This shall include the following: the number of positions or shared positions (such as building inspectors who will inspect for erosion control measures) for administration, plan review, inspection, secretarial and other activities with cost by positions; the itemized cost of office space, telephone, postage and other office supplies, vehicles and any other; and the source of funding, whether by fees or appropriations from local revenues or a combination thereof.

IV. The Projected Date the Erosion and Sediment Control Program Will Become Effective.

V. General Program Description. A general description of the local Erosion and Sediment Control Program should be given. Since items I through IV above are to be specifically addressed, only reference to them is needed here. On the other hand, other details of the "Program" should be thoroughly explained. Such other details would include, but not be limited to, provisions for optional requirements such as performance bonds, cash escrows, and letters of credit, collection of fees, and for appeals to any local body. Any cooperative agreements or relationships with other local jurisdictions should be explained here as should plans for periodic review and evaluation of the "Program". Care should be exercised in development of this section so as not to significantly duplicate information required in other items.

VI. The Submission to the Commission of Two Copies of the Above Items or Proper Certification Where Appropriate.

VII. Handbook Submission. Since elements of a local handbook will be submitted rather than a complete handbook, one copy of the approved and completely assembled handbook shall be submitted as soon as it is available.

VIII. Commission Action on Disapproval. In the event the Commission cannot approve the local control program as submitted, the Commission may disapprove the program and specify what is needed for approval, or the Commission may approve the program contingent upon the correction of the deficiency.

RESPONSIBILITY AND ALTERNATIVES FOR LOCAL CONTROL PROGRAMS

Virginia's Erosion and Sediment Control Law provides for two processes in its implementation:

- Development of a statewide soil erosion and sediment control program containing standards, guidelines, and criteria to be adopted by the Virginia Soil and Water Conservation Commission by July 1, 1974.

- Development and adoption of local control programs which meet the minimum standards, guidelines, and criteria of the state program but which may include more stringent standards. (Although more stringent standards may be adopted, this does not mean that more stringent requirements for approval of the erosion and sediment control plan or permit issuance other than those provided by state law can be adopted nor does it mean that local government can require compliance for those land disturbing activities excluded by state law.)

These local control programs are to be carried out by soil and water conservation districts, by counties, cities, and incorporated towns, or jointly.

- By July 1, 1975, any county, city or town (within a district) may adopt its own control program which has been approved by the Commission (optional as to a joint venture with the district).

- In any county or city, within a district, which has not adopted its approved program by July 1, 1975, the district shall develop, adopt, and submit a program by January 1, 1976, and within twelve months after the program has been approved by the Commission; establish standards for the control of erosion and sediment.

- Counties and cities not within a district shall develop, adopt, and submit a program by January 1, 1976, and within twelve months after the program has been approved by the Commission, establish standards for the control of erosion and sediment.

Any incorporated town, lying within a county which adopts its own erosion and sediment control program, must adopt its own program, or adopt jointly with the county, an erosion and sediment control program, or authorize the county to adopt the program for the town. If a town lies within the boundaries of more than one county, such town shall be considered to be wholly within the county in which the larger portion of the town lies.

When a town adopts the program jointly with the county or authorizes the county to adopt the program for the town, the permit issuing authority and enforcement authority are exercised independently by each jurisdiction; the county plan approval authority will extend over both jurisdictions; and inspections may be handled by any arrangement between the two jurisdictions. Therefore, in developing the local control programs and "Pro-

cedures for the Plan Submission and Review, On-Site Inspection, and Ordinance Enforcement", appropriate parts of those procedures must be modified to show the requirement of the county and town (s) with respect to site plan, grading, building and other permit requirements and the requirements for bonding, cash escrow, etc.

Some Factors to be Considered in Developing a Local Control Program

The basic factors are plan approval, inspection and enforcement. If not factors, then closely related are the functions of the following: (1) overall program administration, (2) the requirement of fees for plan review and inspection, (3) the requirement of a performance bond, cash escrow or letter of credit and (4) the issuance of permits for land disturbing activities and/or notifying permit issuance authorities of an approved erosion control plan. For some localities, all of these factors (and functions) may appropriately be handled by one existing department of local government. Even in such cases, consideration may be given to the soil and water conservation district being the plan approving authority or being given some other responsibility.

Many localities do not have a department of local government that can assume the responsibilities of the local control program, but alternatives do exist. For example, the zoning administrator, county engineer or the building inspector could be the overall program administrator. The district or the program administrator could be the plan approving authority. The building inspector, program administrator, district or some combination thereof, can inspect. Enforcement can be vested with the program administrator. Fee and performance bond requirements can be handled by the program administrator. The program administrator can be authorized to issue land disturbing permits or other permits. Where the Commissioner of Revenue or some person other than the program administrator is issuing building or other permits for land disturbing activities, the program administrator will notify the Commissioner or that other person that an erosion and sediment control plan has been approved so that the permit can be issued.

An Approach to Developing a Local Control Program

Establish a committee composed of representatives from the county and the district directors within the county and the district technician. The committee can --

- Estimate the number of erosion and sediment control plans that will be submitted annually, the number of manhours available to handle the workload and the additional manhours needed for plan review.
- Look at the remaining factors of a local control program and the existing resources of the county and the district in meeting these needs, and identify and estimate the cost of additional resources needed.

- Identify and estimate the cost of such items as office space, telephone, files, postage and other office supplies, vehicles and secretarial help.

- Develop a flow chart showing the existing requirements for development (subdivision plans, site plans, permits, etc.)

- Interfuse the requirements of erosion and sediment control with existing requirements so that costs and delays in construction will be minimized. Further delays may be prevented when provisions are made for simultaneous submission and review of various types of plans which may be required.

- Recommend levels of responsibility in the local program for the county and the district and identify by title the person or agency responsible.

- Recommend source of funding such as a fee system for plan review and inspection, or by county appropriation or by a combination of the two.

- Recommend, when it is proposed that the district have a responsibility requiring additional manpower, whether such persons will be district employees funded by the county or whether such persons will be county employees assigned to the district.

Alternative Levels of Responsibility

The following page on "Alternative Levels of Responsibility for Local Erosion and Sediment Control Programs" outlines various county (city or town) and district combinations of responsibility. It should be noted that the enforcement on land disturbing activities requiring a permit is vested with the county, except in column "F" where the county agrees to give the authority and the district agrees to accept the authority by joint resolution of the two governing bodies. It should also be noted that the county cannot divorce itself of responsibility in a local control program. The county and not the district is authorized to charge fees for plan review and inspection, tax for other program costs or require a performance bond, cash escrow or letter of credit. Therefore, the county having an interest in its land and water resources has a responsibility in supporting the district in achieving those objectives identified as "Elements of an Effective Erosion and Sediment Control Program".

ALTERNATIVE LEVELS OF RESPONSIBILITY FOR LOCAL EROSION AND SEDIMENT CONTROL PROGRAMS

(Listed in columns of increasing district involvement, going from Column "A" in which a district has no responsibility to Column "F" where there is maximum district responsibility.)

A	B	C	D	E	F
County adopts* program and ordinance	Same as "A" with district serving in advisory capacity for the county's program and district reviews and comments on conservation plans	County adopts program and ordinance	County adopts program and ordinance	District adopts program	District adopts program
County approves conservation plans		District approves conservation plans	District approves conservation plans	District approves conservation plans	District approves conservation plans
County issues building, grading, and other permits		County issues building, grading, and other permits	County issues building, grading, and other permits	County issues building, grading, and other permits	County issues building, grading, and other permits
County inspects and serves notice to comply and takes legal action against violators		District may inspect, monitor, or make reports	County inspects, monitors, and enforces on plan requiring a permit	County inspects, monitors, and enforces on plans requiring a permit	District inspects, monitors, and enforces on all conservation plans (requires a joint resolution of county and district)
		County serves notice to comply, takes legal action against violators	District inspects, monitors, and services notice to comply and County takes legal action against violators where permits are not required	District inspects, monitors, serves notice to comply, takes legal action against violators where permits are not required	

*Where "county" is used, "city" and "incorporated town" is also appropriate.

(Alternatives A,B,C, and D provide for adoption of the program by July 1, 1975, except for those local jurisdictions not within a district. In such cases as in alternatives E and F, the program would need to be adopted within 18 months after adoption of State program or by January 1, 1976.)

GUIDELINES FOR DEVELOPMENT OF PROCEDURES FOR PLAN SUBMISSION AND REVIEW, ON-SITE INSPECTION, AND ORDINANCE ENFORCEMENT

After the decision has been made as to who will have what responsibility in the local control program, the procedures for plan submission and review, on-site inspection and ordinance enforcement can be developed. These procedures placed in the local Erosion and Sediment Control Handbook will be a useful tool in informing the public of program requirements and provide an outline of how the program is implemented.

The ordinance provisions and the procedures provisions must be correlated. Possibly, wording in the ordinance can be reduced when such provisions are included in the procedures and the procedures are adopted by reference in the ordinance.

I. Guide for Counties, Cities, and Towns

This guide is to be used when the county, city or town enacts the ordinance and adopts the program. It is to be used regardless of whether or not implementation involves a soil and water conservation district and is to be used where there is no district.

A. Statement of References

1. List by chapter and section numbers the erosion and sediment control ordinance.

2. If applicable, list by chapter and section numbers the amendments to subdivision, grading, zoning, or other ordinances containing provisions for erosion and sediment control.

3. When applicable, list by chapter and section numbers the provisions of other ordinances relating to a building permit, site development plan, subdivision plat, or other provisions dealing with permit requirements for land disturbing activities or other local provisions requiring the coordination and review of the erosion and sediment control plan or a preliminary plan.

B. Plan Submission and Preliminary Erosion and Sediment Control Plans

This section should be developed in coordination with Sections C and D. It should state the number of copies of plans required to be submitted and to whom they are to be submitted.

1. In the absence of an application form developed by the local

jurisdiction, the letter of transmittal may contain the following information:

a. The name, address and phone number of the applicant.

b. The name, address and phone number of the landowner of record.

c. The name, address and phone number of the person responsible for carrying out the plan.

d. The name, address and phone number of the person preparing the plan.

e. Location of the site, including lot number and tax map page number (relate to location requirements on the "map" in Part II, "Guidelines for Erosion and Sediment Control Plans", of the Erosion and Sediment Control Handbook, which may be sufficient in some jurisdictions).

f. Other information as determined by the local jurisdiction.

2. The local jurisdiction may require that a preliminary erosion and sediment control plan be submitted with a preliminary site plan. The preliminary erosion control plan should not be cluttered with detailed control measures and might contain the following information:

a. Soil boundaries of all major soil types.

b. Approximate limits of clearing and grading.

c. Tentative means of erosion and sediment control.

d. Phasing of development to minimize area and duration of exposure.

C. Department or Person Responsible: _____

(Enter in blank the name of department or title of person having overall administrative responsibility for the local control program, such as the Department of Public Works, Director of Public Works, Zoning Administrator, County Engineer, Building Inspector or other department or position. See Sections B, D and K of this outline.)

D. Plan Approving Authority: _____

(Enter in blank the name of department, title of person or district who has been designated to receive, review, approve or disapprove erosion and sediment control plans such as the soil and water conservation district, Department of Public Works, Director of Public Works, Planning Office, Director of Planning, County

Planner, County Engineer or other. This could be the same as Section B or C of this outline if the soil and water conservation district is not designated as the plan approving authority.)

1. The preparation and submission of an erosion and sediment control plan to the (plan approving authority), (mailing address), (telephone number), shall be the responsibility of the owner, lessee, or duly authorized agent of either the owner or lessee.

2. In determining the adequacy of the plan, the (plan approving authority) shall be guided by the requirements and recommendations contained in the (name of locality) Erosion and Sediment Control Handbook.

