

FINAL

**New York State
Standards and Specifications
for Erosion and Sediment Control**



November 2016



NEW YORK
STATE OF
OPPORTUNITY

**Department of
Environmental
Conservation**

November 2016 Blue Book Corrections	
Page Number	Change
3.19	Inserted missing language under item 7.D. “Mowing”, right-hand column.
3.42	Removed “R” values (Riprap size) from figures 3.16
3.43	Removed “R” values (Riprap size) from figures 3.17
4.52	The fourth sentence under Item 1 of the “Specification for Full Soil Restoration” section has been updated to state “The physical parameters of the compost shall meet the standards listed in Table 5.2 – Compost Standards Table, except for “Particle Size” 100% will pass the ½” sieve”.
5.8	The “Particle size” in Table 5.2 – Compost Standards Table now reads “100% passing a 1” screen”.

NEW YORK STATE STANDARDS AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL

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General Disclaimer

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For:



New York State
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DEDICATION

Since 1993 there has been a relatively small group of dedicated individuals within NYS DEC Division of Water who were charged with the responsibility to protect the state's surface waters from pollution from construction site runoff. Their environmental vision, passion and energy have led us to this advanced document. It is for this we thank and acknowledge the following individuals:

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- Delaware Erosion and Sediment Control Handbook
- Pennsylvania Erosion & Sediment Pollution Control Program Manual
- Maryland Standards and Specifications for Soil Erosion and Sediment Control
- Environmental Management and Construction Standards and Practices for Underground Transmission and Distribution Facilities in New York State

PREFACE

The parent document, “Guidelines for Erosion and Sediment Control in Urban Areas of New York State,” was originally published by the USDA Soil Conservation Service in 1972 to provide information on minimizing erosion and sediment problems on land undergoing development. These guidelines were used by soil and water conservation districts, planning boards, property owners, land developers, contractors, and consultants.

Based upon the experience gained in the use of this document, a committee was formed in 1978 to update this guide. This committee contained specialists and representatives from government, academia and the private sector.

This committee completed their draft document, “Sediment and Erosion Control for Developing Areas,” in May 1980. Before this document could be finalized, technological advances and increased demand for natural resource planning due to increased urban pressure on rural areas, caused an additional need for revision and expansion of the technical chapters.

In March 1985, work resumed on the guide to expand the standards and specifications to include temporary and permanent structural measures for erosion and water control, update the discipline vocabulary, incorporate the most recent methods and procedures available, and to provide local planners and legislators with examples of public administration. This guidance document was completed and published in February 1987. The guide was again revised in mid-1991 to incorporate general updates, a chapter on calculating runoff, a chapter on bio-engineering, the addition of temporary and permanent practices and a site-specific example demonstrating the planning and design process.

A General State Pollution Discharge Elimination System (SPDES) permit for construction activities was approved for New York State by the Environmental Protection Agency (USEPA) on August 1, 1993.

A General SPDES permit was required for any construction site that disturbed five or more acres. It required that a Stormwater Pollution Prevention Plan (SWPPP) be prepared for each specific site. The SWPPP was required to address erosion and sediment control and stormwater management.

The General SPDES permit was revised in January, 2003 to incorporate the USEPA’s - National Pollutant Discharge Elimination System (NPDES) Phase 2 requirements. These required construction sites disturbing one or more acres to have an erosion and sediment control plan. The guidance document was re-written to incorporate the most recent developments in the discipline at that time and became the New York State Standards and

Specifications for Erosion and Sediment Control, August 2005.

Since the 2005 New York Standards and Specifications were published, the Construction General Permit has been re-issued twice. In 2008 the General Permit incorporated regulations for construction on slopes steeper than 25% with limits for over-lot and linear construction. It also excluded coverage from construction that impacted sites that were on national or state Historic Registers; and included a requirement that any disturbance that exceeded five (5) acres at one time had to have a letter from NYSDEC accepting the proposed work plan. The 2008 revision also provided standards for three watersheds that required the use of enhanced phosphorous removal techniques.

The 2010 version of the Construction General Permit added an additional phosphorous-impaired watershed as well as incorporated additional SWPPP requirements. Items incorporated in the SWPPP by reference to the New York State Stormwater Management Design Manual include soil restoration of over compacted construction areas and source control green infrastructure practices to promote runoff reduction and water quality maintenance.

The 2015 version of the Construction General Permit added EPA’s Construction and Development Effluent Limit Guidelines (ELGs) as required by 40 CFR 450.21. The ELGs apply primarily to the selection, design, and implementation of erosion and sediment controls (i.e. during-construction controls) to be used on a construction site. ELGs are technology-based effluent limitations that represent the degree of reduction attainable by the application of best practicable technology currently available. These non-numeric effluent limits require an owner or operator to ensure that water quality standards are being met and the discharge of pollutants are minimized through the selection, design and implementation of erosion and sediment control measures.

The purpose of this book of standards and specifications is to provide site developers with the minimum design standards for erosion and sediment control to protect water quality from adverse impacts due to construction activity and reduce sediment damage and associated maintenance costs of road ditches, storm sewers, streams, lakes, and flood control structures. It is distributed by the Empire State Chapter of the Soil and Water Conservation Society and also available on the New York State Department of Environmental Conservation’s stormwater web site.

This book of standards and specifications should be used by site developers in preparing their erosion and sediment control plans, and by local municipalities in preparing and

implementing their soil erosion and sediment control programs, reviewing proposed site development plans, establishing or encouraging uniformity through standards in applying erosion control techniques, and helping developers, private engineers, and planners make maximum use of potential development sites by proper management of their natural resources.

This book of standards and specifications was prepared with and under the direction of, the New York State Department of Environmental Conservation, Division of Water. It is issued by the New York State Department of Environmental Conservation as minimum standards for erosion and sediment control plans prepared for state permits.

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SECTION 1—INTRODUCTION

Purpose & Scope

The purpose of this document is to provide minimum standards and specifications for meeting criteria set forth by the New York State Department of Environmental Conservation (NYS DEC) for stormwater discharges associated with construction activity. The standards and specifications provide criteria on minimizing erosion and sediment impacts from construction activity involving soil disturbance. They show how to use soil, water, plants, and products to protect the quality of our environment. These standards and specifications were developed in cooperation with the USDA Natural Resources Conservation Service, New York State Soil and Water Conservation Committee (NYSSWCC), NYS DEC and other state and local agencies for use by planners, design engineers, developers, contractors, landscape architects, property owners, and resource managers. Proper use of these standards will protect the waters of the state from sediment loads during runoff events.

Authority

These standards and specifications apply to lands within New York State where housing, industrial, institutional, recreational, or highway construction, and other land disturbances are occurring or imminent. They are statewide in scope and, in some cases, are somewhat generalized due to variations in climate, topography, geology, soils, and plant requirements. Feasible ways to minimize erosion and sedimentation are varied and complex. Following these standards and specifications is presumed to be in compliance with the SPDES general permit for construction activities. Alternative methods may be explored on a case specific basis and shall be discussed with NYS DEC regional staff.

The Environmental Protection Agency delegated stormwater responsibility for the National Pollutant Discharge Elimination System (NPDES) Permit to New York on October 1, 1992. New York State issued its first General Permit for stormwater discharges from construction activities on August 1, 1993. This permit was issued pursuant to Article 17, Titles 7, 8 and Article 70 of Environmental Conservation Law. At a minimum, an erosion and sediment control plan must be prepared for any construction activity that disturbs one or more acres and, in some special watersheds, 5,000 square feet.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

Erosion and Sediment Hazards Associated with Development

Many people may be adversely affected by development on relatively small areas of land. Uncontrolled erosion and sediment from these areas may cause considerable economic damage to individuals and society in general. Stream pollution and damages to public facilities and private homes are examples. Hazards associated with land disturbance include:

1. A large increase of soil exposed to erosion from wind and water;
2. Increased water runoff, soil movement, sediment accumulation and peak flows caused by:
 - a. Removal of plant cover and topsoil;
 - b. A decrease in the area of soil which can absorb water because of construction of streets, buildings, sidewalks, and parking lots;
 - c. Changes in drainage areas caused by grading operations, diversions, and streets;
 - d. Changes in volume and duration of water concentrations caused by altering steepness, distance, and surface roughness;
 - e. Soil compaction by heavy equipment, which can reduce the water intake of soils as much as 90 percent of the original rate; and,
 - f. Prolonged exposure of unprotected sites and disturbed areas to poor weather conditions.
3. Altering the groundwater regime that may adversely affect drainage systems, slope stability, survival of existing vegetation and establishment of new plants;

4. Exposing subsurface materials that are too rocky, too acid, or otherwise unfavorable for establishing plants;
5. Obstructing stream flow with new buildings, dikes, and landfills;
6. Improper timing and sequencing of construction and development activities; and,
7. Abandonment of sites before completion of construction.

How to Use This Book of Standards

This book of standards is organized in a manner to emphasize good planning and environmental site design at the onset of a project, followed by the design process noting the differences with different types of construction operations. Standards are presented in the order of proper site management in the beginning followed by erosion control, using runoff control and soil stabilization, and then sediment control practices.

The standards and specifications listed in this book have been developed over time to reduce the impact of soil loss from construction sites to receiving water bodies and adjacent properties. This book provides designers with details on how to plan a site for erosion and sediment control and how to select, size, and design specific practices to meet these resource protection objectives. The appendices at the end of this book contain additional information as guidance for site plan design and review, construction implementation, and site inspection. Review and inspection checklists are provided to aid planners and designers in meeting the standards requirements.

Section 2. Site Planning, Preparation, and Management

This section discusses the objectives of the erosion and sediment control plan. Site and off-site resources are identified and incorporated into a seven step design process. In addition, special considerations for different types of project development and their needs for erosion and sediment control planning are discussed. Typical site management standards are located in this section.

Section 3. Erosion Control Part 1- Runoff Control

This section provides a number of specific runoff control standards to meet a variety of project needs. Both temporary and permanent practices are presented to manage stormwater runoff to and within the site. The design of some of these practices can be completed by selecting dimensions based on tributary drainage areas; while others require more detailed design analysis

Section 4. Erosion Control Part 2- Soil Stabilization

This section presents detailed standards and specifications for soil stabilization, the second part of erosion control. It includes standards for grading activities, stabilization with seeding and mulching, use of stabilization matting, application of loose stabilization blankets and addresses special applications. Standards for lime and fertilizer application are also included. Bio-technical standards for live fascines, brush mattress and others, are presented for stabilizing steep slopes, road banks, and stream banks. Structural components are also included to aid where vegetative applications alone are inadequate to stabilize an area.

Section 5. Sediment Control

This section addresses the capture, retention and control of sediment within the boundaries of the disturbed construction site. Standards and specifications are included for perimeter controls, storm drain inlet protection, buffer filter strips, temporary sediment traps, tanks, tubes, bags and sediment basins and dewatering devices. A standard for polymer flocculation of dispersive soils is also included in this section.