3. The plan shall be approved, within 45 days from receipt thereof, if such plan meets the requirements of the local control program, and if the person responsible for carrying out the plan certified that he will properly perform the control measures included in the plan.

4. If the plan is disapproved, within 45 days from receipt thereof, the (plan approving authority) shall specify in writing such modifications, terms, and conditions as will permit approval of the plan and communicate these requirements to the applicant.

5. If no action is taken by the (plan approving authority) within 45 days of receipt of the plan, the plan shall be deemed approved. Certification of this fact shall be provided by the (plan approving authority) to the person or agency issuing grading, building, or other permits for activities involving land disturbing activities so that such permits may be issued.

6. A plan for which land disturbing activities involve lands under the jurisdiction of this local control program and one or more other local control programs may, at the option of the applicant, be submitted to the Virginia Soil and Water Conservation Commission for review and approval rather than submission to each jurisdiction concerned.

7. An approved plan may be changed --

   a. Where inspection has revealed the inadequacy of the plan to accomplish the erosion and sediment control objectives of the plan, the appropriate modifications to correct the deficiencies of the plan are agreed to by the plan approving authority which approved the plan and the person responsible for carrying out the plan;

   or

   b. When the person responsible for carrying out the approved

plan finds that because of changed circumstances or for other reasons the approved plan cannot be effectively carried out, and proposed amendments to the plan, consistent with the requirements of the local control program, are agreed upon by the (plan approving authority) and the person responsible for carrying out the plan.

(Further development of this section may be necessary to coordinate other functions of local government involving site plans, subdivision plans, etc.)

E. Issuance of Grading, Building, or Other Permits

1. The (Commissioner of Revenue, department of local government, or any agency authorized under any other law to issue grading, building, or other permits for land disturbing activites) shall not issue (grading, building, or other permits) unless --

   a. The applicant submits with his application the approved erosion and sediment control plan,

   or

   b. There is certification of such approved plan from the (plan approving authority) or certification that a plan was submitted and no action was taken within the 45 days,

   or

   c. There is certification from the Virginia Soil and Water Conservation Commission, when applicable, that the plan has been approved.

2. When the permit issuing authority does not have in hand a certification that the person responsible for carrying out the plan has certified that he will properly perform the control measures included in the plan or notification from the plan approving authority, or the Commission, when applicable, that such certification has been obtained, the permit issuing authority shall obtain the certification of performance prior to the issuance of the permit.

F. Performance Bond, Cash Escrow, Letter of Credit (optional)

While this requirement is optional, such requirement is a necessary element of an effective control program. Subsections below, particularly Section 1, will have to be developed to meet local situations and requirements imposed. A decision must be made on each proposed land disturbing activity as to the provisions (amount of coverage or dollars required, etc.) under a reasonable performance bond, cash escrow, letter of credit, or any combination thereof, or such other legal arrangements which are acceptable to the (local governing body) to ensure that conservation measures could be taken by the county, city or town at the applicant's expense should he fail within the time specified to initiate appropriate conservation action which may be required of him as a result of

his land disturbing activites. Such requirement may be a condition for issuance of building, grading, or other permits. If so, a system of notifying the permit issuing authority must be developed if the authority for issuing permits is not vested with the authority which determines and requires the bond, escrow, etc. Where the Commissioner of Revenue issues building permits, the responsibility for determining the bond, escrow, etc. and administering the requirements should be the plan approving authority or the authority having overall administrative responsibility for the local control program. Where a soil and water conservation district is designated as the plan approving authority, the district shall have no responsibility concerning the bond, escrow, etc., beyond that of advising on the cost of installing emergency conservation measures, if requested.

1. No permit for (grading, building or other permits involving land disturbing activities) shall be issued by the (Commissioner of Revenue, department of local government, or any agency authorized under any other law to issue grading, building, or other permits for land disturbing activities) until the requirements of the (could designate a department or title listed in Section B, C, or D of this outline except a soil and water conservation district) have been met with respect to a performance bond, cash escrow, letter of credit, or any combination thereof, or such other legal arrangement acceptable to the (same department or position as immediately above) to ensure that emergency measures could be taken by the (county, city or town) at the applicant's expense should he fail within the time specified to initiate appropriate conservation action which may be required of him as a result of his land disturbing activity.

2. Certified checks shall be made payable to the Treasurer of (city, county or town). NOTE: Cash escrow should be deposited in individual interest bearing accounts with the interest accruing to the person putting up the cash.

3. Within 60 days of the completion of the land disturbing activity, such bond, cash escrow, letter of credit or other legal arrangement, or the unexpended or unobligated portion thereof, shall be refunded to the applicant or terminated, as the case may be.

4. These requirements are in addition to all other provisions of law relating to the issuance of such permits and are not intended to otherwise affect the requirements for such permits.

G. Erosion and Sediment Control Agreement.

Some legal instrument should be executed by each applicant for an approved erosion and sediment control plan to provide right-of-entry by the appropriate persons for the purpose of inspection, monitoring, and installation, reinstallation, or maintenance of

erosion and sediment control measures in the event the applicant fails to install or maintain such measures after notice in writing. This "right-of-entry clause" should be incorporated in the requirements of the performance bond or other legal requirements under that section. For those projects involving land disturbing activities for which no performance bond or other legal requirements include the "right-of- entry clause", an erosion and sediment control agreement should be executed by the applicant to provide the "right-of-entry".

H. Fees (optional)

Fees are to be used if the county, city or town desires to charge the cost of the local control program to those involved in land disturbing activities.

I. Appeals on the Erosion Control Plan, Bonding, Cash Escrow, Etc. (optional)

While this is an optional provision, it is recommended that a mechanism be established to provide for an administrative appeal on the requirements of an erosion control plan and/or the requirements, if any, for a performance bond, cash escrow, etc. The appeal could be made to the governing body of the county, city or town, or to a Board of Appeals for Erosion and Sediment Control appointed by the governing body of the county, city or town, or appeal to some other body already established in the local jurisdiction. Any appeal should be filed within 30 days of the date of any decision.

J. Education - Information and Technical Training Programs

While this is also an optional provision in the local Erosion and Sediment Control Handbook, each local control program submitted to the Virginia Soil and Water Conservation Commission shall include a plan for education, information, and technical training programs. This plan shall include --

1. The means whereby developers and others affected will be informed as to the requirements of the local control program and the education materials to be used for this purpose.

2. The proposed plan for training seminars for developers, engineers, landscape architects, consultants, contractors and others involved in the technical aspects of erosion and sediment control.

3. The proposed plan for training workshops for local government and soil and water conservation district personnel having responsibilities in the local control program such as inspection, plan review, and administrative duties.

4. The department or title of person having the responsibility for the education-information program and the department or

title of person having the responsibility for technical training programs.

5. A systematic plan for training such as annual training programs or refresher courses.

6. An initial training program for new employees or employees such as building inspectors who are assigned responsibilities in erosion and sediment control for which they have had little or no training.

Assistance in planning and conducting local technical training programs may be available from state and federal agencies and associations. These programs may be conducted on a regional basis or limited to a local jurisdiction.

K. On-Site Inspection and Ordinance Enforcement: _____
(Enter in blank name of department or title of person designated in Section B, C, or D of this outline, except a soil and water conservation district.)

1. Responsible for developing and implementing a systematic program for on-site inspection to ensure that the erosion and sediment control measures on approved erosion control plans are actually provided (the actual inspection may be the responsibility of a building inspector or someone else).

2. Responsible for developing and implementing a file system by land disturbing projects. The file should contain a record of each inspection, date of inspection, date land disturbing activities commenced and comments concerning compliance or non-compliance.

3. In cases of non-compliance, the report shall contain statements of the conservation measures needed for compliance and a recommended time in which such measures should be commenced and/or completed. Such reports shall be communicated immediately to (same as Section K above).

4. Upon determination that a violation exists the (same as Section K) shall prepare either:

   a. A Notice to Comply which shall contain a detailed description of the conservation measures necessary for compliance. When no action is taken within (48 hours) of delivery of the Notice to Comply, the (same as Section K) shall prepare a letter of intent to utilize the performance bond, cash escrow or other legal arrangement to apply the conservation measures to correct the deficiency. This letter of intent will be cleared the (county, city, town) Attorney and sent by registered

mail to the person responsible for carrying out the plan. If no action is taken within the time specified in the letter, dependent on the urgency of the action, the (person designated to act on behalf of the county, city or town) will be requested in writing, with a copy to the person responsible for carrying out the plan, to undertake the corrective conservation measures. (This subsection 4a is to be developed for land disturbing activities for which a performance bond, cash escrow or some other legal arrangement has been made whereby the county, city or town may take action to apply conservation practices when the approved erosion control plan is not being followed.)

or

b. A Notice to Comply which shall contain a detailed description of the conservation measures necessary for compliance and the time within which such conservation measures shall be completed. Such Notice shall be served by registered or certified mail to the person responsible for carrying out the erosion control plan. If the conservation measures are not completed within the time specified, the (same as Section K) shall notify in writing the governing body of the (county, city or town) of the circumstances and recommend whether or not legal action should be taken against the violator. (This subsection 4b is to be developed for all land disturbing activities covered under the local control program for which a performance bond, cash escrow, etc. is not required.)

5. The (same as Section K) shall notify all permit issuing authorities when a Notice to Comply has been issued to withhold all future permits to the violator until the violation is corrected, and, upon failure to comply within the time specified in the Notice to Comply, the permit for the project in violation may be revoked.

6. The (same as Section K) shall be responsible for handling complaints concerning absent or ineffective erosion control measures.

7. When, upon investigation, it is determined that ineffective erosion control measures are being followed, but such measures comply with the approved erosion control plan, the (same as Section K) shall notify the (plan approving authority). (See Section D-7 of this outline.)

II. Guide for Soil and Water Conservation Districts

Any soil and water conservation district may adopt an erosion and sediment control program, subject to approval of the Virginia Soil and Water Conservation Commission, to be effective in localities not having adopted their own program by July 1, 1975. Such action gives the same legal authority as adoption of an ordinance.

A. Statement of Reference (Describe scope of program and list date on which the district took action adopting it.)

B. Plan Submission and Preliminary Erosion and Sediment Control Plan. (See Part I, Section B of this outline and use appropriate information.)

C. Department or Person Responsible (Not Applicable)

D. Plan Approving Authority (See Part I, Section B of this outline.)

E. Issuance of Grading, Building, or Other Permits
The district will not issue permits but will certify to the appropriate permit issuing agency either that the submitted erosion and sediment control plan was approved or that no action was taken within the 45 days.

F. Performance Bond, Cash Escrow, Letter of Credit
(See Part I, Section F of this outline - this responsibility lies with the county, city or town, not the district.)

G. Erosion and Sediment Control Agreement (See Part I, Section G of this outline.)

H. Fees (See Part I, Section H of this outline - this responsibility is with the county, city or town, not the district.)

I. Appeals on Erosion Control Plan, Bonding, Cash Escrow, Etc.

1. Erosion Control Plan. Appeals on the district's decision regarding the plan may be made to the Virginia Soil and Water Conservation Commission provided the district is so notified and given an opportunity to further negotiate for a period not to exceed five working days.

2. Bonding, Cash Escrow (See Part I, Section I of this outline - it is the responsibility of the county, city or town to provide and appeal mechanism.)

J. Education - Information and Technical Training Programs
(See Part I, Section J of this outline.)

K. On-Site Inspection and Enforcement
The county, city or town will inspect, monitor and enforce on plans requiring a permit, while the district will inspect, monitor, serve notice to comply and take legal action against violators where permits are not required. However, by joint resolution of the two governing bodies, the district will inspect, monitor and enforce on all projects requiring a plan. (See Part I, Section K of this outline for development in accordance with the provisions stated above.)

MODEL EROSION AND SEDIMENT CONTROL ORDINANCE

(name of locality)

Erosion and Sediment Control Ordinance

Section 1 Title

This ordinance shall be known as the "Erosion and Sediment Control Ordinance of (name of locality), Virginia".

Section 2 Purpose

The purpose of this ordinance is to conserve the land, water, air and other natural resources of (name of locality) and promote the public health and welfare of the people in (name of locality) by establishing requirements for the control of erosion and sedimentation, and by establishing procedures whereby these requirements shall be administered and enforced.

Section 3 Authorization

This ordinance is authorized by the Code of Virginia, Title 21, Chapter 1, Article 6.1., known as the "Erosion and Sediment Control Law". This article provides for a comprehensive statewide program with standards and guidelines to control soil erosion and sedimentation, which is implemented on the local level.

Section 4 Definitions

As used in this ordinance, unless the context clearly indicates otherwise.

4-1 Administrator: The representative of the Governing Body who has been appointed to serve as the agent of the Governing Body in administrating this ordinance.

4-2 Governing body: The (type of governing body) of (name of locality).

4-3 District or soil and water conservation district: Means a governmental subdivision of the State, and a public body corporate and politic, organized in accordance with the provisions of the Soil Conservation Districts Law, Title 21, Chapter 1, Code of Virginia as amended.

4-4 Land disturbing activity: Means any land change which may result in soil erosion from water or wind and the movement of sediments into State waters or onto lands in the State, including, but not limited to, clearing, grading, excavating, transporting and filling of land, other than federal lands, except that the term shall not include: (i) such minor land disturbing activities as home gardens and individual home landscaping, repairs and maintenance work; (ii) individual service connections and construction or installation of public utility lines; (iii) septic tank lines or drainage fields unless included in an overall plan for land disturbing activity relating to construction of the building to be served by the septic tank system; (iv) surface or deep mining, neither shall it include tilling, planting or harvesting of agricultural, horticultural, or forest crops; (v) construction, repair or rebuilding of the tracks, right-of-way, bridges, communication facilities and other related structures and facilities of a railroad company; (vi) preparation for single-family residences separately built, unless in conjunction with multiple construction in subdivision development; (vii) disturbed land areas for commercial or noncommercial uses of less than ten thousand square feet in size; provided, however, that the governing body of the county, city, town or district, may reduce this exception to a smaller area of disturbed land and/or qualify the conditions under which this exception shall apply; (viii) installation of fence and sign posts or telephone and electric poles and other kinds of posts or poles; (ix) shore erosion control projects on tidal waters recommended by the soil and water conservation districts in which the projects are located or approved by the Marine Resources Commission; (x) emergency work to protect life, limb or property, and emergency repairs; provided that if the land disturbing activity would have required an approved erosion and sediment control plan, if the activity were not an emergency, then the land area disturbed shall be shaped and stabilized in accordance with the requirement of the local plan approving authority or the Commission when applicable.

4-5 Person: Means any individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, county, city, town or other political subdivision of this State, any interstate body, or any other legal entity.

4-6 Town: Means an incorporated town.

4-7 Conservation standards or standards: Means the criteria, guidelines, techniques, and methods for the control of erosion and sedimentation.

4-8 Conservation plan, erosion and sediment control plan or plan: Means a document containing material for the conservation of soil and water resources of a unit or group of units of land. It may include appropriate maps, an appropriate soil and water plan inventory and management information with needed interpretations, and a record of decisions contributing to conservation treatment. The plan shall contain all major conservation decisions to assure that the entire unit or units of land will be so treated to achieve the conservation objectives.

4-9 State erosion and sediment control program or State program: Means the program adopted by the Commission consisting of conservation standards, guidelines and criteria to minimize erosion and sedimentation.

4-10 Local erosion and sediment control program or local control program: Means an outline or explanation of the various elements or methods employed by a district, county, city, or town to regulate land disturbing activities and thereby minimize erosion and sedimentation in compliance with the State program and may include such items as a local ordinance, policies and guidelines, technical materials, inspection, enforcement and evaluation.

4-11 Plan approving authority: Means the district or county, city, or town, or a department of a county, city, or town, responsible for determining the adequacy of a conservation plan submitted for land disturbing activities on a unit or units of lands and shall approve such plan if the plan is determined to be adequate.

4-12 Commission or Virginia Soil and Water Conservation Commission: Means the agency created in §21-6 of the Code of Virginia.

4-13 Clearing: Means any activity which removes the vegetative ground cover including but not limited to the removal, root mat removal and/or topsoil removal.

4-14 Filling: Means any depositing or stockpiling of earth materials.

4-15 Excavating: Means any digging, scooping or other methods of removing earth materials.

4-16 Grading: Means any excavating or filling of earth materials or any combination thereof, including the land in its excavated or filled condition.

4-17 Transporting: Means any moving of earth materials from one place to another, other than such movement incidental to grading, when such movement results in destroying the vegetative ground cover either by tracking or the buildup of earth materials to the extent that erosion and sedimentation will result from the soil or earth materials over which such transporting occurs.

4-18 Land disturbing permit: Means a permit issued by the (county, city or town) for clearing, filling, excavating, grading or transporting, or any combination thereof, on all lands except privately owned, occupied or operated, agricultural, horticultural or forestry lands.

Section 5 Local Erosion and Sediment Control Program

5-1 This ordinance, the "Guidelines for Erosion and Sediment Control Planning", the "Guidelines for Erosion and Sediment Control Plans", and the "Procedures for Plan Submission and Review, On-Site Inspection, and Ordinance Enforcement" shall be an integral part of the (name of locality) erosion and sediment control program and included in the (name of locality) Erosion and Sediment Control Handbook.

5-2 The guidelines, procedures, and other elements of the local control program, shall be developed consistent with the State program and guidelines. Upon development, the local program shall be adopted by the (name of locality).

5-3 To carry out the local control program, conservation standards shall be established. Such standards shall include criteria, guidelines, techniques, and methods for the control of erosion and sedimentation. The effective date of the adoption of such standards shall be the effective date for implementation of the local control program. (See subsection 6-1 of this ordinance.) The conservation standards shall be included as Part III of the (name of locality) Erosion and Sediment Control Handbook.

5-4 The "Guidelines for Erosion and Sediment Control Planning", the "Guidelines for Erosion and Sediment Control Plans" and the conservation standards, shall be used by the applicant, making a submittal under the provisions of this ordinance, in preparing his erosion and sediment control plan. The (plan approving authority) in considering the adequacy of such submitted plan shall be guided by the same guidelines and standards.

Section 6 Regulated Land Disturbing Activities

6-1 Except as provided in subsections 6-2, 6-3, and 6-4, no person shall engage in any land disturbing activity after (the effective date of the adoption of conservation standards) until he has submitted to the (plan approving authority) an erosion and sediment plan for such land disturbing activity and until that plan has been reviewed and approved by the (plan approving authority).

6-2 Any person who owns, occupies, or operates private agricultural, horticultural or forest lands shall not be deemed to be in violation of this ordinance for land disturbing activities which result from the tilling, planting or harvesting of agricultural, horticultural or forest crops or products or engineering operations such as the construction of terraces, terrace outlets, check dams, desilting basins, floodwater retarding structures, channel improvements, floodways, dikes, ponds, ditches, and the like; the utilization of strip cropping, lister furrowing, contour cultivating, and contour furrowing; land drainage; land irrigation; seeding and planting of waste, sloping, abandoned or eroded lands to water-conserving and erosion preventing plants, trees and grasses; forestation and reforestation; rotation of crops;

soil stabilization with trees, grasses, legumes, and other thick growing, soil holding crops; retardation of runoff by increasing absorption of rainfall; and retirement from cultivation of steep, highly erosive areas and areas now badly gullied or otherwise eroded. Any person who owns, occupies, or operates private agricultural, horticultural or forest lands shall comply with the requirements of this ordinance wherever that person proposes to conduct grading, excavating or filling operations.

6-3 Any State agency that undertakes a project involving a land disturbing activity.

6-4 Any person whose land disturbing activities involve lands which extend into the jurisdiction of another local erosion and sediment control program; provided, such person has a plan approved by the Virginia Soil and Water Conservation Commission. Such persons shall comply with the requirements of this ordinance concerning a performance bond, cash escrow, letter of credit, any combination thereof, or such other legal arrangement as is acceptable to the (permit issuing authority).

6-5 Whenever a land disturbing activity is proposed to be conducted by a contractor performing construction work pursuant to a construction contract, the preparation, submission and approval of the required erosion and sediment control plan shall be the responsibility of the owner of the land.

6-6 Nothing in this ordinance shall be construed to effect any land disturbing activity which is commenced prior to (the effective date of the adoption of conservation standards).

Section 7 Action on Erosion and Sediment Control Plans

7-1 The (plan approving authority) shall, within 45 days, approve any erosion and sediment control plan submitted to it if it determines that the plan meets the conservation standards of the local control program and if the person responsible for carrying out the plan certifies that he will properly perform the erosion and sediment control measures included in the plan and will comply with the provisions of this ordinance.

7-2 The (plan approving authority) shall act on all plans submitted to it within 45 days from receipt thereof by either approving said plan in writing or by disapproving said plan in writing and giving the specific reasons for its disapproval. When a plan submitted for approval pursuant to this ordinance is found, upon review by the (plan approving authority), to be inadequate, the (plan approving authority) shall specify such modifications, terms, and conditions as will permit approval of the plan and shall communicate these requirements to the applicant. If no action is taken by the (plan approving authority) within the time specified above, the plan shall be deemed approved and the person shall be authorized to proceed with the proposed activity.

7-3 An approved plan may be changed by the (plan approving authority) which has approved the plan in the following cases:

- Where inspection has revealed the inadequacy of the plan to accomplish the erosion and sediment control objectives of the plan, and appropriate modifications to correct the deficiencies of the plan are agreed to by the (plan approving authority) and the person responsible for carrying out the plan;

or

- Where the person responsible for carrying out the approved plan finds that because of changed circumstances or for other reasons the approved plan cannot be effectively carried out, and proposed amendments to the plan, consistent with the requirements of this ordinance, are agreed to by the (plan approving authority) and the person responsible for carrying out the plan.

Section 8 Issuance of Land Disturbing Permit; Fees (both optional)

8-1 Except as provided in subsections 8-2 and 8-3, no person shall engage in any land disturbing activity until he has acquired a land disturbing permit from the (person or department authorized by the local governing body to issue permits).

8-2 Any person whose land disturbing activities require the issuance of a (grading, building and other) permit(s) and such issuance is conditioned on an approved erosion and sediment control plan. Such persons shall comply with the requirements of this ordinance concerning a performance bond, cash escrow, letter of credit, any combination thereof, or such other legal arrangement as is acceptable to the (permit issuing authority) and to the fees herein levied for land disturbing activities.

8-3 Any person grading, filling, or excavating on privately owned, occupied, or operated agricultural, horticultural or forest lands.

8-4 A plan review and inspection fee of _____ plus _____ per acre of land to be paid to the (county, city or town) at the time of filing erosion and sediment control plans.

Section 9: Approved Plan Required for Issuance of Permits; Certification; Bonding of Performance

9-1 After (the effective date of the adoption of the conservation standards), the (permit issuing authority) shall not issue any (grading, land disturbing, building or other) permits for activities which involve land disturbing activities unless the applicant therefore submits with his application the approved erosion and sediment control plan or certification of such approved plan from the (plan approving authority), and certification that such plan will be followed.