Appendices

Appendix A. Revised Universal Soil Loss Equation

Soil types at construction sites play a predominant role in how the site should be constructed to control erosion. Knowledge of soil properties, particularly when soils are highly erosive, is essential. This appendix discusses soil properties and provides a method to calculate potential soil loss and provide a measure of reduction depending on slope, area, and protective cover.

Appendix B. Design Process for Erosion & Sediment Control Practices

This appendix demonstrates the design processes for a number of standard practices presented in this book. Specific site examples are used to show step by step procedures to complete detailed designs of the practices, including the appropriate construction specifications, maintenance, and inspection requirements. These processes will allow a designer to evaluate an existing condition or design to a specific level of performance higher than the minimum level presented in these standards.

Appendix C. Cost Analysis of Erosion & Sediment Control Practices

This appendix provides historical bid information for most of the practices contained in the manual. Sources included the NYS Department of Transportation, Monroe County SWCD, national periodicals, and erosion and sediment control cost data from other states. This information will assist a designer in preparing cost estimates for specific

erosion and sediment control plans.

Appendix D. Erosion Control for Small Residential Sites

Within New York State SPDES requirements, many small residential sites have to file for permit coverage. For those sites that require the preparation of a SWPPP which only requires erosion and sediment control plans, this appendix presents example plans for scenarios that can be used by the local authorities and site owners. Attaching the appropriate plan to the building permit assists the owner with compliance with the provisions of the permit.

Appendix E. Sample Checklist for Reviewing Erosion and Sediment Control Plans

This appendix includes a comprehensive checklist for use by all site plan reviewers (including planning board members, conservation board members, conservation district personnel, engineers, consultants, approval authorities, and others) when reviewing erosion and sediment control plans for completeness and proper management.

Appendix F. Construction Site Inspection & Maintenance Site Log Book

A proper site inspection, whether conducted by local authorities or project staff, is necessary to assess the site conditions and the practices implemented. This appendix includes a detailed checklist to assist inspectors in conducting a thorough evaluation of the site when judging the effectiveness of the erosion and sediment control measures.

Appendix G. Tree Species for New York State

This appendix identifies trees suitable for landscape and conservation plantings in New York State.

Appendix H. Glossary

This appendix presents a list of terms commonly used in site planning, design, erosion and sediment control, soil science, construction activities, streambank stabilization and corridor restoration, vegetation, engineering, hydrology and water quality.

Appendix I. Directories

This appendix presents listings of contact information and locations of federal, state, regional and local agencies, who may be involved with environmental and technical review of erosion and sediment control plans. These agencies may also provide data important to the development of stormwater management plans.

BASIC PRINCIPLES OF EROSION AND SEDIMENT CONTROL

The Erosion and Sedimentation Processes

The standards, specifications, and planning procedures presented in this document are intended to be utilized when development activities change the natural topography and vegetative cover of an area. Erosion and sediment control plans must be designed and constructed to minimize erosion and sediment problems associated with soil disturbance. To understand how erosion and sediment rates are increased requires an understanding of the processes themselves.

Soil erosion is the removal of soil by water, wind, ice, or gravity. This document deals primarily with the types of soil erosion caused by rainfall and surface runoff accelerated due to soil disturbance. Raindrops strike the soil surface at a velocity of approximately 25-30 feet per second and can cause splash erosion. Raindrop erosion causes particles of soil to be detached from the soil mass and splash into the air. After the soil particles are dislodged, they can be transported by surface runoff, which results when the soil becomes too saturated to absorb falling rain or when the rain falls at an intensity greater than the rate at which the water can enter the soil. Scouring of the exposed soil surface by runoff can cause further erosion. Runoff can become concentrated into rivulets or well-defined channels up to several inches deep. This advanced stage is called rill erosion. If rills and grooves remain unrepaired, they may develop into gullies when more concentrated runoff flows downslope.

Sediment deposition occurs when the rate of surface flow is insufficient for the transport of soil particles. The heavier particles, such as sand and gravel, transport less readily than the lighter silt and clay particles. Previously deposited sediment may be re-suspended by runoff from another storm and transported farther downslope. In this way, sediment is carried intermittently downstream from its upland point of origin.

Factors That Influence Erosion

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

1. **Soil Erodibility** – The vulnerability of a soil to erosion is known as erodibility. The soil structure, texture, and percentage of organic matter influence its erodibility. The most erodible soils generally contain high proportions of silt and very fine sand. The presence of clay (except for dispersive clay) or organic matter, tends to decrease soil erodibility. Clays are sticky and tend to bind soil particles together.

Organic matter helps to maintain stable soil structure (aggregates).

2. **Vegetative Cover** – Vegetation protects soil from the erosive forces of raindrop impact and runoff scour in several ways. Vegetation (top growth) shields the soil surface from raindrop impact while the root mass holds soil particles in place. Grass buffer strips can be used to filter sediment from the surface runoff. Grasses also slow the velocity of runoff, and help maintain the infiltration capacity of a soil. **The establishment and maintenance of vegetation are the most important factors in minimizing erosion during development.**
3. **Topography** – Slope length and steepness greatly influence both the volume and velocity of surface runoff. Long slopes deliver more runoff to the base of slopes and steep slopes increase runoff velocity. Both conditions enhance the potential for erosion to occur.
4. **Climate** – Climate also affects erosion potential in an area. Rainfall characteristics such as frequency, intensity, and duration directly influence the amount of runoff that is generated. As the frequency of rainfall increases, water has less chance to drain through the soil between storms. The soil will remain saturated for longer periods of time and stormwater runoff volume may be potentially greater. Therefore, erosion risks are high where rainfall is frequent, intense, or lengthy.
5. **Season** – Seasonal variation in temperature and rainfall defines periods of high erosion potential during the year. High erosion potential may exist in the spring when the surface soil first thaws and the ground underneath remains frozen. A low intensity rainfall may cause substantial erosion because the frozen subsoil prevents water infiltration. In addition, the erosion potential increases during the summer months due to more frequent, high intensity rainfall.

Predicting Soil Losses

Prediction of soil loss is a planning tool. The predictions guide planners on the degree of erosion and sediment control at specific sites. Predicted soil losses also creates awareness among developers, local governments and others of the urgent need to install erosion and sediment control measures before, during and after construction activity.

Soil losses can be predicted for a whole year, part of a year or on the basis of rainfall amounts. The Revised Universal Soil Loss Equation (RUSLE) is used to estimate soil losses on construction sites from sheet and rill erosion. The equation uses site-specific rainfall intensity, soil erodibility and slope factors (see Appendix A). Other soil losses, such as gully erosion or wind erosion, are calculated separately.

There are over 440 different soils in New York State. These soils are made up of different percentages of gravel, sand, silt, clay and organic material. Thus, they erode at different rates. Table 2.5 in Section 2 provides a general characterization of erosion risk based on slope and associated physical factors.

Estimating Sediment Yield

Sediment yield involves both soil erosion on the site and the transport mechanism acting to carry the eroded material off the site.

Where sediment yields from a developing area are needed for estimating sediment basin design volumes, the method in Appendix A can be used for determining the amount of the eroded material that will leave the site as sediment.

Determining Stormwater Runoff

Stormwater hydrology should be calculated using the hydrologic data and rainfall distributions published by the Northeast Regional Climate Center (NRCC) on their website <http://precip.eas.cornell.edu/>. These data can be imported into HydroCAD, USDA NRCS TR20, and other computer models for use in watershed evaluations and stormwater management practice design. Detailed soils information, such as the appropriate Hydrologic Soil Group for drainage analysis, should be obtained from the USDA NRCS Web Soil Survey at their website <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>

Professional Certification

It is important that erosion and sediment control plans be prepared by qualified individuals. State licensed engineers, registered landscape architects and Certified Professional in Erosion and Sediment Control (CPESC) provide the technical skills required to design erosion and sediment control plans and inspect construction sites. EnviroCert

International, Inc. administers a program to evaluate individuals as a CPESC. Such individuals have acquired specific training and passed an examination in erosion and sediment control (ESC). These individuals are generally available for site design and/or implementation oversight. Their website is <http://www.envirocertintl.org/cpesc>.

ESC Ordinances and Subdivision Regulations

Local ESC Laws and land use regulations protect the public welfare by saving money on public infrastructure and maintenance, increasing public safety, protecting water supplies (including groundwater), providing flood control protection and preserving aquatic and riparian wildlife habitat. All ESC plans shall meet or exceed all local and state laws, ordinances and regulations.

Supplemental Standards

The standards set forth in this manual should be appropriately incorporated into all ESC plans unless the designer shows that alteration of these standards or inclusion of practices not included in this document will perform to or exceed the level of performance of the current practices. Proposed supplemental standards or procedures must be submitted to the regional NYSDEC office and include the following information:

1. The name of the product and type of control if a brand name is used.
2. The proposed use (e.g. runoff control), reason for use, calculated level of performance (e.g. impact at the 1 year 24 hour storm), field test performance results, and specifications conforming to any manufacturer's recommendations.
3. The definition of product failure should be clearly stated.
4. Sufficient installation information should be provided to ensure its proper use. This shall include a clear, concise sequence and a typical detail(s) showing all critical dimensions and elevations.
5. The plan maps shall show all locations where the proposed new product or procedure will be used. All receiving waters shall be identified.
6. A suitable maintenance program shall be provided which shall include instructions for remedy of potential problems. An alternative conventional erosion control practice should be specified for immediate installation should the innovative product or procedure fail.

Proposed standards, products or procedures which meet the above criteria will be reviewed on a case-by-case basis until their effectiveness has been sufficiently demonstrated by successful use in the field.

SECTION 2

EROSION CONTROL PLANNING AND SITE MANAGEMENT

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SITE PLANNING, PREPARATION, AND MANAGEMENT

Natural Resource & Watershed Planning

The most effective solutions to erosion and sediment problems begin with natural resource and watershed planning. This type of planning can guide and control development growth, preventing wasteful and haphazard development. The natural resource planning process integrates ecological (natural resource), economic, and social considerations to meet private and public needs. This approach, which emphasizes identifying desired future conditions, improves natural resource management, minimizes conflict, and addresses problems and opportunities.

Watershed planning is another useful tool for building a community's land use plans because watersheds are defined by natural hydrology, representing the most logical basis for managing water resources. The resource becomes the focal point, and planners are able to gain a more complete understanding of overall conditions in an area and the stressors which affect those conditions.

Regional, county and local planning agencies, Soil and Water Conservation Districts (SWCD), and the Natural Resource Conservation Service (NRCS) have technical expertise, resource data and information that can assist decision making by local authorities. These decisions should consider reserving quality agricultural areas for cropland; maintaining the economic viability of agriculture; protecting historical, scenic, and natural beauty areas; protecting wetlands and stream corridors; providing for open spaces and parks; developing attractive residential, institutional and industrial areas; and maintaining floodplains for flood storage, groundwater recharge, water supply source protection, critical habitat preservation by connecting wildlife populations in fractured landscapes, recreation buffer zones, and conservation education uses. Environmental quality is enhanced when open spaces, parks, recreational areas, ponds, wildlife habitat and other areas of public use become integral parts of the plan. These areas should be well delineated and protected from damage that may occur from nearby construction. Selections of such areas should be based upon soils, vegetation, water, topography, accessibility, wildlife, and aesthetic values.