9-2 The (permit issuing authority), prior to the issuance of any (grading, land disturbing, building or other) permit, may require from any applicant a reasonable performance bond, cash escrow, letter of credit, any combination thereof, or such other legal arrangement as is acceptable to the (permit issuing authority), to insure that emergency measures could be taken by the (local government) at the applicant's expense should he fail within the time specified to initiate appropriate conservation action which may be required of him as a result of his land disturbing activity. Within 60 days of the completion of the land disturbing activity, such bond, cash escrow, letter of credit or other legal arrangement, or the unexpended or unobligated portion thereof, shall be refunded to the applicant or terminated, as the case may be.

9-3 The requirements of this section are in addition to all other provisions of law which relate to the issuance of such permits and shall not be construed to otherwise effect the requirements for such permits.

Section 10 Monitoring, Reports, and Inspections

10-1 The (permit issuing authority or plan approving authority) shall periodically inspect the land-disturbing activity to insure compliance with the approved plan and to determine whether the measures required in that plan are effective in controlling erosion and sediment resulting from the land disturbing activity. The right-of-entry to conduct such inspections shall be expressly reserved in the permit. The permit-holder, or his duly designated representative, shall be afforded the opportunity to accompany the inspectors.

If the (permit issuing authority or plan approving authority) determines that the permit-holder has failed to comply with the plan, the (permit issuing authority or plan approving authority) shall immediately serve upon the permit-holder by registered or certified mail to the address specified by the permit-holder in his permit application a notice to comply. Such notice shall set forth specifically the measures needed to come into compliance with such plan and shall specify the time within which such measures shall be completed. If the permit-holder fails to comply within the time specified, he may be subject to revocation of the permit; furthermore, he shall be deemed to be in violation of this ordinance and upon conviction shall be subject to the penalties provided by this ordinance.

10-2 With respect to approved plans for erosion and sediment control in connection with all regulated land disturbing activities which require no permit, the (plan approving authority) may require of the person responsible for carrying out the plan such monitoring and reports, and may make such on-site inspections after notice to that person as are deemed necessary to determine whether the soil erosion and sediment control measures required by the approved plan are being properly performed, and whether such measures are effective in controlling soil erosion and sediment resulting from the land disturbing activity. Such person shall be afforded an opportunity to accompany the inspectors on any on-site inspection.

If it is determined that there is a failure to comply with the approved plan, the (plan approving authority) shall serve notice upon the person who is responsible for carrying out the plan at the address specified by him in his certification at the time of obtaining his approved plan. Such notice shall set forth the measures needed for compliance and the time within which such measures shall be completed. Upon failure of such person to comply within the specified period, he will be deemed to be in violation of this ordinance and upon conviction shall be subject to the penalties provided by this ordinance.

Section 11 Administrative Appeal; Judicial Review

11-1 Final decisions of the (plan approving authority or permit issuing authority) under this ordinance shall be subject to review by the (appropriate agency of the local governing body or by the local governing body), provided an appeal is filed within 30 days from the date of any written decision by the (plan approving authority or permit issuing authority) which adversely effects the rights, duties or privileges of the person engaging in or proposing to engage in land disturbing activities.

11-2 Final decisions of (the appropriate agency of the local governing body or the local governing body) under this ordinance shall be subject to review by (the court of record of the county or city), provided an appeal is filed within 30 days from the date of the final written decision which adversely effects the rights, duties or privileges of the person engaging in or proposing to engage in land disturbing activities.

Section 12 Penalties, Injunctions, and Other Legal Actions

12-1 A violation of this ordinance shall be deemed a misdemeanor and upon conviction shall be subject to a fine not exceeding one thousand dollars or thirty days imprisonment for each violation or both.

12-2 The (permit issuing authority or person designated to act on behalf of the local governing body) may apply to the Circuit Court of (county, town or city) for injunctive relief to enjoin a violation or a threatened violation of this ordinance, without the necessity of showing that there does not exist an adequate remedy at law.

12-3 The Commonwealth's Attorney shall, upon request of (permit issuing authority or person designated to act on behalf of the local governing body) take legal action to enforce the provisions of this ordinance.

12-4 Compliance with the provisions of this ordinance shall be prima facie evidence in any legal or equitable proceeding for damages caused by erosion, siltation on sedimentation that all requirements of law have been met and the complaining party must show negligence in order to recover any damages.

Section 13 Severability

If any provision of this ordinance is held to be unconstitutional or invalid, such unconstitutionality or invalidity shall not affect the remaining provisions.

Section 14 Effective Date

This ordinance was duly considered, following a required public hearing held on (date of hearing), and was adopted by the (type of government and locality name), Virginia, at its regular meeting held on (date of meeting).

This ordinance shall be effective on and after 12:01 A.M. (date ordinance becomes effective).

COMMENTS ON THE MODEL ORDINANCE

The idea of developing a model grading ordinance was discarded because certain legal difficulties might be encountered. There is no problem in defining "grading" to include clearing, filling, excavating, grading and transporting when such term applies to lands other than agricultural, horticultural or forestry. However, the all-encompassing definition for "grading" would be incorrect when applied to privately owned, occupied or operated agricultural, horticultural or forestry lands because the state law excludes clearing and transporting operations on such lands.

Section 8 includes an optional provision for a "land disturbing permit". This permit would not be required on those projects for which another permit requires an approved erosion and sediment control plan. Utilizing this approach in conjunction with a land disturbing permit has great value for localities in which land disturbing activities are not covered under existing permits because the requirements for a performance bond, cash escrow, letter of credit, any combination thereof, or such other legal arrangement acceptable to the local government are limited to those projects for which a permit is required.

EROSION AND SEDIMENT CONTROL LAW

Title 21, Chapter 1, Article 6.1. of the Code of Virginia
[1950 as amended]

§ 21-89.1. This article shall be known as the "Erosion and Sediment Control Law"

§ 21-89.2. The General Assembly has determined that the lands and waters comprising the watersheds of the State are great natural resources; that as a result of erosion of lands and sediment deposition in waters within the watersheds of the State, said waters are being polluted and despoiled to such a degree that fish, aquatic life, recreation and other uses of lands and waters are being adversely affected; that the rapid shift in land use from agricultural to nonagricultural uses has accelerated the processes of soil erosion and sedimentation; and further, it is necessary to establish and implement, through the Virginia Soil and Water Conservation Commission, hereinafter referred to as the "Commission", and the soil and water conservation districts, hereinafter referred to as "districts", in cooperation with counties, cities, towns, other subdivisions of this State, and other public and private entities, a Statewide coordinated erosion and sediment control program to conserve and to protect the land, water, air and other natural resources of the Commonwealth.

§ 21-89.3. Definitions. -- As used in this article, unless the context clearly indicates otherwise:

(a) "Land disturbing activity" shall mean any land change which may result in soil erosion from water or wind and the movement of sediments into State waters or onto lands in the State, including, but not limited to, clearing, grading, excavating, transporting and filling of land, other than federal lands, except that the term shall not include: (i) such minor land-disturbing activities as home gardens and individual home landscaping, repairs and maintenance work; (ii) individual service connections and construction or installation of public utility lines; (iii) septic tank lines or drainage fields unless included in an overall plan for land-disturbing activity relating to construction of the building to be served by the septic tank system; (iv) surface or deep mining, neither shall it include tilling, planting, or harvesting of agricultural, horticultural, or forest crops; (v) construction, repair or rebuilding of the tracks, right-of-way, bridges, communication facilities and other related structures and facilities of a railroad company; (vi) preparation for single-family residences separately built, unless in conjunction with multiple construction in subdivision development; (vii) disturbed land areas for commercial or noncommercial uses of less than ten thousand square feet in size; provided, however, that the governing body of the county, city, town or district, may reduce this exception to a smaller area of disturbed land and/or qualify the conditions under which this exception shall apply; (viii) installation of fence and sign posts or telephone and electric poles and other kinds of posts or poles; (ix) shore erosion control projects on tidal waters recommended by the soil and water conservation districts in which the projects are located or approved by the

Marine Resources Commission; (x) emergency work to protect life, limb or property, and emergency repairs; provided that if the land disturbing activity would have required an approved erosion and sediment control plan, if the activity were not an emergency, then the land area disturbed shall be shaped and stabilized in accordance with the requirement of the local plan approving authority or the Commission when applicable.

(b) "Person" shall mean any individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, county, city, town or other political subdivision of this State, any interstate body, or any other legal entity.

(c) "Town" shall mean an incorporated town.

(d) "Conservation standards" or "standards" shall mean standards adopted by the Commission or the districts, counties, cities and towns pursuant to §§ 21-89.4 and 21-89.5, respectively, of this act.

(e) "Specifications" shall mean the written procedures, requirements or plans to control erosion and sedimentation as officially adopted by the Governing Board or Commission of a State agency or institution or by an agency's administrative head if there is no Board or Commission.

(f) "Conservation plan", "erosion and sediment control plan", or "plan", shall mean a document containing material for the conservation of soil and water resources of a unit or group of units of land. It may include appropriate maps, an appropriate soil and water plan inventory and management information with needed interpretations, and a record of decisions contributing to conservation treatment. The plan shall contain all major conservation decisions to assure that the entire unit or units of land will be so treated to achieve the conservation objectives.

(g) "State erosion and sediment control program" or "State program" shall mean the program adopted by the Commission consisting of conservation standards, guidelines and criteria to minimize erosion and sedimentation.

(h) "Local erosion and sediment control program" or "local control program" shall mean an outline or explanation of the various elements or methods employed by a district, county, city, or town to regulate land disturbing activities and thereby minimize erosion and sedimentation in compliance with the State program and may include such items as a local ordinance, policies and guidelines, technical materials, inspection, enforcement and evaluation.

(i) "Plan approving authority" shall mean the district or a county, city, or town, or a department of a county, city, or town, responsible for determining the adequacy of a conservation plan submitted for land disturbing activities on a unit or units of lands and shall approve such plan if the plan is determined to be adequate.

§ 21-89.4. State erosion and sediment control program. (a) The Commission shall establish minimum standards, guidelines and criteria for the effective control of soil erosion, sediment deposition and nonagricultural runoff which must be met in any control program. To assist in the development of the program, the Commission shall seek the advice of the State Water Control Board (the opinion of the State Water Control Board shall be advisory only) and may seek the advice of other appropriate State and federal agencies and shall name an advisory board of not less than seven nor more than eleven members which shall include but not be limited to representatives of such interests as residential development and construction, nonresidential construction, and agriculture. At least two members of the advisory board shall be from the public

at large having no direct pecuniary interest and at least two members shall be from local governments.

(b) To implement this program, the Commission shall develop and adopt by July one, nineteen hundred seventy-four, guidelines for erosion and sediment control, which guidelines may be revised from time to time as may be necessary. In accordance with Chapter 1 of Title 9 of this Code, the Commission shall give due notice and conduct public hearings on the proposed guidelines or proposed change in existing guidelines before adopting or revising such guidelines. The guidelines for carrying out the program shall:

(1) be based upon relevant physical and developmental information concerning the watersheds and drainage basins of the State, including, but not limited to, data relating to land use, soils, hydrology, geology, size of land area being disturbed, proximate water bodies and their characteristics, transportation, and public facilities and services;

(2) include such survey of lands and waters as may be deemed appropriate by the Commission or required by any applicable law to identify areas, including multijurisdictional and watershed areas, with critical erosion and sediment problems; and

(3) contain conservation standards for various types of soils and land uses, which standards shall include criteria, techniques, and methods for the control of erosion and sediment resulting from land disturbing activities.

(c) The program and guidelines shall be made available for public inspection at the office of the Commission.