Environmental Site Design (ESD) Plan

As land is subdivided or proposals brought forward for land development, an assessment of suitability of the site for the proposed development needs to be made. ESD is using small scale stormwater management practices, non-structural techniques, and site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources. ESD emphasizes conserving natural features, drainage patterns, and vegetation; minimizing impervious surfaces; slowing down

runoff; and increasing infiltration. Erosion and sediment control needs to be considered from the beginning planning stages and the design and review of erosion and sediment control and stormwater management plans. This includes elements for the preservation of natural features and green infrastructure techniques for the reduction of impervious cover which must be integrated into the site plan approval process (refer to NYS Stormwater Management Design Manual, Chapters 3 and 5).

Natural resources need to be identified in the planning process in order to design an appropriate ESC plan. The plan should have resource protection at its core and emphasize **EROSION CONTROL** (controlling runoff and stabilizing soil), first as its main component and sediment control, second as a management practice. The reduction of soil loss decreases the cost and maintenance of sediment control practices, reduces the risk of degrading natural resources and improves the overall appearance of the construction site.

Erosion and Sediment Control Plan Components

I. Technical Data Requirements

Features of the site including location, site boundaries, accessibility, present land use, delineation of areas protected by local, state and federal regulations (e.g. wetlands and streams), size of proposed tract(s), topography, drainage pattern, geology, hydrology, soils, vegetation and climate need to be assembled. Such information is obtained from on-site examinations and existing technical reports, maps, records, and other documented material usually available from local sources.

This technical data provides the framework necessary to make informed decisions about a site's ultimate use and the types of erosion and sediment controls that will work. Soils information such as detailed soil maps and interpretations are available on the USDA NRCS website, <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> and will specifically provide the following soils information:

- a. Descriptions, erodibility, limitations, capabilities, and hydrologic soil groups;
- b. Engineering properties of soils;
- c. Suitability of the soil as a resource material for topsoil, gravel, highway sand, dams and levees;
- d. Site suitability for buildings, roads, winter soil disturbance, foundations, septic tank disposal fields, sanitary land fills, vegetation, reservoirs, dams,

artificial drainage, recreational areas and wildlife development.

II. General Design Process

1. Plan the Development to Fit the Site

Assess the physical characteristics of the site during a site visit to determine how it can be developed with the lowest risk of environmental impact. Minimize grading by utilizing the existing topography wherever possible. Delineate and avoid disturbing wetlands, stream corridors and, to the extent practicable, wood lots, steep slopes and other environmentally sensitive areas.

Minimize impacts by maintaining vegetative buffer strips between disturbed area and water resources.

Existing woody or State protected vegetation on a project site should be delineated, retained, and protected as required. Planning of streets and lots should relate to site conditions. Streets laid out at right angles to contours often have excessive grades that increase erosion hazards and sedimentation.

2. Divide the Site into Natural Drainage Areas

Determine how runoff will drain from the site. Natural waterbodies should not be altered or relocated without the proper approvals. Pursuant to Article 15 of the Environmental Conservation Law (ECL), a protected waterbody and the bed and banks thereof should not be altered or relocated without the approval of the Department of Environmental Conservation. Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act also protects water resources and proposed disturbances may require approvals from The US Army Corps of Engineers.

Integrated surface and storm drainage systems are an essential part of any planned development. The plan should clearly specify: location and capacity of diversions and stormwater basins; paved or other types of lined channels, outlets and waterways; drop inlets; open or closed drains; stream channel protection and bank erosion structures. Consider how erosion and sedimentation can be controlled in each small drainage area before looking at the entire site.

Diversion of offsite surface water run on away from exposed soils provides the most economic and effective erosion control possible since it is more advantageous to control erosion at the source than to design controls to trap suspended sediment. However, attempting to divert large drainage areas can be problematic. Therefore, the channel should be stabilized and conveyed to a stable outlet/receiving stream. The receiving stream should be evaluated to ensure that its flow regime will not be disrupted. Whenever possible the diversion should be temporary to restore the natural drainage patterns.

3. Determine Limits of Clearing and Grading

Decide exactly which areas must be disturbed in order to accommodate the proposed construction. Pay special attention to critical areas (e.g. steep slopes, highly erodible soils, surface water bodies), which must be disturbed. Additional erosion and sediment controls are often necessary to mitigate the potential impacts to critical or sensitive areas. Staged clearing and grading is necessary to keep unprotected areas of disturbance to less than 5 acres at one time.

4. Design The Erosion and Sediment Control (ESC) Plan

An ESC plan shows the site's existing topography, and how and when it will be altered. It also shows the ESC measures that will be used to reduce sediment pollution and how and when they will be constructed and maintained. The coordination of ESC practices with construction activities is explained on the plan by a phasing and construction sequencing schedule. All projects shall have ESC plans prepared for each phase of the work.

In addition to regulatory control, an ESC plan should be prepared for all land development and construction activity when uncontrolled erosion and sedimentation is anticipated. At a minimum, this includes:

- a. sites on slopes that exceed 15%;
- b. sites in areas of severe erosion potential;
- c. sites within 100 ft. and draining to wetland;
- d. sites within 100 ft. and draining to a watercourse; and/or;
- e. sites with a high percentage of colloidal solids

It is essential for the ESC designer to remember that sediment control facilities, even when designed and constructed properly, rarely exceed 80 percent removal rates for sediment. A properly designed ESC plan for a large scale commercial or industrial site will typically involve several phases, possibly more than one ESC stage and utilize many different practices.

ESC practices are categorized as vegetative and/or structural controls. While more details on these practices are contained in other sections of this book of standards, general information on vegetative and structural controls is outlined below:

- A. Vegetative Controls—The best way to protect the soil surface and limit erosion is to preserve the existing vegetative groundcover. Where land disturbance is necessary, temporary seeding or mulching must be used on areas which will be exposed for more than 14 days. Permanent stabilization should be performed as soon as possible

after completion of final grading. ESC plans must contain provisions for permanent stabilization of disturbed areas. Seed type, application rates, soil amendments, seedbed preparation in accordance with standards contained in this book, mulch, and mulch anchoring must be described on the plans. Selection of permanent vegetation will include the following considerations for each plant species:

- 1) establishment requirements;
- 2) adaptability to site conditions;
- 3) aesthetic and natural resource values;
- 4) maintenance requirements.

B. **Structural Controls**—Structural erosion control practices may be necessary when disturbed areas cannot be promptly stabilized with vegetation. Structural practices shall be constructed and maintained in accordance with the standards and specifications in this document. Structural practices may be temporary or permanent. Temporary practices are removed after site stabilization is completed. Permanent practices, such as diversions, are an integral part of the site design and are left in place.

The ESC plans shall include the following elements:

1. Existing and proposed contours shown at two foot intervals or less. Other scales or contour intervals may be favored for special types of land disturbance projects (i.e. plans are often drawn to scales of 1 in. = 200 ft. or 1 in. = 500 ft. with contour intervals of 5 to 20 feet). The following scales are recommended for use on ESC plans because they facilitate the review process for site specific detailed plans: 1 in. = 20 ft., 1 in. = 30 ft., 1 in. = 40 ft., or 1 in. = 50 ft.
2. Details of temporary and permanent structural and vegetative measures that will be used to control erosion and sedimentation for each stage of the project from land clearing to the finished stage. Stabilizing land with plant materials or mulches shall be part of a planned development. Retention of existing natural vegetation in strategic areas is beneficial, desirable, and cost efficient.
3. The location of structural ESC measures with standard symbols to facilitate the understanding and review of plans. Symbols should have a consistent line weight and be easily discernible on the plans.
4. The dimensions, material specifications, installation details, and operation and maintenance

requirements, for all erosion and sediment control practices, including the locations and size of any temporary sediment traps, basins, or structural practice.

5. Notes regarding temporary ESC facilities which will be converted to permanent stormwater management facilities.
6. A schedule to establish the construction sequence of temporary and permanent practices and their timing relative to other construction activities.
7. An inspection and maintenance schedule for soil ESC facilities which describes maintenance activities to be performed.
8. Dewatering practices for subsurface construction activities.

A sample ESC checklist is contained in Appendix E.

III. Construction of ESCs

Effective erosion and sediment control requires good construction site management. Proper management can reduce the need for maintenance of structural controls, regrading of severely eroded areas, and reconstruction of controls that were improperly or poorly constructed or maintained. Good construction site management also results in efficient use of manpower, financial savings and improves the overall site appearance.

Good construction site management includes the following site phasing and construction sequencing measures:

1. Physically mark limits of land disturbance on the site with tape, signs, or orange construction fence, so that workers can see the areas to be protected.
2. Divert runoff from adjacent land away from exposed highly erodible soils and steep slopes on the construction site toward stable vegetated areas.
3. Clear only what is required for immediate construction activity. Large projects should be cleared and graded as construction progresses. Areas exceeding two acres in size should not be disturbed without a sequencing plan that requires practices to be installed and the soil stabilized, as disturbance beyond the two acres continues. Mass clearings and grading of the entire site should be avoided.
4. Re-stabilize disturbed areas as soon as possible after construction is completed. Fourteen days (seven days in certain cases) shall be the maximum exposure period. Waiting until all

disturbed areas are ready for seeding is unacceptable. Maintenance must be performed as necessary to ensure continued stabilization. Except as noted below, all sites shall be seeded and stabilized with erosion control materials, such as straw mulch, jute mesh, or excelsior, including areas where construction has been suspended or sections completed:

a. For active construction areas such as borrow or stockpile areas, roadway improvements and areas within 50 ft. of a building under construction, a down-slope perimeter sediment control system consisting, for example, silt fencing, shall be installed and maintained to contain soil. Exposed disturbed areas adjacent to a conveyance that provides rapid offsite discharge of sediment, such as a cut slope at an entrance, shall be covered with plastic or geotextile to prevent soil loss until it can be stabilized. Stabilized construction access will be maintained to control vehicle tracking material off site.

b. On the cut side of roads, ditches shall be stabilized immediately with rock rip-rap or other non-erodible liners (e.g. Rolled Erosion Control Products (RECP)), or where appropriate, vegetative measures such as sod.

c. Permanent seeding should optimally be undertaken in the spring from March through May, and in late summer and early fall from September to October 15. During the peak summer months and in the fall after October 15, when seeding is found to be impracticable, an appropriate temporary mulch shall be applied. Permanent seeding may be undertaken during the summer if plans provide for adequate watering. Temporary seeding with rye can be utilized through November.

d. All slopes steeper than 3:1 (h:v), or 33.3%, as well as perimeter dikes, sediment basins or traps, and embankments shall, upon completion, be immediately stabilized with sod, seed and anchored straw mulch, or other approved stabilization measures (e.g. RECP). Areas outside of the perimeter sediment control system shall not be disturbed. Maintenance shall be performed as necessary to ensure continued stabilization.

e. Temporary sediment trapping devices shall not be removed until permanent stabilization (i.e. 80% uniform density of permanent vegetation or permanent mulch/stone) is established in all contributory drainage areas. Similarly, stabilization shall be established prior to converting sediment traps/basins into permanent (post- construction) stormwater management

practices.

5. Where temporary work roads or haul roads cross stream channels, adequate waterway openings shall be constructed using spans, culverts, washed rock backfill, or other acceptable, clean methods that will ensure that road construction and their use do not result in turbidity and sediment downstream. **All crossing activities and appurtenances on streams regulated by Article 15 of the Environmental Conservation Law shall be in compliance with a permit issued pursuant to Article 15 of the ECL.**
6. Make sure that the contractor(s) responsible for the implementation of the Stormwater Pollution Prevention Plan (SWPPP), understands the ESC plan and signs the certification statement required by NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP).

Inspection & Maintenance

The implementation of an erosion and sediment control inspection and maintenance program is critical for the proper operation of the plan and protection of water resources. Without proper vigil and timely repair and support for the installed erosion and sediment control measures, the practices can easily be overwhelmed and lose their functional effectiveness. To ensure the performance of the erosion and sediment control measures, the contractor(s) that has been identified by the owner as being responsible for the implementation of the SWPPP shall inspect the practices within the active work area daily and after every stormwater event that generates runoff. If deficiencies are identified, the contractor shall implement the necessary corrective actions within one business day of the inspection.

Maintenance for all erosion and sediment control practices shall be in accordance with the specific details included in the SWPPP and incorporated on the ESC plan drawings as appropriate.

Construction Activities

There is a wide array of different types of construction activities. These projects can be grouped into separate categories for the purpose of developing an erosion and sediment control strategy. These generalized categories of land development are:

1. Linear Projects
 - a. Highway and Road Construction
 - b. Gas and Oil Pipeline, Water Supply Line, and Sanitary Sewer Line Construction
 - c. Wind Farm and Power Line Construction

- d. Stream Restoration and Streambank Stabilization
- e. Shoreline Stabilization
- f. Flood Dike Systems
- 2. Residential Projects
 - a. Small scale
 - b. Large scale
- 3. Commercial/Industrial Development Projects
 - a. Small scale
 - b. Large scale
- 4. Institutional Construction Projects
- 5. Water Resources Projects
- 6. Large Overlot Grading Projects

Any one individual project may fall into more than one generalized category but these are offered to guide the development of an overall successful site erosion and sediment control plan for the project.

Site variables such as topography, depth to ground water, soil types, and rights-of-way (ROW) constraints all affect the methods of construction including choices of equipment to accomplish the work, phasing and sequencing of construction, and the appropriate erosion and sediment control practices to be employed on the project. In addition, site attributes such as very steep slopes, perched groundwater tables, tidal water fluctuations, stream corridor management, and traffic control requirements impose extra challenges in preparing a comprehensive erosion and sediment control plan.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

The following are examples of projects, with important considerations for plan evaluation, which illustrate the generalized land development categories shown above:

1. Linear Projects

- a. Highway and Road Construction

In developing plans for highway and road construction, the plan designer will encounter design situations ranging from new highway construction, existing road expansion, intersection and drainage improvements and bridge and culvert rehabilitation; to shoulder widening and overlay projects. While these types of projects differ greatly in their scope and complexity, they all share similar challenges to the ESC plan designer.



These construction projects are typically linear in nature, with limited ROW. Given the limited space within the ROW it may be necessary to obtain temporary easements for control practices such as sediment basins. Working around waterways, streams, or drainage channels within a ROW will also require that special attention be given to the construction details and methods of construction being used in and around the waterways.



When an existing roadway is under construction, traffic must often times continue around and through the work area. In these situations, the ESC plan designer needs to address lane shifts, interim access roads being constructed, and other efforts taken to minimize the travel time delay when designing ESC practices. The ESC plan will also need to address the issue of highway

safety from sediment leaving the construction area, and employ a dust control strategy. The use of tire wash facilities and street brooms may also become part of the ESC plan. Proper ESC planning will be necessary to ensure that the use of storm drain inlet devices do not pose a flooding hazard or risk to existing travel lanes. Highway work is typically more dynamic than other types of construction with disturbed areas usually not being left inactive for long periods of time. This may require the use of rolled erosion control products (RECP's) or plastic in order to address temporary stabilization requirements. The following ESC measures must be addressed in the ESC plan:

- Sequence the work to minimize disturbance
- Protect existing drainage ways
- Evaluate de-watering needs and methods
- Minimize access locations
- Stabilize the exposed areas as each phase is completed

b. Gas and Oil Pipeline, Water Supply Line, and Sanitary Sewer Line Construction

The construction of underground pipelines for gas and oil conveyance, water supply lines, or sanitary sewer lines, can result in potentially adverse impacts to natural and cultural resources. Through advance planning of the pipeline construction work, working in the appropriate season, application of erosion and sediment control practices and appropriate construction techniques, natural resources will be protected and adverse impacts minimized.



Utility construction is generally performed in narrow ROW on a specified width. There are several unique aspects of utility work that pose challenges to the ESC plan designer and need to be recognized. Large utility projects pose the greatest risk for ESC problems during construction. Gas and oil transmission lines may be located across multiple watersheds, wetlands, streams, and up and down steep slopes. Pipeline construction involving welded steel pipe requires the trench to be

open for multiple processes of pipe staging, welding, testing and placement. Construction methods must be employed to protect these natural resources. Sanitary sewer lines typically rely on gravity or a combination of gravity with lift stations as needed to operate efficiently. As such they are often sited in lower areas near wetlands, flood plains, and along stream corridors. Where streams must be crossed for utility line construction, the designer must plan for waterway construction permits as well as prepare detailed methods for temporary stream diversions, de-watering operations, and stream or wetland crossings as appropriate.



Smaller utility projects often include servicing residential development with water, sewer, telephone, electricity, gas, and cable TV. While the trend is toward using a common trench for several or more of these utilities, the installation of separate utilities can disrupt the overall sequence of construction, especially with street construction and stabilizing adjacent ROW areas. Direct bury techniques may be used to install electric lines, cable or fiber optic cables, which limits land disturbances by not requiring an open trench. In a residential plan, the installation of utilities must be coordinated, and ESC planned for, especially the restoration and stabilization of disturbed areas. The following objectives, where applicable, must be incorporated in the ESC plan:

- Consider the location of wetland stream resources during the design and planning phase of the project to minimize crossings of such resources;
- Limit vegetation clearing in accordance with safe construction practices to minimize adverse environmental and ecological impacts;
- Construction ROW has to be sized properly, with careful consideration of limiting disturbance yet providing sufficient space for safe operation of large equipment. Areas adjacent to river or large wetland crossings need to be large enough so that all

operations have sufficient space to support work tasks. Confining the crossing staging areas into locations of insufficient space is inefficient and may create extensive damage;

- Confine construction activities to the ROW and vehicular use to designated access roads, construction paths, and staging areas;
- Schedule construction for time periods when sensitive resources are least susceptible to damage or disruption;
- Use construction and pipe laying equipment that minimizes damage and disruption of soils during wet periods or in areas with high ground-water tables, and use the smallest sized equipment to complete the work;
- Limit equipment movement in or near sensitive resources. Phase and sequence the work to limit exposure of work areas such as road crossings, stream and river crossings, wetlands, steep slopes, rocky terrain, and agricultural land;
- Minimize topsoil loss and general soil erosion by limiting ROW grading and other soil scarifying activities, and promptly stabilize disturbed soil;
- Minimize traffic disruption on public roads during pipeline construction by providing adequate traffic controls;
- Provide adequate space for construction paths adjacent to trench systems, temporary sites for material storage and construction staging, and designate the disposition of construction waste material;
- Incorporate adequate trench and site de-watering facilities;
- Provide provisions for site clean-up and a soil and area restoration plan on a phase by phase basis as practical; and
- Provide for pipeline ROW maintenance that includes vegetative treatment, maintenance of erosion and sediment control practices, and landowner improvements as detailed in individual easement agreements.

c. Wind Farm and Power Line Construction

The construction of wind farms and power transmission lines has many similarities to the utility construction methods noted previously. Wind turbine construction, and to a lesser extent transmission line construction will require delivery of both large or long components and very heavy equipment. Wind turbine blades delivery requires a wide turning radius, which requires work at road intersections along the delivery route. Due to the length of blades, both horizontal and vertical profiles of access roads have to be considered. Cranes for wind farms typically arrive on three to five large flat bed

trucks. The individual weights of trucks require special permits and road structures must be considered.



Transmission line substations require delivery of large, heavy components that also require special consideration. Of particular concern are the access routes to reach the wind farm pads and power-line towers, the construction at the turbine pad and power-line tower foundations, and the impact on natural resources at these sites. The following items, where applicable, must be included in the ESC plan:

- Design permanent access roads to avoid wetland and stream resources;
- Limit the amount of clearing and grubbing to that needed to provide access, staging and site construction;
- The construction ROW will have to accommodate large cranes and delivery of long components that will require additional clearing to provide space for turning movements;
- Confine construction to the ROW and vehicular use to the designated access road and staging areas;
- Phase and sequence the work for time periods when sensitive resources and land uses are least sensitive to damage;
- Design appropriate ESC practices to control runoff



during and after construction, and sediment loss while soils are disturbed;

- Provide for the handling of construction waste materials, proper site clean-up, and site stabilization plan; and
- Provide for an operations and maintenance, and inspection plan for the project.

d. Stream Restoration and Streambank Stabilization

Stream corridors and streambanks and their respective buffer areas are extremely sensitive areas and must be adequately protected during construction operations. Diligent planning is required to properly phase the work with particular attention paid to accessing the work locations, dewatering the work areas, providing adequate staging area for construction equipment and operation, and handling construction waste such as cleared and grubbed material and excess spoil.

To protect fish spawning, timing restrictions may be imposed for all instream work as well as any adjacent work that may result in suspension of sediment in a stream. In general, instream work should occur during low flow conditions, typically between June and September, to minimize impacts to fisheries and water quality. For additional information on timing restrictions, please contact the regional NYS DEC office for the county in which the project is located. The following measures, where applicable, must be incorporated in the ESC plan:

- Implement an appropriate de-watering scheme
- Utilize existing former channels where available
- Plan and conduct work in phases upstream to downstream
- Utilize pumps to remove standing turbid water to treatment areas such as traps, basins or filters appropriately sized and stabilized to reduce turbidity
- Stabilize each phase as the work moves downstream
- Timing of planting work is critical for successful vegetative stream bank stabilization



e. Shoreline Stabilization

Stabilization projects for eroded or undermined shorelines can range in scope from shallow grading of beach areas to very high steep banks. These sites can extend from small lot type applications to several hundred feet long. A major concern is the protection the water resource and any surrounding resource attributes such as buffers and wetlands. Slope stability should be assured prior to constructing a project on steep or very high slopes. Consideration of overland surface drainage must be incorporated in the site plan.