§ 21-89.5. Local erosion and sediment control programs. (a) Each district in the Commonwealth, except as provided in subsection (c) of this section, shall within eighteen months after the adoption of the State guidelines, develop and adopt a soil erosion and sediment control program consistent with the State program and guidelines for erosion and sediment control. Districts adopting such programs shall do so pursuant to the provisions of the General Administration Agencies Act. To assist in developing its program, each district shall name an advisory committee of not less than seven nor more than eleven members which shall include but not be limited to representatives of such interests as residential development and construction, nonresidential construction, and agriculture. At least two members of the advisory board shall be from the public at large having no direct pecuniary interest, and at least two members shall be from local governments. Upon the request of a district the Commission shall assist in the preparation of the district's program. Upon adoption of its program, the district shall submit the program to the Commission for review and approval.

To carry out its program the district shall, within one year after the program has been approved by the Commission, establish consistent with the State program and guidelines, conservation standards for various types of soils and land uses, which standards shall include criteria, guidelines, techniques, and methods for the control of erosion and sediment resulting from land disturbing activities. Such conservation standards may be revised from time to time as may be necessary. Before adopting or revising conservation standards, the district shall, after giving due notice, conduct a public hearing on the proposed conservation standards or proposed changes in existing standards. The program and conservation standards shall be made available for public inspection at the principal office of the district.

(b) In areas where there is no district, a county, city, or town shall develop, adopt and carry out the erosion and sediment control program and exercise the responsibilities of a district with respect thereto, as provided in this act; except that the provisions for an advisory committee shall not be mandatory.

(c) Any county, city, or town that, prior to July one, nineteen hundred seventy-five, has adopted its own erosion and sediment control program which has been approved by the Commission shall be treated under this act as a county, city, or town which lies in an area where there is no district, whether or not such district in fact exists.

Any town, lying within a county which adopts its own erosion and sediment control program, must adopt its own program, or adopt jointly with the county an erosion and sediment control program or authorize the county to adopt the program for the town. If a town lies within the boundaries of more than one county, such town shall be considered for the purposes of this article to be wholly within the county in which the larger portion of the town lies. Any county, city, or town adopting an erosion and sediment control program may designate its department of public works or a similar local government department as the plan approving authority or may designate the district as the plan approving authority for all or some of the conservation plans.

(d) If a district, or county, city, or town not in a district, fails to submit a program to the Commission within the period specified herein, the Commission shall, after such hearings or consultations as it deems appropriate with the various local interests involved, develop and adopt an appropriate program to be carried out by such district, county, city, or town. The Commission shall do likewise with respect to any town lying within a county which adopts its own erosion and sediment control program and such town does not provide for land disturbing activities within the town to be covered by a local control program.

§ 21-89.6. Regulated land disturbing activites. (a) Except as provided in subsections (e) and (f) of this section, no person may engage in any land disturbing activity after the adoption of the conservation standards by the districts, counties, cities or towns until he has submitted to the district, county, city, or town an erosion and sediment control plan for such land disturbing activity and such plan has been reviewed and approved by the plan approving authority. Where land disturbing activities involve lands under the jurisdiction of more than one local control program an erosion and sediment control plan may, at the option of the applicant, be submitted to the Commission for review and approval rather than submission to each jurisdiction concerned.

(b) Upon submission of an erosion and sediment control plan to a plan approving authority or to the Commission:

(1) the plan approving authority shall, within forty-five days, approve any such plan if it determines that the plan meets the conservation standards of the local control program and if the person responsible for carrying out the plan certifies that he will properly perform the erosion and sediment control measures included in the plan and will conform to the provisions of this act;

(2) the Commission shall review plans submitted to it and shall within forty-five days approve any such plan if it determines that the plan is adequate in consideration of the Commission's guidelines and the conservation

standards of the local control program or programs involved, and if the person responsible for carrying out the plan certifies that he will properly perform the conservation measures included in the plan and will conform to the provisions of this act.

(c) The plan approving authority or Commission must act on all plans submitted within forty-five days from receipt thereof by either approving said plan in writing or by disapproving said plan in writing and giving the specific reasons for its disapproval. When a plan submitted for approval under this section is found, upon review by the respective agency, to be inadequate, such agency shall specify such modifications, terms, and conditions as will permit approval of the plan and communicate these requirements to the applicant as herein required. If no action is taken by the plan approving authority or Commission within the time specified above, the plan shall be deemed approved and the person authorized to proceed with the proposed activity.

(d) An approved plan may be changed by the authority which has approved the plan or by the Commission when it has approved the plan in the following cases:

(1) where inspection has revealed the inadequacy of the plan to accomplish the erosion and sediment control objectives of the plan; and appropriate modifications to correct the deficiencies of the plan are agreed to by the plan approving authority and the person responsible for carrying out the plan; or

(2) where the person responsible for carrying out the approved plan finds that because of changed circumstances or for other reasons the approved plan cannot be effectively carried out, and proposed amendments to the plan, consistent with the requirements of this act, are agreed to by the plan approving authority and the person responsible for carrying out the plan.

(e) Any person owning, occupying, or operating private agricultural, horticultural or forest lands shall not be deemed to be in violation of this act for land disturbing activities resulting from the tilling, planting or harvesting of agricultural, horticultural or forest crops or products, or engineering operations under § 21-2(c) of the Code of Virginia. Such person shall comply with the provisions of this act when grading, excavating or filling.

(f) Any State agency that undertakes a project involving a land disturbing activity shall file specifications or a conservation plan with the Commission for review and written comments. The Commission shall have sixty days in which to comment and such comment shall be binding on the State agency or the private business hired by the State agency. Individual approval of separate projects is not necessary when approved specifications are followed.

The State agency shall submit changes in the conservation plan or specifications as they occur to the Commission and shall submit specifications and plans at least annually for review.

Further, the State agency responsible for the land disturbing activity shall ensure compliance with the approved plan or specifications.

(g) For the purposes of subsections (a) and (b) of this section, when land disturbing activity will be required of a contractor performing construction work pursuant to a construction contract, the preparation, submission and approval of an erosion and sediment control plan shall be the responsibility of the owner.

§ 21-89.7. Approved plan required for issuance of grading, building, or other permits. Upon the effective date of the adoption of the conservation

standards by the districts, counties, cities or towns, when standards have not otherwise been adopted, no agency authorized under any other law to issue grading, building, or other permits for activities involving land disturbing activities may issue any such permits unless the applicant therefor submits with his application the approved erosion and sediment control plan or certification of such approved plan from the local plan approving authority or from the Commission where appropriate, as well as certification that such plan will be followed. Such agency, prior to issuance of any permit, may also require from any applicant a reasonable performance bond, cash escrow, letter of credit, any combination thereof, or such other legal arrangement acceptable to the agency, to ensure that emergency measures could be taken by the county, city or town at the applicant's expense should he fail within the time specified to initiate appropriate conservation action which may be required of him as a result of his land activity. Within sixty days of the completion of the land disturbing activity, such bond, cash escrow, letter of credit or other legal arrangement, or the unexpended or unobligated portion thereof, shall be refunded to the applicant or terminated, as the case may be. These requirements are in addition to all other provisions of law relating to the issuance of such permits and are not intended to otherwise affect the requirements for such permits.

§ 21-89.8. Monitoring, reports and inspections. (a) Land disturbing activities where permit is issued. With respect to approved plans for erosion and sediment control in connection with land disturbing activities which involve the issuance of a grading, building, or other permit, either the permit issuing authority or plan approving authority shall provide for periodic inspections of the land disturbing activity to ensure compliance with the approved plan, and to determine whether the measures required in the plan are effective in controlling erosion and sediment resulting from the land disturbing activities. Notice of such right of inspection shall be included in the permit. The owner, occupier or operator shall be given an opportunity to accompany the inspectors. If the permit issuing authority or plan approving authority determines that the permittee has failed to comply with the plan, the authority shall immediately serve upon the permittee by registered or certified mail to the address specified by the permittee in his permit application a notice to comply. Where the plan approving authority serves notice, a copy of each notice shall also be sent to the issuer of the permit. Such notice shall set forth specifically the measures needed to come into compliance with such plan and shall specify the time within which such measures shall be completed. If the permittee fails to comply within the time specified, he may be subject to revocation of the permit; furthermore, he shall be deemed to be in violation of this act and upon conviction shall be subject to the penalties provided by the act.

(b) Other regulated land disturbing activites. With respect to approved plans for erosion and sediment control in connection with all other regulated land disturbing activities, the plan approving authority may require of the person responsible for carrying out the plan such monitoring and reports, and may make such on-site inspections after notice to the resident owner, occupier or operator as are deemed necessary to determine whether the soil erosion and sediment control measures required by the approved plan are being properly performed, and whether such measures are effective in controlling soil erosion and sediment resulting from the land disturbing activity. Such resident owner, occupier or operator shall be given an opportunity to accompany the inspectors. If it is determined that there is failure to comply with the approved plan, the plan approving authority shall serve notice upon the person who is responsible

for carrying out the plan at the address specified by him in his certification at the time of obtaining his approved plan. Such notice shall set forth the measures needed for compliance and the time within which such measures shall be completed. Upon failure of such person to comply within the specified period, he will be deemed to be in violation of the act and upon conviction shall be subject to the penalties provided by the act.

(c) Additional provisions. Notwithstanding the above provisions of this section the following may be applied:

(1) Where a county, city, or town adopts the local control program and the permit issuing authority and the plan approving authority are not within the same local government department, the county, city, or town may designate one department to inspect, monitor, report and insure compliance. In the event a district has been designated as the plan approving authority for all or some of the conservation plans, the enforcement of the program shall be with the local government department; however, the district may inspect, monitor and make reports for the local government department.

(2) Where a district adopts the local control program and permit issuing authorities have been established by a county, city, or town, the district by joint resolution with the appropriate county, city, or town may exercise the responsibilities of the permit issuing authorities with respect to monitoring, reports, inspections and enforcement.

(3) Where a permit issuing authority has been established, and such authority is not vested in an employee or officer of local government but is the Commissioner of Revenue or some other person, the county, city, or town shall exercise the responsibilities of the permit issuing authority with respect to monitoring, reports, inspections and enforcement unless such responsibilities are transferred as provided for in the above provisions of this section.

§ 21-89.9. Cooperation with federal and State agencies. The districts, counties, cities or towns operating their own programs, and the Commission are authorized to cooperate and enter into agreements with any federal or State agency in connection with plans for erosion and sediment control with respect to land disturbing activities.

§ 21-89.10. Appeals. (a) Final decisions of counties, cities or towns under this act shall be subject to review by the court of record of the county or city, provided an appeal is filed within thirty days from the date of any written decision adversely affecting the rights, duties or privileges of the person engaging in or proposing to engage in land disturbing activities.

(b) Final decision of the districts shall be subject to an administrative review by the Commission, provided an appeal is filed within thirty days from the date of the written decision.

(c) Final decisions of the Commission either upon its own action or upon the review of the action of a district shall be subject to review by the Circuit Court of the City of Richmond, provided an appeal is filed within thirty days from the date of the written decision of the Commission.

§ 21-89.11. Penalties, injunctions and other legal actions. (a) A violation under §§ 21-89.6 or 21-89.8 of this chapter shall be deemed a misdemeanor and upon conviction shall be subject to a fine not exceeding one thousand dollars or thirty days imprisonment for each violation or both.

(b) The appropriate permit issuing authority, a district, a county, city, or town operating its own program, or the Commission may apply to the court of record in the jurisdiction wherein the land lies, or to the Circuit Court of the City of Richmond should the lands lie in more than one jurisdiction, for injunctive relief to enjoin a violation or a threatened violation under §§ 21-89.6

or 21-89.8 of this act, without the necessity of showing that there does not exist an adequate remedy at law.

(c) The Commonwealth's Attorney shall, upon request of a district, county, city, or town operating its own program, or the permit issuing authority, take legal action to enforce the provisions of this act. The State Attorney General shall, upon request of the Commission, take appropriate legal action on behalf of the Commission to enforce the provisions of this act.