Additional items that must be included in the ESC plan are:

- Utilize turbidity curtains or appropriate structural barriers in close proximity to the work area
- Phase and conduct the work in lateral sections
- Permanently stabilize one section prior to disturbing the next section.



f. Flood Dike Systems

These linear structures are usually placed in close proximity to a stream or river extending significant distances to protect the interior area from flood waters. The construction, repair, or rehabilitation of these structures requires that the water resources and adjacent areas be protected from sediment from all disturbance activities. Management of the interior drainage water during construction is critical. Clean water should be bypassed or otherwise diverted around or through the work area. Materials handling should also be recognized and specified. This will include spoil, earthfill, topsoil, as well as waste such as cleared and grubbed vegetative material.



Key measures that must be included in the ESC plan are:

- Phase and conduct the work based on the topography and cut and fill needs
- Sequence the operations to minimize disturbed area exposure
- Install perimeter controls to protect adjacent resources
- Delineate stockpile areas, construction staging areas, and access points
- Bypass clean water around or through the construction site with a stable outlet
- Standing turbid water should be captured or pumped to a treatment device such as a trap, basin, or filter.
- Utilize temporary surface stabilization as the work progresses and apply final stabilization as each phase is completed

2. Residential Development Projects

a. Small Scale- This generally involves the development of interior roads only or single lot grading for home construction. Typical ESC plans for single

family home construction are shown in Appendix D.

b. Large Scale- This activity involves large areas of disturbance for developing interior road access to multiple home sites. Mass or bulk grading is usually performed to complete the infrastructure, individual lots, and the stormwater management practices. There are three stages to a large scale residential development:

- Bulk Grading
- Site improvements
- Home Construction



Each stage is unique with respect to erosion and sediment control, and the management of stormwater during construction. Residential projects will often include multiple phases that may take years to complete. Depending on the size of the development, the developer may not construct the infrastructure (i.e. roads, stormwater conveyance system, other utilities, etc.) for all the phases at the same time. For this reason, it is important that the ESC plans include the necessary integration of the different phases of the project.

Bulk Grading Stage: Bulk or mass grading (sometimes referred to as overlot grading) would require a separate ESC component for that stage. As basins and traps are constructed, there is the added consideration for the planner that home lots will eventually become part of the plan, and the siting of these facilities needs to consider their long term use. As earthwork progresses, the road areas will be “roughed” or “boxed” out if the roadway is in cut; or earth brought in if the road area is in fill. The amount of bulk grading will depend on the earthwork balance for the site. If cuts and fills are balanced within a phase, typically, the bulk grading stage will be easier to manage. Once this stage is completed, the major infrastructure stage begins.

Site Improvements Stage: The next stage involves the installation of roads, major utilities such as sewer and water, and drainage systems. The ESC designer will need to realize that the construction of the roadway and drainage system will alter the interception of stormwater runoff and, in many cases, that the sheet flow occurring during the bulk grading is now concentrated. Energy dissipation with check dams, drop structures, and possibly turf reinforcement in swales and ditches is now necessary. Putting the base course of stone on the road as soon as possible will also reduce erosion potential.

As the roadway cuts and fills are completed and drainage established, temporary stabilization may take place on the lot areas and many of the roadway swales and completed drainage channels are ready for permanent stabilization treatment. It is still too early in the construction phase to activate any of the permanent infiltration/filtration facilities or systems that may have been installed. If located underground the storm drain system must be protected to prevent soil from migrating to the infiltration system. The contributing drainage area including lot areas must be stabilized before permanent infiltration/filtration facilities are put on-line. After the infrastructure is installed and before the site contractor leaves the site, the sediment basins and traps, and the rest of the site, should be checked to determine if maintenance is needed. Although the site should be inspected during the entire construction process, it is crucial to ensure that any major work is performed before the site contractor leaves. Often the building lots and homes are constructed by different sub-contractors that may not have the proper equipment



to perform the necessary maintenance.

Home Construction Stage: The final stage involves the home construction. The lot areas of the site that have been previously stabilized will be disturbed during the construction of the homes. Minor utility installation

such as cable, electric, and telephone are generally installed in a common trench along the road right-of-way. This installation will sometimes interfere with previously installed silt fence and other ESC controls. Ideally, the utilities are installed before the home construction begins, and before the road right-of-way area is stabilized. When utility installation requests are high however, the installation priority may be tied to the number of building permits issued in a given development phase. This may necessitate the road right-of-way areas having to be stabilized twice.



3. Commercial and Industrial Development

These development projects share many of the attributes of large scale residential development; that is significant overlot grading and drainage challenges. It is important that the stormwater management systems and treatments be installed for the project site early in the development process to assure proper control. Particular care should be taken to stabilize access locations and control dust during the construction operations.

a. Small Scale- These sites are generally less than 3 acres with a building footprint of 5,000 to 20,000 square feet, such as **convenience stores, gas stations, fast food restaurants, individual retail outlets or industrial park building pad sites**. Typically, perimeter controls such as silt fence may be employed. A stabilized construction access to all point of ingress and egress is important and will need constant attention to maintenance due to frequent traffic from trucks hauling structural building materials. Depending on the permanent stormwater design of the site, a stormwater pond may be utilized as a temporary sediment basin. If not, a temporary sediment trap may be employed with perimeter berms to direct sediment laden runoff to the trap. These berms may be constructed from the topsoil stripped from the site. Used as berms around the perimeter, the topsoil does not take up room as a

stockpile, which is often a problem on a small site. After final grades are established, the topsoil should then be restored to areas of the site that will be permanently vegetated.

Generally, the building foot area or pad site is excavated first, with rough grading taking place around the remainder of the site. While the building area is being constructed, the stormwater system is installed and inlet protection is constructed. If the remainder of the site requires extensive grading later, temporary stabilization will be applied initially. Once stabilized, this site should require simple routine maintenance until the remainder of the site area is final graded for parking and landscaping. If only minor grading on the site is required, the sequence may be such that grading and base course stone could occur early in the construction. This would also reduce the amount of bare soil exposure. One important note; some small commercial sites rely on infiltration, filtration, or bio-retention for their permanent stormwater management. The function of these facilities is often compromised when they are utilized for sediment control, compacted by heavy equipment, or installed prematurely and allowed to become clogged with sediment. The ESC portion of the plan has to be developed to complement the post-development stormwater management strategy.

b. Large Scale- These projects are greater than 3 acres in area, such as **shopping centers, office complexes, industrial parks, transportation facilities, and multi-use development projects**. The designer can introduce phasing into the site planning process even when the site is less than 20 acres to make complex sites more manageable. In discussing phasing it is important to define the clearing, grubbing, and grading stages of construction. Land disturbing activities include land change such as clearing, grading, excavating, transporting and filling of land. On a wooded site, cutting down or clearing trees is a land disturbing activity. There is a way through proper sequencing, to develop a portion or phase of a site

while simultaneously clearing and grading another phase. While phasing is an important tool in managing ESC activities, the plan needs to consider some flexibility among phases. If a sediment basin is to be constructed in Phase 1, it may be necessary to place the excavated material at a central location, possibly in another phase. Phasing also works well if the phases are broken into separate drainage areas.

A well designed ESC plan for commercial/industrial development will reflect that the site will likely be mass or bulk graded. There are typically very few areas of these sites that will remain undisturbed except for areas that are protected. In some cases extreme changes in grading are necessary to ensure a relatively flat building site. In other cases multiple drainage areas will be graded to one control point, or drainage areas may be divided to outlet at different locations.

During the bulk grading of a large site, the phasing is clearly the key to managing ESC activity. However, even within a phase of construction, it may be necessary to develop two ESC plans. The first plan would be developed for the bulk grading activity. Since the stormwater or drainage collection system is not installed at this time, the ESC plan will rely on temporary berms, swales, and diversions to convey sediment laden water to traps and basins. A second plan would be necessary when rough grading nears completion, buildings, roads, and parking areas are under construction, and now drain to the same traps and basins through an improved stormwater conveyance system. The ESC strategies are very different during the bulk grading and infrastructure development stages.

It is essential for the ESC designer to remember that sediment control facilities, even when designed and constructed properly, rarely exceed 80 percent removal rates for sediment. A properly designed ESC plan for a large scale commercial or industrial site will typically involve several phases, possibly more than one ESC stage and utilize many different practices.



4. Institutional Development Projects

These projects include the development of structures, facilities, and infrastructure such as roads, utilities and stormwater drainage systems in institutional settings such as **college campuses, correctional facilities, public and private school construction, and transportation terminals such as bus stations**. Many of the key points previously discussed for ESC plans are applicable here as well. It is especially important to note that often institutional construction projects are undertaken in close proximity to ongoing public activities and the drainage from these projects is often tied into the existing stormwater system. The following measures shall be incorporated in the

ESC plan:

- Establish safe, stabilized, controlled access points for the construction limits
- Develop a materials handling protocol for all potential pollutants and construction waste generated by construction activities
- Control dust from construction operations and vehicular traffic
- Maintain noise levels of the construction operations to acceptable levels for the surrounding environment
- Utilize temporary stabilization and permanently stabilize each phase as soon as its work is completed



5. Water Resources Projects

These projects are unique in that they are generally constructed within or in very close proximity to water resources. These include **dam construction for lakes, ponds, or reservoirs**, whose purposes may be flood protection, energy creation or recreational for fish and wildlife. It also includes **embankments and grading for wetland restoration projects** as well as construction activities for agricultural support such as **agricultural waste storage and management facilities such as lagoons, waste treatment wetlands, barnyard runoff treatment systems and composting facilities**. The ESC plan for these projects should contain many of the points listed previously for general grading activities. In addition, key elements of the construction sequence for earthen dam embankments shall include the following:

- Divert the stream flow in stable manner
- Construct the cutoff trench and service spillway system
- Utilize earthfill from the auxiliary spillway first
- Permanently stabilize the auxiliary spillway
- Re-locate the stream flow through the service spillway system
- Complete the earthfill and permanently stabilize all disturbed areas



6. Large Bulk, Overlot Grading Projects

These projects include construction of golf courses, recreational ski areas and facilities, large municipal projects such as airports and sewage treatment plants, and steep slope stabilization areas. The majority of these projects share many of the same attributes, concerns and ESC plan requirements as large scale residential, commercial, and industrial projects. However, the stabilization of steep slopes is unique and deserves separate evaluation. Many factors will determine the engineering treatment for stabilizing an unstable steep slope. These include, but are not limited to, soil type, gradation, groundwater levels and seepage, slope steepness and length, surface drainage, active erosive forces, and the proposed use of the area within the bigger site complex. Key measures that must be included in the ESC plan and construction sequence are:

- Divert surface runoff at the top of the slope
- Divert water by use of water bars
- Make sure the slope and its toe area are stable
- Utilize slope drains as necessary to control seepage
- Bench the slope as needed for stability, access, and surface drainage
- Plan and conduct the work to minimize exposure
- Stabilize exposed areas as soon as possible as the work progresses

In summary, these six categories of construction activities highlight some of the variables that should be addressed in ESC plans.