(d) Compliance with the provisions of this article shall be prima facie evidence in any legal or equitable proceeding for damages caused by erosion, siltation or sedimentation that all requirements of law have been met and the complaining party must show negligence in order to recover any damages.

§ 21-89.12. Authorization for more stringent standards. A district, county, city or town is hereby authorized to adopt more stringent soil erosion and siltation standards than those necessary to ensure compliance with the State's minimum standards, guidelines and criteria. However, nothing in this section shall be construed to authorize any district, county, city or town to impose any more stringent regulations for plan approval or permit issuance than those specified in §§ 21-89.6 and 21-89.7.

§ 21-89.13. No limitation on authority of Water Control Board or Department of Conservation and Economic Development. Nothing contained within the provisions of this chapter shall limit the powers or duties presently exercised by the State Water Control Board under Chapter 3.1 of Title 62.1 of this Code, or the powers or duties of the Department of Conservation and Economic Development as it relates to strip mine reclamation under Chapters 16 and 17 of Title 45.1 of this Code.

§ 21-89.14. Severability. If any provision of this act is held to be unconstitutional or invalid, such unconstitutionality or invalidity shall not affect the remaining provisions of this act.

§ 21-89.15. Nothing in this act shall affect any project commenced prior to the adoption of the conservation standards by the districts, counties, cities or towns.

SUGGESTED TABLE OF CONTENTS FOR LOCAL EROSION AND SEDIMENT CONTROL HANDBOOK

Introduction

Part I - Local Erosion and Sediment Control Program

- Ordinance(s) relating to erosion and sediment control
- Procedures for Plan Submission and Review, On-Site Inspection, and Ordinance Enforcement

Part II - Erosion and Erosion Control Planning and Plans

- Guidelines for Erosion and Sediment Control Planning
- Guidelines for Erosion and Sediment Control Plans
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Part III - Erosion and Sediment Control Practices

- Overview of Erosion and Sediment Control Practices
- Standards and Specifications for Mechanical Practices
- Appendices for Mechanical Practices
- Standards and Specifications for Vegetative Practices
- Appendix for Vegetative Practices

Glossary

Notes--The introduction in the state handbook could be used as the basis for a rewrite which would be applicable for the locality. The ordinance(s) could be placed in the appendix rather than Part I. A list of the sources of information and technical assistance for conservation planning should be contained somewhere in the local handbook.

Erosion and Sediment Control Handbook

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EROSION AND SEDIMENT CONTROL HANDBOOK

GLOSSARY

GLOSSARY

The list of terms that follows is representative of those used by soil scientists, engineers, developers, conservationist planners, etc. The terms are not necessarily used in the text, nonetheless they are in common use in conservation matters. The aim of this Glossary is representativeness, not completeness. Unless indicated by a dash "—", the terms are all from the GLOSSARY published by the Soil Conservation Society of America.

AASHO CLASSIFICATION (soil engineering) - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

AGGRADATION - The process of building up a surface by deposition. This is a long-term or geologic trend in sedimentation.

ACRE-FOOT - The volume of water that will cover 1 acre to a depth of 1 foot.

ALLUVIAL - Pertaining to material that is transported and deposited by running water.

ALLUVIAL LAND - Areas of unconsolidated alluvium, generally stratified and varying widely in texture, recently deposited by streams, and subject to frequent flooding. A miscellaneous land type.

ALLUVIAL SOILS - An azonal great soil group of soils, developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soilforming processes.

ALLUVIUM - A general term for all detrital material deposited or in transit by streams, including gravel, sand, silt, clay, and all variations and mixtures of these. Unless otherwise noted, alluvium is unconsolidated.

- ANTI-SEEP COLLAR - A device constructed around a pipe or other conduit and placed through a dam, levee, or dike for the purpose of reducing seepage losses and piping failures.

- ANTI-VERTEX-DEVICE - A facility placed at the entrance to a pipe conduit structure such as a drop inlet spillway or hood inlet spillway to prevent air from entering the structure when the pipe is flowing full.

BEDROCK - The more or less solid rock in place either on or beneath the surface of the earth. It may be soft or hard and have a smooth or irregular surface.

- BEDROCK, DEPTH
  (a) Shallow to bedrock. Less than 20 inches to solid bedrock.
  (b) Moderately deep to bedrock. 20 to 36 inches to solid bedrock.
  (c) Deep to bedrock. 3 feet or more to solid bedrock.

- BEDROCK, HARDNESS
  (a) Soft. Presents no excavation problems with modern equipment.
  (b) Medium. Presents some excavation problems with modern equipment.
  (c) Hard. Usually requires specialized techniques such as drilling and blasting for excavation.

BLINDING MATERIAL - Material placed on top of and around a closed drain to improve the flow of water to the drain and to prevent displacement during back-filling of the trench.

BLIND INLET - Inlet to a drain in which entrance of water is by percolation rather than open flow channels.

BORROW AREA - A source of earth fill material used in the construction of embankments or other earth fill structures.

BOTTOM LANDS - A term often used to define lowlands adjacent to streams.

CHANNEL - A natural stream that conveys water; a ditch or channel excavated for the flow of water.

CHANNEL IMPROVEMENT - The improvement of the flow characteristics of a channel by clearing, excavation, realignment, lining, or other means in order to increase its capacity. Sometimes used to connote channel stabilization.

CHANNEL STABILIZATION - Erosion prevention and stabilization of velocity distribution in a channel using jetties, drops, revetments, vegetation, and other measures.

CHANNEL STORAGE - Water temporarily stored in channels while enroute to an outlet.

CONDUIT - Any channel intended for the conveyance of water, whether open or closed.

CONSERVATION - The protection, improvement, and use of natural resources according to principles that will assure their highest economic or social benefits.

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, usually a subdivision of state government with a local governing body and always with limited authorities. Often called a soil conservation district or a soil and water conservation district.

CONTOUR

(1) An imaginary line on the surface of the earth connecting points of the same elevation.
(2) A line drawn on a map connecting points of the same elevation.

CONTOUR DITCH - Irrigation ditch laid out approximately on the contour.

- COVER CROP - A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.

- CRADLE - A device usually concrete, used to support a pipe conduit or barrel.

CUT - Portion of land surface or area from which earth has been removed or will be removed by excavation; the depth below original ground surface to excavated surface.

CUT-AND-FILL - Process of earth moving by excavating part of an area and using the excavated material for adjacent embankments or fill areas.

- CUTOFF TRENCH - A long, narrow excavation constructed along the center line of a dam, dike, levee or embankment and filled with relatively impervious material intended to reduce seepage of water through porous strata.

DAM - A barrier to confine or raise water for storage or diversion, to create a hydraulic head, to prevent gully erosion, or for retention of soil, rock, or other debris.

DEBRIS - A term applied to the loose material arising from the disintegration of rocks and vegetative material; transportable by streams, ice or floods.

DEBRIS DAM - A barrier built across a stream channel to retain rock, sand, gravel, silt, or other material.

DEBRIS GUARD - Screen or grate at the intake of a channel, drainage, or pump structure for the purpose of stopping debris.

- DEGRADE - The alteration of a channel caused by erosion and scour of the channel bottom.

DETENTION DAM - A dam constructed for the purpose of temporary storage of streamflow or surface runoff and for releasing the stored water at controlled rates.

- DESIGN HIGHWATER - The elevation of the water surface as determined by the flow conditions of the design floods.

- DESIGN LIFE - The period of time for which a facility is expected to perform its intended function.

DIKE (engineering) - An embankment to confine or control water, especially one built along the banks of a river to prevent overflow of lowlands; a levee. (geology) A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks.

DISCHARGE (hydraulics) - Rate of flow, specifically fluid flow; a volume of fluid passing a point per unit time, commonly expressed as cubic feet per second, million gallons per day, gallons per minute, or cubic meters per second.

DISCHARGE COEFFICIENT (hydraulics) - The ratio of actual rate of flow to the theoretical rate of flow through orifices, weirs, or other hydraulic structures.

DISCHARGE FORMULA (hydraulics) - A formula to calculate rate of flow of fluid in a conduit or through an opening. For steady flow discharge, $Q=AV$, wherein Q is rate of flow, A is cross-sectional area and V is mean velocity. Common units are cubic feet per second, square feet, and feet per second, respectively. To calculate the mean velocity, V for uniform flow in pipes or open channels. See Manning's Formula.

DIVERSION - A channel with or without a supporting ridge on the lower side constructed across or at the bottom of a slope for the purpose of intercepting surface runoff. See terrace.

DIVERSION DAM - A barrier built to divert part or all of the water from a stream into a different course.

DIVERSION TERRACE - Diversions, which differ from terraces in that they consist of individually designed channels across a hillside, may be used to protect bottomland from hillside runoff or may be needed above a terrace system for protection against runoff from an unterraced area. They may also divert water out of active gullies, protect farm building from runoff, reduce the number of waterways, and are sometimes used in connection with stripcropping to shorten the length of slope so that the strips can effectively control erosion. See terrace.

DRAIN

(1) A buried pipe or other conduit (closed drain)
(2) A ditch (open drain) for carrying off surplus surface water or groundwater.
(3) To provide channels, such as open ditches or closed drains, so that excess water can be removed by surface flow or by internal flow.
(4) To lose water (from the soil) by percolation.

DRAINAGE

(1) The removal of excess surface water or groundwater from land by means of surface or subsurface drains.
(2) Soil characteristics that affect natural drainage.

DRAINAGE, SOIL - As a natural condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation; for example, in well-drained soils the water is removed readily but not rapidly; in poorly drained

soils the root zone is waterlogged for long periods unless artifically drained, and the roots of ordinary crop plants cannot get enough oxygen: in excessively drained soils the water is removed so completely that most crop plants suffer from lack of water. Strictly speaking, excessively drained soils are a result of excessive runoff due to steep slopes or low available waterholding capacity due to small amounts of silt and clay in the soil material. The following classes are used to express soil drainage:

Well drained - excess water drains away rapidly and no mottling occurs within 36 inches of the surface.

Moderately well drained - water is removed from the soil somewhat slowly, resulting in small but significant periods of wetness. Mottling occurs between 18 and 36 inches.

Somewhat poorly drained - water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Mottling occurs between 8 and 18 inches.

Poorly drained - water is removed so slowly that the soil is wet for a large part of the time. Mottling occurs between 0 and 8 inches.

Very poorly drained - water is removed so slowly that the water table remains at or near the surface for the greater part of the time. There may also be periods of surface ponding. The soil has a black to gray surface layer with mottles up to the surface.

DRAWNDOWN - Lowering of the water surface (in open channel flow), water table, or piezometric surface (in groundwater flow) resulting from a withdrawal of water.

DROP-INLET SPILLWAY - Overall structure in which the water drops through a vertical riser connected to a discharge conduit.

DROP SPILLWAY - Overall structure in which the water drops over a vertical wall onto an apron at a lower elevation.

DROP STRUCTURE - A structure for dropping water to a lower level and dissipating its surplus energy; a fall. A drop may be vertical or inclined. Syn. drop.

EARTH DAM - Dam constructed of compacted soil materials.

- EMBANKMENT - A man-made deposit of soil, rock, or other material used to form an impoundment.

- EMERGENCY SPILLWAY - A vegetated earth channel used to safely convey flood discharges in excess of the capacity of the principal spillway.

- ENERGY DISSIPATOR - A device used to reduce the energy of flowing water.

ERODIBLE (geology and soils) -- Susceptible to erosion.

EROSION

(1) The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

(2) Detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

ACCELERATED EROSION - Erosion much more rapid than normal, or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of other animals or natural catastrophies that expose base surfaces, for example, fires.

GEOLOGICAL EROSION - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc. Syn. natural erosion.

GULLY EROSION - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.

NATURAL EROSION - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Syn. geological erosion.

NORMAL EROSION - The gradual erosion of land used by man which does not greatly exceed natural erosion. See natural erosion.

RILL EROSION - An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See rill.

SHEET EROSION - The removal of a fairly uniform layer of soil from the land surface by runoff water.

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.

EROSION CLASSES (soil survey) - A grouping of erosion conditions based

on the degree of erosion or on characteristic patterns. Applied to accelerated erosion, not to normal, natural, or geological erosion. Four erosion classes are recognized for water erosion and three for wind erosion.

EROSIVE - Refers to wind or water having sufficient velocity to cause erosion. Not to be confused with erodible as a quality of soil.

ESCARPMENT - A steep face or a ridge of high land; the escarpment of a mountain range is generally on that side nearest the sea.

- FLAT - Section of stream with current too slow to be classed as riffle and too shallow to be classed as a pool. Stream bottom usually composed of sand or fine materials, with coarse rubble, boulders or bedrock occasionally evident.

- FILTER BLANKET - A layer of sand and/or gravel designed to prevent the movement of fine grained soils.

FILTER STRIP - A long, narrow vegetative planting used to retard or collect sediment for the protection of diversions, drainage basins or other structures.

FLOOD - An overflow or inundation that comes from a river or other body of water and causes or threatens damage.

FLOOD CONTROL - Methods of facilities for reducing flood flows.

FLOOD CONTROL PROJECT - A structural system installed for protection of land and improvements from floods by the construction of dikes, river embankments, channels, or dams.

FLOODGATE - A gate placed in a channel or closed conduit to keep out floodwater or tidal backwater.

FLOOD PEAK - The highest value of the stage or discharge attained by a flood, thus, peak stage or peak discharge.

FLOODPLAIN - Nearly level land situated on either side of a channel which is subject to overflow flooding.

- FLOODROUTING - Determining the changes in the rise and fall of floodwater as it proceeds downstream through a valley or reservoir.

FLOOD STAGE - The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured.

FLOODWATER RETARDING STRUCTURE - A structure providing for temporary storage of floodwater and for its controlled release.

FLOODWAY - A channel, either natural, excavated, or bounded by dikes and levees, used to carry excessive flood flows to reduce flooding. Sometimes considered to be the transitional area between the active channel and the floodplain.

FLUME - A device constructed to convey water on steep grades lined with erosion resistant materials.

FRAGIPAN - A natural subsurface horizon with high bulk density relative to the solum above, seemingly cemented when dry but showing a moderate to weak brittleness when moist. The layer is low in organic matter, mottled, slowly or very slowly permeable to water, and usually shows occasional or frequent bleached cracks forming polygons. It may be found in profiles of either cultivated or virgin soils but not in calcareous material.

FREEBOARD - A vertical distance between the elevation of the design highwater and the top of the dam, levee, or diversion ridge.

GAGE OR GAUGE - Device for registering precipitation, water level, discharge, velocity, pressure, temperature, etc.

GAGING STATION - A selected section of a stream channel equipped with a gage, recorder, or other facilities for determining stream discharge.

GRADATION (geology) - The bringing of a surface or a stream bed to grade, by running water. As used in connection with sedimentation and fragmental products for engineering evaluation, the term gradation refers to the frequency distribution of the various sized grains that constitute a sediment, soil, or other material.

GRADE

(1) The slope of a road, channel, or natural ground.
(2) The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction like paving or laying a conduit.
(3) To finish the surface of a canal bed, roadbed, top of embankment or bottom of excavation.

GRADED STREAM - A stream in which, over a period of years, the slope is delicately adjusted to provide, with available discharge and with prevailing channel characteristics, just the velocity required for transportation of the load (of sediment) supplied from the drainage basin. The graded profile is a slope of transportation. It is a phenomenon in which the element of time has a restricted connotation. Works of man are limited to his experience and of design and construction.

GRADE STABILIZATION STRUCTURE - A structure for the purpose of stabilizing the grade of a gully or other watercourse, thereby preventing further head-cutting or lowering of the channel grade.

GRADIENT - Change of elevation, velocity, pressure, or other characteristics per unit length; slope.

GRADING - Any stripping, cutting, filling, stock piling, or any combination thereof and shall include the land in its cut and filled condition.

GRASS - A member of the botanical family Gramineae, characterized by bladelike leaves arranged on the culm or stem in two ranks.

GRASSED WATERWAY - A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from cropland.

GULLY - An incised channel or miniature valley cut by concentrated runoff but through which water commonly flows only during snow. A gully may be dendritic or branching or it may be linear, rather long, narrow, and of uniform width. The distinction between gully and rill is one of depth. A gully is sufficiently deep that it would not be obliterated by normal tillage operations, whereas a rill is of lesser depth and would be smoothed by use of ordinary tillage equipment. Syn. arroyo. See erosion; rill.

GULLY EROSION - See erosion.

GULLY CONTROL PLANTINGS - The planting of forage, legume, or woody plant seeds, seedlings, cuttings, or transplants in gullies to establish or re-establish a vegetative cover adequate to control runoff and erosion and incidentally produce useful products.

HABITAT - The environment in which the life needs of a plant or animal are supplied.

HEAD (hydraulics)
(1) The height of water above any plane or reference.
(2) The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. Used in various compound terms such as pressure head, velocity head, and lost head.

HEAD GATE - Water control structure; the gate at the entrance to a conduit.

HEAD LOSS - Energy loss due to friction, eddies, changes in velocity, or direction of flow. See friction head.

HEADWATER
(1) The source of a stream.
(2) The water upstream from a structure or point on a stream.

HIGHWAY EROSION CONTROL - The prevention and control of erosion in ditches, at cross drains, and on fills and road banks within a highway right-of-way. Includes vegetative practices and structural practices.

HYDROGRAPH - A graph showing for a given point on a stream or for a given point in any drainage system the discharge, stage, velocity, or other property of water with respect to time.

IMPACT BASIN - A device used to dissipate the energy of flowing water. Generally constructed of concrete in the form of a partially depressed or partially submerged vessel and may utilize baffles to dissipate velocities.

IMPOUNDMENT - Generally, an artificial collection or storage of water, as a reservoir, pit, dugout, sump, etc. See reservoir.

INFILTRATION - The flow of a liquid into a substance through pores or other openings, connoting flow into a soil in contradistinction to the word, percolation, which connotes flow through a porous substance.

INLET (hydraulics)
(1) A surface connection to a closed drain.
(2) A structure at the diversion end of a conduit.
(3) The upstream end of any structure through which water may flow.

INOCULANT - A peat carrier impregnated with bacteria which forms a symbiotic relationship enabling legumes to utilize atmospheric nitrogen. Most legumes require a specific bacteria.

INOCULATION - The process of introducing pure or mixed cultures or micro-organisms into natural or artificial cultural media.

INTAKE
(1) The headworks of a conduit, the place of diversion.
(2) Entry of water into soil. See infiltration.

INTAKE RATE - The rate of entry of water into soil. See infiltration rate.

INTENSITY - See rainfall intensity.

INTERCEPTION (hydraulics) - The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs, and other vegetation. Often used for "interception

loss" or the amount of water evaporated from the precipitation intercepted.

INTERCEPTION CHANNEL - A channel excavated at the top of earth cuts, at the foot of slopes or at other critical places to intercept surface flow; a catch drain. Syn. interception ditch.

INTERCEPTOR DRAIN - Surface or subsurface drain, or a combination of both, designed and installed to intercept flowing water.

INTERFLOW - That portion of rainfall that infiltrates into the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface at some point downslope from its point of infiltration.

INTERMITTENT STREAM - A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources. It is dry for a large part of the year, ordinarily more than 3 months.

INTERNAL SOIL DRAINAGE - The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are: none, very slow, slow, medium, rapid, and very rapid.

LAND - The total natural and cultural environment within which production takes place; a broader term than soil. In addition to soil, its attributes include other physical conditions, such as mineral deposits, climate, and water supply; location in relation to centers of commerce, populations, and other land, the size of the individual tracts or holdings; and existing plant cover, works of improvement, and the like. Some use the terms loosely in other senses: as defined above but without the economic or cultural criteria; especially in the expression "natural land" as a synonym for "soil"; for the solid surface of the earth; and also for earthy surface formations, especially in the geomorphological expression "land form".

LAND CAPABILITY - The suitability of land for use without permanent damage. Land capability, as ordinarily used in the United States, is an expression of the effect of physical land conditions, including climate, on the total suitability for use without damage for crops that require regular tillage, for grazing, for woodland, and for wildlife. Land capability involves consideration of (1) the risks of land damage from erosion and other causes and (2) the difficulties in land use owing to physical land characteristics, including climate.

LAND CAPABILITY CLASSIFICATION - A grouping of kinds of soils into special units, subclasses, and classes according to their capability for intensive use and the treatments required for sustained use, prepared by the Soil Conservation Service, USDA.

LAND CAPABILITY MAP - A map showing land capability units, subclasses and classes, or a soil survey map colored to show land capability classes.

LAND CAPABILITY UNIT - Capability units provide more specific and detailed information for application to specific fields on a farm or ranch than the subclass of the land capability classification. A capability unit is a group of soils that are nearly alike in suitability for plant growth and responses to the same kinds of soil management.

LAND CLASSIFICATION - The arrangement of land units into various categories based on the properties of the land or its suitability for some particular purpose.

LAND FORM - A discernible natural landscape, such as a floodplain, stream terrace, plateau, valley, etc.

LEGUME - A member of the legume or pulse family, Leguminosae. One of the most important and widely distributed plant families. The fruit is a "legume" or pod that opens along two sutures when ripe. Flowers are usually papilionaceous (butterflylike). Leaves are alternate, have stipules, and are usually compound. Includes many valuable food and forage species, such as the peas, beans, peanuts, cloves, alfalfas, sweet clovers, lespedezas, vetches, and kudzu. Practically all legumes are nitrogen-fixing plants.

LEVEL SPREADER - A shallow channel excavation at the outlet end of a diversion with a level section for the purpose of diffusing the diversion outflow.

LIME - Lime, from the strictly chemical standpoint, refers to only one compound, calcium oxide (CaO); however, the term "lime" is commonly used in agriculture to include a great variety of materials which are usually composed of the oxide, hydroxide, or carbonate of calcium or of calcium and magnesium. The most commonly used forms of agricultural lime are ground limestone (carbonates), hydrated lime (hydroxides), burnt lime (oxides), marl, and oyster shells.

LIME AGRICULTURAL - A soil amendment consisting principally of calcium carbonate but including magnesium carbonate and perhaps other materials, used to furnish calcium and magnesium carbonate and perhaps other materials, used to furnish calcium and magnesium as essential elements for the growth of plants and to neutralize soil acidity.

LIMING - The application of lime to land, primarily to reduce soil acidity and supply calcium for plant growth. Dolomitic limestone supplies both calcium and magnesium. May also improve soil structure, organic matter content, and nitrogen content of the soil by encouraging the growth of legumes and soil microorganisms. Liming an acid soil to pH value of about 6.5 is desirable for maintaining a high degree of availability of most of the nutrient elements required by plants.

- LIQUEFICATION - (spontaneous liquefication) The sudden large decrease of the shearing resistance of a cohesionless soil, caused by a collapse of the structure from shock or other type of strain and associated with a sudden but temporary increase in the pore-fluid pressure. It involves a temporary transformation of the material into a fluid mass.

- LIQUID LIMIT - The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and low capacity for supporting loads.

- LOAMY - Intermediate in texture and properties between fine-textured and coarse-textured soils.