Recognize that every construction project is unique. It may involve a totally new land disturbance or re-configuring and re-developing previous work. It could be located in an urban, suburban or rural area and may involve working with existing impervious areas. Regardless of these circumstances, the erosion and sediment control plan must be prepared to deal with all the potential adverse impacts that could occur to on-site and off-site water resources.

The majority of the standards contained in this book are applicable and adaptable to most of the construction activities previously discussed. However, some of the standards will not be applicable for all activities. The Erosion and Sediment Control Practices Matrix, Table 2.1, indicates which construction activities summarized above, where a particular standard practice is most likely suited for implementation.



Design Process for Erosion and Sediment Control Plans

The design of erosion and sediment control needs to be integrated with the stormwater plan for the project. Since every project is different in its topography, soils, geometry, hydrology, groundwater depths, and intended purpose, it is important to consider all of these attributes as well as post construction stormwater management as ESC plans are developed. A firm knowledge of the New York State Stormwater Management Design Manual criteria and requirements is helpful when integrating green infrastructure planning and practices for runoff reduction such as preservation of natural areas and soil restoration as well as the implementation of standard stormwater treatment practices such as infiltration basins and others. The following design steps detail the process and required elements for developing an ESC plan:

Step 1. Identify existing drainage patterns, drainage area boundaries, and slopes

Current drainage information for the project site, as well as off-site, needs to be obtained and verified through a site visit and survey. Field check drainage patterns, drainage area boundaries, vegetation and land use. Look for existing storm drains, culverts, underground utilities, and other drainage features. Evaluate flow onto, through, and off of the site for existing conditions. Examine the drainage areas to determine the size, slope, slope length, flow path, and, for areas with concentrated flow, the discharge. Decide if off-site flow can be diverted through or around the site. Using ESD principles and green infrastructure techniques, maintain or mimic the existing drainage patterns that give preference to sheet flow and small drainage areas.

Step 2. Identify areas of special concern

Areas of particular environmental concern, such as wetlands, streams, buffers, wooded areas, slopes 15 percent or steeper, and highly erodible and unique soils, need to be identified within both the project site and adjacent areas and shown on the plan. Other considerations include phosphorous impaired watershed areas; National Wetland Inventory; natural heritage areas; rare, threatened, and endangered species habitat; and impaired stream segments with a Total Maximum Daily Load for sediment. Areas of special concern must be verified with a site visit. Note any erosion, lack of vegetation, drainage problems, and other features that may be pertinent to the design. If an unmapped resource is found, contact the appropriate authority to determine additional regulatory requirements.

Step 3. Inventory site and layout development

The initial assessment of the layout needs to be based on the

existing features and proposed construction, minimizing the project's impervious area, acreage of soil disturbance and the encroachment on natural resources in accordance with the green infrastructure planning principles described in chapters 3 and 5 of the New York State Stormwater Management Design Manual and the environmental site design techniques noted earlier in this section. A site program plan has to provide space for the project water, sewer, stormwater facilities, parking, recreation areas and green space. A comprehensive approach to developing the erosion and sediment control and stormwater management plans will minimize changes from the natural hydrology. In addition, expansion of forest, wetland, and stream buffers needs to be considered for enhanced sediment control and improved water quality.

Step 4. Determine phasing requirements and design initial erosion and sediment controls

Depending on the scope of the project, phasing of sediment control and grading may be necessary (e.g., initial, interim, and final phase). Initial controls need to consider existing topography, drainage areas, ground cover, and access throughout the site. If possible, sediment controls installed during the initial phase should be designed to function for all phases of the project. The best designs incorporate careful phasing and sequencing into the overall erosion and sediment control plan and construction strategy. This is often evident in the project's contract construction schedule.

In designing erosion and sediment controls, consider possible locations for staging and stockpile areas and access or haul roads. If staging/stockpile areas are within the project's limit of disturbance, the proposed perimeter controls may suffice. However, if a soil stockpile creates a longer slope length or steeper slope, perimeter controls must be adjusted accordingly. Additionally, an access road may be required down a slope thereby concentrating flow that was previously sheet flow. Considerations must be made for handling this concentrated flow and stabilizing and maintaining the access road. The design and installation of erosion and sediment control practices must not impact areas identified for green infrastructure purposes. For example, compacting soils in areas designated for infiltration, or removing trees or other vegetation identified for stormwater management, is not permissible. However, infiltration basin locations may be used as sediment basins/traps where partial excavation is performed to a minimum limit of 18" above the bottom of the infiltration basin.

Table 2.1 identifies the erosion and sediment control practices contained in this book of standards and lists the primary purpose of each practice along with design criteria and associated practices that might be found used in combination with the listed practice. For example, rock outlet protection, sediment trap, and storm drain inlet are listed as associated practices for the earth dike practice.

Each practice application needs to be evaluated on a case-by-case basis for its associated practices due to the changing characteristics of the project.

The sequencing of a site must take into account the time and access needed to install the initial sediment controls. If earth dikes and a sediment basin are designed as initial controls, these must be completed before beginning other grading. This could require stockpiling the excavated material from the basin rather than using it immediately for fill on the site. Sequencing is also important to ensure that the basin is completed and stabilized prior to the construction of the berms. Additional sediment controls may be required if extensive clearing is needed to reach the proposed basin location.

Step 5. Identify interim drainage patterns, drainage areas, slopes; and design interim controls

Interim conditions are often overlooked yet are important considerations for erosion and sediment control design. Typically, evaluating interim conditions is more difficult than evaluating initial phase or final phase. Project plans always include existing and proposed site conditions. Unlike the initial or final phases, interim conditions are not definitive; they represent the in-between. Due to the shifts in drainage areas and changes in slope and exposure of sub-surface soils, drainage patterns and discharges for an interim phase may be entirely different from initial or final phase, and therefore the erosion and sediment controls may also need to be different. To design interim controls, apply the same procedures used to design initial phase sediment controls. Initial and final phase controls may need to be adjusted or modified to better correlate with the interim phase controls. Depending on the scope of the project, an interim phase erosion and sediment control plan may not be required.

Step 6. Identify proposed drainage patterns, drainage areas, slopes; and design final controls

Follow the same procedures used to design the initial phase erosion and sediment controls. Initial and interim phase controls may need to be adjusted or modified to better correlate with the final phase plans. As construction progresses, consider impacts to staging and stockpile areas and access roads. Also, consideration needs to be given to how the controls implemented for the final phase will be removed.

Step 7. Prepare the Construction Sequence

The sequence of construction describes how the plan will progress. It directs the installation and removal of the different erosion and sediment controls shown on the plan. Sequencing of the project needs to be considered throughout the entire design process. When writing a

sequence of construction, consider whether additional instructions will be helpful to ensure that the controls function as intended. Different types of construction activities will require different sequences for construction. If the disturbed area in any one particular phase of the construction work exceeds 5 acres at any one time, additional control efforts will be required and written acceptance of this plan from the Regional NYSDEC office or MS4 (for projects subject to a traditional land use control MS4) must be received and incorporated in the project documents.

Writing a sequence of construction requires the visualizing and the progression and connection of various site development activities (e.g. clearing, grubbing, grading, utility installation, maintenance of traffic, drainage systems, building systems, stream diversions, erosion and sediment control, stormwater management, etc.) to ensure that the erosion and sediment control practices will be installed and removed at the proper times, and function properly. Depending on the project's complexity, the sequence can be relatively simple or it can involve many small steps. Multiple steps can occur concurrently, while others must be sequential. Large projects that have been segmented into phases should have a separate sequence for each phase. Large projects often follow a prescribed critical path for the construction work. These paths are helpful in developing narratives to explain to contractors and inspectors why a certain erosion and sediment control practice was selected or why following the sequence is imperative to the proper progression of the construction and erosion control effectiveness.

The sequence of construction, at a minimum, must include the following:

- Schedule a pre-construction meeting with appropriate permitting authority
- Delineate resources to protect
- Establish staging area, construction entrance, topsoil stockpile, and concrete truck washout areas
- Protect post-construction practice areas during construction to preserve native soil permeability, install SMP's only after site is stabilized
- Clearing and grubbing as necessary for the installation of perimeter controls
- Establish method of spoils disposal (on-site or off)
- Construction and stabilization of perimeter controls
- Install initial runoff controls and stabilization
- Remaining clearing and grubbing within perimeter
- Road grading
- Grading for the remainder of the site or phase
- Utility installation and connections
- Construction of buildings, roads, and other construction
- Installation of permanent stormwater management measures
- Conduct soil restoration

- Final fine grading, landscaping and stabilization
- Removal of temporary erosion and sediment controls
- Restore and stabilize any disturbed areas remaining upon removal of temporary ESC measures

Most sequences of construction will be more detailed, especially for plans requiring stream diversion, ground water management, or the coordination between the removal of controls in one phase and the installation of different controls in a subsequent phase. If traffic control is a factor, then the erosion and sediment control plan should coordinate with the maintenance of the traffic plan. For subdivision projects, the sequence of construction must identify lots having sediment control practices that preclude the lot from being developed until the contributing drainage area has been final graded and stabilized. Each project is unique and the level of detail in the sequence of construction needs to be tailored to each specific project.

The Erosion and Sediment Control Practices Matrix was prepared as a quick reference for designers and reviewers to obtain major pertinent information about a practice. The matrix is alphabetical and is sectioned by each major control group in this book of standards. Each practice has listed its primary use on the site, the important site characteristics and criteria for application, the type of construction activity where it is best applied, and other associated practices that are often used with it to complement its performance.

The Construction Activity Key, shown below, assigns a number or number and letter to indicate a specific construction activity. Those symbols are listed in the Construction Activity column of the matrix to indicate the applicability of a practice to a particular type of construction. This information is presented as a guide for use and is not to be considered as limiting any particular practice to the activity listed.

Erosion and Sediment Control Practice Matrix Construction Activity Key

1. Linear Projects
 - a. Highway and Road Construction
 - b. Gas and Oil Pipeline, Water Supply Line, and Sanitary Sewer Line Construction
 - c. Wind Farm and Power Line Construction
 - d. Stream Restoration and Streambank Stabilization
 - e. Shoreline Stabilization
 - f. Flood Dike Systems
2. Residential Projects
 - a. Small scale
 - b. Large scale
3. Commercial/Industrial Development Projects
 - a. Small scale
 - b. Large scale
4. Institutional Construction Projects
5. Water Resource Projects
6. Large Overlot Grading Projects

Table 2.1
Erosion and Sediment Control Practices Matrix
Site Planning, Preparation and Management

Practice	Primary Purpose	Site Characteristics	Construction Activity*	Associated Practices
Concrete Truck Washout	Collect Waste	Concrete construction	All	Stabilized Access
Construction Road Stabilization	Control sediment	All construction routes	All	Dust control, temporary swales, temporary or permanent seeding
Dust Control	Stabilize soil	Access points, construction roads	1a,1b,2,3,4,6	Stabilized construction access, construction road stabilization
Protecting Vegetation During Construction	Preserve existing vegetation	Site specific	All	Recreational area improvement
Site Pollution Prevention	Manage waste	Site logistics	All	Those in this section
Stabilized Construction Access	Control sediment	Access points	All	Filter fence, construction road stabilization
Temporary Access Waterway Crossing	Prevent sediment	Streams and banks	All	Construction road stabilization, streambank protection
Winter Stabilization	Soil stabilization	Disturbed areas	All	Seeding, mulching, buffer strips
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.2
Erosion and Sediment Control Practices Matrix
Erosion Control Part 1 - Runoff Control (See Section 3)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Check Dam	Control runoff	Drainage area \leq 2 Ac.	All	Lined waterway, rock outlet protection
Construction Ditch	Divert runoff	Drainage area \leq 10 Ac.	All	Sediment traps, storm drain inlet protection, sediment basin, level spreader
Dewatering Sump Pit	Control sediment	Site specific	All	Sediment trap, sediment basin
Diversion	Intercept and divert runoff	Minimum 10 year design Q	1a,2b,3b,4,5,6	Permanent seeding, rock outlet protection, flow spreader, sediment basin
Earth Dike	Control runoff	Drainage area \leq 10 ac.	1a,1b,1c,2,3,4,5,6,	Sediment trap, rock outlet protection, sediment basin
Flow Diffuser	Control runoff	Minimum design Q = 10 yr. 24 hr.	1a,1b,1c,5,6	Seeding, sodding, land grading, diversion
Flow Spreader	Control runoff	Minimum design Q = 10 yr. 24 hr.	1a,1b,1c,5,6	Diversion, grassed waterway, construction ditch
Grade Stabilization Structure	Prevent erosion	Minimum design Q = 10 yr. 24 hr.	1d,1e,5,6	Permanent seeding, rock slope protection, structural stream-bank protection
Grassed Waterway	Convey runoff	Minimum 10 year design Q	2a,3b,5,6	Rock outlet protection, vegetated waterways, sediment basin, flow spreader
Lined Waterway (rock materials)	Convey runoff	Minimum design Q = 10 yr. 24 hr.	1a-c,2,3,4,5,6	Rock outlet protection, subsurface drain
Paved Flume	Convey runoff	Minimum design Q = 10 yr. 24 hr.	1a,3,4,6	Rock outlet protection
Perimeter Dike/Swale	Divert runoff	Drainage area \leq 5 Ac.	1a-c,2a,3a,5,6	Sediment trap, flow spreader, check dam, temporary seeding
Pipe Slope Drain	Convey runoff down slope	Drainage area \leq 3.5 Ac.	1a,1d,5,6	Rock outlet protection
Rock Outlet Protection	Prevent erosion	Rock varies with pipe discharge	All	Diversion, grassed waterway, sediment basin, sediment traps
Storm Drain Diversion	Divert runoff	On-site drainage area > 50% total drainage area	1a,2,3,4,6	Sediment trap/basin
Subsurface Drain	Intercept and convey drainage water	1" Drainage Coefficient	1a,2,3,4,6	Rock outlet protection, land grading, retaining wall
Water Bars	Divert runoff	Slope areas < 100 ft. width	1b,1c,5	Rock outlet protection, flow spreader
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.3
Erosion and Sediment Control Practices Matrix
Erosion Control Part 2 - Soil Stabilization (See Section 4)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Anchored Stabilization Matting	Stabilize soil	Site specific	All, steep slopes	Seeding, topsoiling
Armored Slope and Channel Stabilization	Prevent erosion	Minimum design Q= 10 yr. 24 hr., velocity > 6 feet per second	1d,1e,1f	Live facines, live stakes, retaining walls
Branch Packing	Stabilize soil	Maximum 1.5:1 slopes	1d,5,6	Diversion, subsurface drain, temporary swale
Brush Layer	Stabilize soil	Site specific slopes	1d,1e,3,4,5,6	Rock slope protection, armored streambank protection
Brush Mattress	Stabilize soil	Stream bank slopes	1a, 6	Rock slope protection
Establishing Trees, Shrubs, and Vines	Stabilize soil	Site specific	All	Topsoiling, seeding, fertilizer application
Fertilizer Application	Promote seeding	Site specific	All	Seeding, mulching, topsoiling, land grading
Fiber Roll	Provide growth medium	Site specific	1d,1e,5	Live facines, live stakes
Land Grading	Stabilize soil	Site specific shaping	All	Topsoiling, subsurface drain, seeding
Lime Application	Stabilize soil	Site specific	All	Topsoiling, seeding
Live Crib Wall	Stabilize soil	Site specific	All	Retaining walls
Live Fascines	Stabilize soil	Max. 1.5:1 slope	1a,1d,1e,5,6	Diversion, seeding
Live Stakes	Stabilize soil	Site specific	1d,1e,4,5,6	Armored streambank protection, fiber roll
Loose Stabilization Blankets	Stabilize soil	Site Specific	All	Permanent and temporary seeding, Recreation area
Mulching	Stabilize soil	Site specific	All	Permanent and temporary seeding, Recreation area
Permanent Seeding for Construction Areas	Stabilize soil	Site specific	All	Surface roughening, topsoiling, sodding
Recreation Area Seeding	Protect areas/soils	Site specific	All	Permanent seeding, mulching, topsoiling
Retaining Walls	Stabilize soil	Site specific constraints	1a,2,3,4,6	Rock slope protection, permanent seeding, subsurface drain
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.3 (Continued)
Erosion and Sediment Control Practices Matrix
Erosion Control Part 2 - Soil Stabilization (See Section 4)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Soil Restoration	Stabilize soil, promote infiltration	Compacted areas	All	Topsoiling, seeding
Stabilization of Sand and Gravel Pits	Stabilize soil	Site specific	1a,1c,3,4,5,6	Topsoiling, seeding
Stabilization With Sod	Stabilize soil	Need quick cover, aesthetics	2,3,4	Inlet protection, top soiling, permanent seeding
Surface Roughening	Stabilize soil	Construction slopes	All	Temporary seeding, permanent seeding, mulching
Temporary Seeding for Construction Areas	Stabilize soil	Site specific	All	Surface roughening, top soiling, sodding
Topsoiling and Amendments	Enhance growing conditions	Poor site soil characteristics	All	Surface roughening, temporary seeding, permanent seeding
Tree Revetment	Stabilize soil	Site specific	1d,1e	Armored streambank protection
Vegetated Gabions	Stabilize soil	Site specific	1a-e,2,3,4,5,6	Live cribwall, retaining wall
Vegetating Sand Dunes and Tidal Banks	Stabilize sand dunes	Sand dune reinforcement	1e, 2,3,4,5,6	Sediment trap, rock outlet, storm drain inlet protection
Vegetating Waterways	Stabilize soil	Site specific	2a,3b,5,6	Grassed waterways, permanent seeding
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.4
Erosion and Sediment Control Practices Matrix
Sediment Control (See Section 5)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Buffer Filter Strip	Filter sediment	Turbid sheet flow	All	Storm drain inlets, water conveyances
Compost Filter Sock	Filter sediment	Turbid sheet flow	All	Storm drain inlets, water conveyances
Dewatering Device	Discharge clean water	Turbidity in sediment basin	All	Sediment basins, sediment traps
Geotextile Filter Bag	Filter sediment	Small areas, pumped	All	Subsurface drain, dewatering sump pit, buffer filter strip
Portable Sediment Tank	Retain sediment	16 times pump discharge	2a,3a,4	Sediment trap, sediment basin
Rock Dam	Trap sediment	Drainage area \leq 50 Ac.	1a,1b,1c,2b3b,4,5,6	Rock outlet protection
Sediment Basin	Capture sediment	Drainage area \leq 50 Ac.	1a,2b,3b,4,5,6	Rock outlet protection, temporary seeding
Sediment Dike	Capture sediment	Small disturbed areas	2a,2b,3a	Buffer filter strip, filter bag
Sediment Trap - Compost Sock	Trap sediment	Drainage area \leq 5 Ac.	All	Seeding, sodding
Sediment Trap - Pipe Outlet	Trap sediment	Drainage area \leq 5 Ac.	All	Sediment basin, rock outlet protection
Sediment Trap - Stone Outlet	Trap sediment	Drainage area \leq 5 Ac.	All	Rock outlet protection
Silt Fence	Control sediment	2:1 slopes maximum, 50 ft. spacing	All	Straw bale dike
Storm Drain Inlet Protection - Excavated	Trap sediment	Drainage area \leq 1 Ac.	1a,2,3,4,6	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Fabric	Trap sediment	Drainage area \leq 1 Ac.	1a,2,3,4,6	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Inserts	Trap sediment	Drainage area \leq 1 Ac.	1a,2,3,4,6	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Paved Surface	Trap sediment	Drainage area \leq 1 Ac.	1a	Sediment traps, storm drain diversion
Storm Drain Inlet Protection - Stone and Block	Trap sediment	Drainage area \leq 1 Ac.	2,3,4,6	Sediment traps, storm drain diversion
Straw Bale Dike	Control sediment	2:1 slopes maximum, 25 ft. spacing	All	Silt fence
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.4 (Continued)
Erosion and Sediment Control Practices Matrix
Sediment Control (See Section 5)

<u>Practice</u>	<u>Primary Purpose</u>	<u>Site Characteristics</u>	<u>Construction Activity</u>	<u>Associated Practices</u>
Turbidity Curtain	Control sediment	Calm water	1b,1d,1e,1f,5	Sediment traps, basins, seeding, mulching
Water structures/barriers	Control sediment	Large area for placement	1d,1e,1f,5	Armored streambank protection, retaining walls
* See Erosion and Sediment Control Practice Matrix Construction Activity Key on page 2.15				

Table 2.5
Erosion Risk

Soil Type and Parameters	<u>Slope %</u>		
	0-5	5-15	>15
Gravelly, $K < 0.35$ Non-cohesive PI= NP, Fines: 0-10%	Low	Low	Med
Sandy, $K > 0.35$ PI= NP, Fines: 0-30%	Med	High	High
Silty, $K > 0.35$ PI= NP, Fines: 50+%	Med	High	Very High
Clay, $K < 0.35$ Cohesive PI=7+, Fines: 50+%	Low	Med	High
Dispersive Clay Soils	High	Very High	Extreme
<p>Note: Erosion risk is the probability that the combination of parameters presented will generate a significant amount of soil loss. There are other factors that contribute to erosion, such as slope length and rainfall intensity and duration. Also, even though there may be low erosion risk, there can be a high risk to water quality when the soil disturbance is close to water resources. Each site needs to be evaluated on its own merit to determine actual soil loss. Methodology for this analysis is presented in Appendix A.</p>			

STANDARD AND SPECIFICATIONS FOR CONSTRUCTION ROAD STABILIZATION



Definition & Scope

The stabilization of temporary construction access routes, on-site vehicle transportation routes, and construction parking areas to control erosion on temporary construction routes and parking areas.

Conditions Where Practice Applies

All traffic routes and parking areas for temporary use by construction traffic.

Design Criteria

Construction roads should be located to reduce erosion potential, minimize impact on existing site resources, and maintain operations in a safe manner. Highly erosive soils, wet or rocky areas, and steep slopes should be avoided. Roads should be routed where seasonal water tables are deeper than 18 inches. Surface runoff and control should be in accordance with other standards.