LOOSE ROCK DAM - A dam built of rock without the use of mortar, a rubble dam. See rock-fill dam.

MADE LAND - Ares filled with earth or earth and trash mixed, usually made by or under the control of man. A miscellaneous land type.

MANNING'S FORMULA (hydraulics) - A formula used to predict the velocity of water flow in an open channel or pipelines:

$$V = \frac{1.486\ r^{2/3}\ S^{1/2}}{n}$$

wherein V is the mean velocity of flow in feet per second; r is the hydraulic radius; s is the slope of the energy gradient or for assumed uniform flow the slope of the channel in feet per foot; and n is the roughness coefficient or retardance factor of the channel lining.

MEAN DEPTH (hydraulics) - Average depth; cross-sectional area of a stream or channel divided by its surface or top width.

MEAN VELOCITY - Average velocity obtained by dividing the flow rate (discharge) by the cross-sectional area for that given cross-section.

MEASURING WEIR - A shaped notch through which water flows are measured. Common shapes are rectangular, trapezoidal, and triangular.

MECHANICAL ANALYSIS - The analytical procedure by which soil particles are separated to determine the particle size distribution.

MECHANICAL PRACTICES - Soil and water conservation practices that primarily change the surface of the land or that store, convey, regulate, or dispose of runoff water without excessive erosion.

MOVEABLE DAM - A moveable barrier that may be opened in whole or in part, permitting control of the flow of water through or over the dam.

MUCK SOIL -
(1) An organic soil in which the organic matter is well decomposed (USA usage).
(2) A soil containing 20 to 50 percent organic matter.

MULCH - A natural or artificial layer of plant residue or other materials, covering the land surface which conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations.

NORMAL DEPTH - Depth of flow in an open conduit during uniform flow for the given conditions. See uniform flow.

OPEN DRAIN - Natural watercourse or constructed open channel that conveys drainage water.

OUTFALL - Point where water flows from a conduit, stream, or drain.

OUTLET - Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

OUTLET CHANNEL - A waterway constructed or altered primarily to carry water from man-made structures, such as terraces, tile lines, and diversions.

OVERFALL - Abrupt change in stream channel elevation, the part of a dam or weir over which the water flows.

PEAK DISCHARGE - The maximum instantaneous flow from a given storm condition at a specific location.

PERMEABILITY - Capacity for transmitting a fluid. It is measured by the rate at which a fluid of standard visosity can move through material in a given interval of time under a given hydraulic gradient.

PERMEABILITY, soil - The quality of a soil horizon that enables water or air to move through it. The permeability of a soil may be limited by the presence of one nearly impermeable horizon even though the others are permeable.

- PERMEABILITY - The rate at which water will move through a saturated soil.

  (a) Slow - Less than 0.20 inches per hour.
  (b) Moderately slow - 0.120 to 0.63 inches per hour.
  (c) Moderate - 0.63 to 2.0 inches per hour.
  (d) Moderately rapid - 2.0 to 6.3 inches per hour.
  (e) Rapid - More than 6.3 inches per hour.

pH SOIL - A numerical measure of the acidity or hydrogen ion activity of a soil. The neutral point is pH 7.0. All pH values below 7.0 are acid and all above 7.0 are alkaline.

- PIPE DROP - A circular conduit used to convey water down steep grades.

- PLASTICITY INDEX - The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

- PLASTIC LIMIT - The moisture content at which a soil changes from a semisolid to a plastic state.

- PLUNGE POOL - A device used to dissipate the energy of flowing water that may be constructed or made by the action of flowing. These facilities may be protected by various lining materials.

- POOL - Section of stream deeper and usually wider than normal with appreciably slower current than immediate upstream or downstream areas and possessing adequate cover (sheer depth or physical condition) for protection of fish. Stream bottom usually a mixture of silt and coarse sand.

- PRINCIPAL SPILLWAY - Generally constructed of permanent material and designed to regulate the normal water level, provide flood protection and/or reduce the frequency of operation of the emergency spillway.

- RATIONAL FORMULA - Q=CIA. Where "Q" is the peak discharge measured in cubic feet per second, "C" is the runoff coefficient reflecting the ratio of runoff to rainfall, "I" is the rainfall intensity for the duration of the storm measured in inches per hour, and "A" is the area of the contributing drainage area measured in acres.

RILL - A small intermittent water course with steep sides, usually only a few inches deep and, hence, no obstacle to tillage operations.

RILL EROSION - See erosion.

RIPRAP - Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for

protection against the action of water (waves); also applied to brush or pole mattresses, or brush and stone, or other similar materials used for soil erosion control.

RISER - The inlet portions of drop inlet spillway that extend vertically from the pipe conduit barrel to the water surface.

RIVER BASIN - The United States has been divided into 20 major water resource regions (river basins).

ROADSIDE EROSION CONTROL - See highway erosion control.

ROCK-FILL DAM - A dam composed of loose rock usually dumped in place, often with the upstream part constructed of handplaced or derrick-placed rock and faced with rolled earth or with an impervious surface of concrete, timber, or steel.

RUNOFF (hydraulics) - That portion of the precipitation on a drainage area that is discharged from the area in stream channels. Types include runoff, groundwater runoff, or seepage.

SEDIMENT - Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.

SEDIMENT BASIN - A depression formed from the construction of a barrier or dam built at a suitable location to retain sediment and debris.

SEDIMENT DISCHARGE - The quantity of sediment, measured in dry weight or by volume, transported through a stream cross-section in a given time. Sediment discharge consists of both suspended load and bedload.

SEDIMENT GRADE SIZES - Measurements of sediment and soil particles that can be separated by screening. A committee on sedimentation of the National Research Council established a classification of textural grade sizes for standard use.

SEDIMENT LOAD - See sediment discharge.

SEDIMENT POOL - The reservoir space allotted to the accumulation of submerged sediment during the life of the structure.

SEEDBED - The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

SEEPAGE

(1) Water escaping through or emerging from the ground along an extensive line or surface as contrasted with a spring where the water emerges from a localized spot.

(2) The process by which water percolates through the soil.
(3) (percolation) The slow movement of gravitational water through the soil.

SILT
(1) A soil separate consisting of particles between 0.05 and 0.002 millimeter in equivalent diameter. See soil separates.
(2) A soil textural class. See soil texture.

SILTING - See sediment.

SILT LOAM - A soil textural class containing a large amount of silt and small quantities of sand and clay. See soil texture.

SILTY CLAY - A soil textural class containing a relatively large amount of silt and clay and a small amount of sand. See soil texture.

SILTY CLAY LOAM - A soil textural class containing a relatively large amount of silt, a lesser quantity of clay, and a still smaller quantity of sand. See soil texture.

SLOPE - Degree of deviation of a surface from the horizontal, usually expressed in percent or degrees.

SLOPE CHARACTERISTICS - Slopes may be characterized as concave (decrease in steepness in lower portion), uniform, or convex (increase in steepness at base). Erosion is strongly affected by shape, ranked in order of increasing erodibility from, concave to uniform to convex.

SOIL - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

SOIL HORIZON - A layer of soil, approximately paralled to the surface, that has distinct characteristics produced by soil forming factors.

SOIL PROFILE - A vertical section of the soil from the surface through all horizons, including c horizons.

SPILLWAY - An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically contolled, to regulate the discharge of excess water.

STABILIZED CENTER SECTION - An area in the bottom of a grassed waterway protected by stone, asphalt, concrete, or other material to prevent erosion.

STABILIZED GRADE - The slope of a channel at which neither erosion

nor deposition occurs.

- STORM FREQUENCY - An expression or measure of how often a hydrologic event of a given size or magnitude should on an average be equaled or exceeded. The average should be based on a reasonable sample.

STREAMBANKS - The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.

STREAM GAGING - The quantitative determination of stream flow using gages, current meters, weirs, or other measuring instruments at selected locations. See gaging station.

STREAM LOAD - Quantity of solid and dissolved material carried by a stream. See sediment load.

SUBSOIL - The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil".

SUBWATERSHED - A watershed subdivision of unspecified size that forms a convenient natural unit.

- TERRACE - An embankment or combination of an embankment and channel across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

TERRACE INTERVAL - Distance measured either vertically or horizontally between corresponding points on two adjacent terraces.

TERRACE OUTLET CHANNEL - Channel, usually having a vegetative cover, into which the flow from one or more terrace is discharged and conveyed from the field.

TERRACE SYSTEM - A series of terraces occupying a slope and discharging runoff into one or more outlet channels.

TILE, DRAIN - Pipe made of burned clay, concrete, or similar material, in short lengths, usually laid with open joints to collect and carry excess water from the soil.

TILE DRAINAGE - Land drainage by means of a series of tile lines laid at a specified depth and grade.

- TOE DRAIN - A drainage system constructed in the downstream portion

of an earth dam or levee to prevent excessive hydrostatic pressure.

- TRASH RACK - A structural device used to prevent debris from entering a spillway or other hydraulic structure.

UNIFIED SOIL CLASSIFICATION SYSTEM (engineering) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index, and liquid limit.

UNIFORM FLOW - A state of steady flow when the mean velocity and cross-sectional area are equal at all sections of a reach.

UNIVERSAL SOIL LOSS EQUATION - An equation used for the design of water erosion control system: A = RKLSPC wherein A = average annual soil loss in tons per acre per year; R = rainfall factor; K = soil erodibility factor; L = length of slope; S = percent of slope. P = conservation practice factor; and C = cropping and management factor. (T = soil loss tolerance value that has been assigned each soil expressed T/A/Year).

- VEGETATIVE PROTECTION - Stabilization of erosive or sediment producing areas by covering the soil with:

  (a) Permanent seeding, producing long-term vegetative cover.
  (b) Short-term seeding, producing temporary vegetative cover, or
  (c) Sodding, producing areas covered with a turf of perennial sod-forming grass.

WATER CLASSIFICATION - Separation of water of an area into classes according to usage, such as domestic consumption, fisheries, recreation, industrial, agricultural, navigation, waste disposal, etc.

WATER CONSERVATION - The physical control, protection, management, and use of water resources in such a way as to maintain crop, grazing, and forest lands; vegetal cover; wildlife; and wildlife habitat for maximum sustained benefits to people, agriculture, industry, commerce, and other segments of the national economy.

WATER CONTROL (soil and water conservation) - The physical control of water by such measures as conservation practices on the land, channel improvement, and installation of structures for water retardation and sediment detention (does not refer to legal control or water rights as defined).

WATER CUSHION - Pool of water maintained to absorb the impact of water flowing from an overfall structure.

WATER DEMAND - Water requirements for a particular purpose, such as irrigation, power, municipal supply, plant transporation, or

storage.

WATER DISPOSAL SYSTEM - The complete system for removing excess water from land with minimum erosion. For sloping land, it may include a terrace system, terrace outlet channels, dams, and grassed waterways. For level land, it may include only surface drains or both surface and subsurface drains.

WATER QUALITY STANDARDS - Minimum requirements of purity of water for various uses; for example, water for agricultural use in irrigation systems should not exceed specific levels of sodium bicarbonates, pH total dissolved salts, etc.

WATER RESOURCES - The supply of groundwater and surface water in a given area.

WATERSHED AREA - All land and water within the confines of a drainage divide or a water problem area consisting in whole or in part of land needing drainage or irrigation.

WATERSHED LAG - Time from center of mass of effective rainfall to peak of hydrograph.

WATERSHED MANAGEMENT - Use, regulation, and treatment of water and land resources of a watershed to accomplish stated objectives.

WATERSHED PLANNING - formulation of a plan to use and treat water and land resources.

WATERWAY - A natural course or constructed channel for the flow of water. See grassed waterway.

WEIR - Device for measuring or regulating the flow of water.

WEIR NOTCH - The opening in a weir for the passage of water.