Road Grade – A maximum grade of 12% is recommended, although grades up to 15% are possible for short distances.

Road Width – 12 foot minimum for one-way traffic or 24 foot minimum for two-way traffic.

Side Slope of Road Embankment – 2:1 or flatter.

Ditch Capacity – On-site roadside ditch and culvert capacities shall be the 10 yr. peak runoff.

Composition – Use a 6-inch layer of NYS DOT sub-base Types 1,2,3, 4 or equivalent as specified in NYSDOT Standard Specifications.

Construction Specifications

1. Clear and strip roadbed and parking areas of all vegetation, roots, and other objectionable material.
2. Locate parking areas on naturally flat areas as available. Keep grades sufficient for drainage, but not more than 2 to 3 percent.
3. Provide surface drainage and divert excess runoff to stabilized areas.
4. Maintain cut and fill slopes to 2:1 or flatter and stabilized with vegetation as soon as grading is accomplished.
5. Spread 6-inch layer of sub-base material evenly over the full width of the road and smooth to avoid depressions.
6. Provide appropriate sediment control measures to prevent offsite sedimentation.

Maintenance

Inspect construction roads and parking areas periodically for condition of surface. Top dress with new gravel as needed. Check ditches for erosion and sedimentation after rainfall events. Maintain vegetation in a healthy, vigorous condition. Areas producing sediment should be treated immediately.

STANDARD AND SPECIFICATIONS FOR CONCRETE TRUCK WASHOUT



Definition & Scope

A temporary excavated or above ground lined constructed pit where concrete truck mixers and equipment can be washed after their loads have been discharged, to prevent highly alkaline runoff from entering storm drainage systems or leaching into soil.

Conditions Where Practice Applies

Washout facilities shall be provided for every project where concrete will be poured or otherwise formed on the site. This facility will receive highly alkaline wash water from the cleaning of chutes, mixers, hoppers, vibrators, placing equipment, trowels, and screeds. Under no circumstances will wash water from these operations be allowed to infiltrate into the soil or enter surface waters.

Design Criteria

Capacity: The washout facility should be sized to contain solids, wash water, and rainfall and sized to allow for the evaporation of the wash water and rainfall. Wash water shall be estimated at 7 gallons per chute and 50 gallons per hopper of the concrete pump truck and/or discharging drum. The minimum size shall be 8 feet by 8 feet at the bottom and 2 feet deep. If excavated, the side slopes shall be 2 horizontal to 1 vertical.

Location: Locate the facility a minimum of 100 feet from drainage swales, storm drain inlets, wetlands, streams and other surface waters. Prevent surface water from entering the structure except for the access road. Provide appropriate access with a gravel access road sloped down to the structure. Signs shall be placed to direct drivers to the facility after their load is discharged.

Liner: All washout facilities will be lined to prevent

leaching of liquids into the ground. The liner shall be plastic sheeting with a minimum thickness of 10 mils with no holes or tears, and anchored beyond the top of the pit with an earthen berm, sand bags, stone, or other structural appurtenance except at the access point.

If pre-fabricated washouts are used they must ensure the capture and containment of the concrete wash and be sized based on the expected frequency of concrete pours. They shall be sited as noted in the location criteria.

Maintenance

- All concrete washout facilities shall be inspected daily. Damaged or leaking facilities shall be deactivated and repaired or replaced immediately. Excess rainwater that has accumulated over hardened concrete should be pumped to a stabilized area, such as a grass filter strip.
- Accumulated hardened material shall be removed when 75% of the storage capacity of the structure is filled. Any excess wash water shall be pumped into a containment vessel and properly disposed of off site.
- Dispose of the hardened material off-site in a construction/demolition landfill. On-site disposal may be allowed if this has been approved and accepted as part of the projects SWPPP. In that case, the material should be recycled as specified, or buried and covered with a minimum of 2 feet of clean compacted earthfill that is permanently stabilized to prevent erosion.
- The plastic liner shall be replaced with each cleaning of the washout facility.
- Inspect the project site frequently to ensure that no concrete discharges are taking place in non-designated areas.

STANDARD AND SPECIFICATIONS FOR DUST CONTROL



dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

Definition & Scope

The control of dust resulting from land-disturbing activities, to prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the NYSDEC.

No polymer application shall take place without written approval from the NYSDEC.

Construction Specifications

A. Non-driving Areas – These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of

B. Driving Areas – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access route to provide short term limited dust control.

Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

Barriers – Woven geo-textiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

Maintenance

Maintain dust control measures through dry weather periods until all disturbed areas are stabilized.

STANDARD AND SPECIFICATIONS FOR PROTECTING VEGETATION DURING CONSTRUCTION



Definition & Scope

The protection of trees, shrubs, ground cover and other vegetation from damage by construction equipment. In order to preserve existing vegetation determined to be important for soil erosion control, water quality protection, shade, screening, buffers, wildlife habitat, wetland protection, and other values.

Conditions Where Practices Applies

On planned construction sites where valued vegetation exists and needs to be preserved.

Design Criteria

1. Planning Considerations

A. Inventory:

1) Property boundaries, topography, vegetation and soils information should be gathered. Identify potentially high erosion areas, areas with tree windthrow potential, etc. A vegetative cover type map should be made on a copy of a topographic map which shows other natural and manmade features. Vegetation that is desirable to preserve because of its value for screening, shade, critical erosion control, endangered species, aesthetics, etc., should be identified and marked on the map.

2) Based upon this data, general statements should be prepared about the present condition, potential problem areas, and unique features of the property.

B. Planning:

1) After engineering plans (plot maps) are prepared, another field review should take place and

recommendations made for the vegetation to be saved. Minor adjustments in location of roads, dwellings, and utilities may be needed. Construction on steep slopes, erodible soils, wetlands, and streams should be avoided. Clearing limits should be delineated (See "Determine Limits of Clearing and Grading" on page 2.2).

2) Areas to be seeded and planted should be identified. Remaining vegetation should blend with their surroundings and/or provide special function such as a filter strip, buffer zone, or screen.

3) Trees and shrubs of special seasonal interest, such as flowering dogwood, red maple, striped maple, serviceberry, or shadbush, and valuable potential shade trees should be identified and marked for special protective treatment as appropriate.

4) Trees to be cut should be marked on the plans. If timber can be removed for salable products, a forester should be consulted for marketing advice.

5) Trees that may become a hazard to people, personal property, or utilities should be removed. These include trees that are weak-wooded, disease-prone, subject to windthrow, or those that have severely damaged root systems.

6) The vigor of remaining trees may be improved by a selective thinning. A forester should be consulted for implementing this practice.

2. Measures to Protect Vegetation

A. Limit soil placement over existing tree and shrub roots to a maximum of 3 inches. Soils with loamy texture and good structure should be used.

B. Use retaining walls and terraces to protect roots of trees and shrubs when grades are lowered. Lowered grades should start no closer than the dripline of the tree. For narrow-canopied trees and shrubs, the stem diameter in inches is converted to feet and doubled, such that a 10 inch tree should be protected to 20 feet.

C. Trenching across tree root systems should be the same minimum distance from the trunk, as in "B". Tunnels under root systems for underground utilities should start 18 inches or deeper below the normal ground surface. Tree roots which must be severed should be cut clean. Backfill material that will be in contact with the roots should be topsoil or a prepared planting soil mixture.

D. Construct sturdy fences, or barriers, of wood, steel, or other protective material around valuable

vegetation for protection from construction equipment. Place barriers far enough away from trees, but not less than the specifications in "B", so that tall equipment such as backhoes and dump trucks do not contact tree branches.

E. Construction limits should be identified and clearly marked to exclude equipment.

F. Avoid spills of oil/gas and other contaminants.

G. Obstructive and broken branches should be pruned properly. The branch collar on all branches whether living or dead should not be damaged. The 3 or 4 cut method should be used on all branches larger than two inches at the cut. First cut about one-third the way through the underside of the limb (about 6-12 inches from the tree trunk). Then (approximately an inch further out) make a second cut through the limb from the upper side. When the branch is removed, there is no splintering of the main tree trunk. Remove the stub. If the branch is larger than 5-6 inches in diameter, use the four cut system. Cuts 1 and 2 remain the same and cut 3 should be from the underside of the limb, on the outside of the branch collar. Cut 4 should be from the top and in alignment with the 3rd cut. Cut 3 should be 1/4 to 1/3 the way through the limb. This will prevent the bark from peeling down the trunk. Do not paint the cut surface.

H. Penalties for damage to valuable trees, shrubs, and herbaceous plants should be clearly spelled out in the contract.

PROTECTING TREES IN HEAVY USE AREAS

The compaction of soil over the roots of trees and shrubs by the trampling of recreationists, vehicular traffic, etc., reduces oxygen, water, and nutrient uptake by feeder roots. This weakens and may eventually kill the plants. Table 2.6 rates the "Susceptibility of Tree Species to Compaction."

Where heavy compaction is anticipated, apply and maintain a 3 to 4 inch layer of undecayed wood chips or 2 inches of No. 2 washed, crushed gravel. In addition, use of a wooden or plastic mat may be used to lessen compaction, if applicable.

Table 2.6
Susceptibility of Tree Species to Compaction¹

Resistant:

Box elder.....	<i>Acer negundo</i>	Willows.....	<i>Salix spp.</i>
Green ash.....	<i>Fraxinus pennsylvanica</i>	Honey locust.....	<i>Gleditsia triacanthos</i>
Red elm.....	<i>Ulmus rubra</i>	Eastern cottonwood.....	<i>Populus deltoides</i>
Hawthornes.....	<i>Crataegus spp.</i>	Swamp white oak.....	<i>Quercus bicolor</i>
Bur oak.....	<i>Quercus macrocarpa</i>	Hophornbeam.....	<i>Ostrya virginiana</i>
Northern white cedar....	<i>Thuja occidentalis</i>		

Intermediate:

Red maple.....	<i>Acer rubrum</i>	Sweetgum.....	<i>Liquidambar styraciflua</i>
Silver maple.....	<i>Acer saccharinum</i>	Norway maple.....	<i>Acer platanoides</i>
Hackberry.....	<i>Celtis occidentalis</i>	Shagbark hickory.....	<i>Carya ovata</i>
Black gum.....	<i>Nyssa sylvatica</i>	London plane.....	<i>Platanus x hybrida</i>
Red oak.....	<i>Quercus rubra</i>	Pin oak.....	<i>Quercus palustris</i>
Basswood.....	<i>Tilia americana</i>		

Susceptible:

Sugar maple.....	<i>Acer saccharum</i>	Austrian Pine.....	<i>Pinus nigra</i>
White pine.....	<i>Pinus strobus</i>	White ash.....	<i>Fraxinus americana</i>
Blue spruce.....	<i>Picea pungens</i>	Paper birch.....	<i>Betula papyrifera</i>
White oak.....	<i>Quercus alba</i>	Mountain ash.....	<i>Sorbus aucuparia</i>
Red pine.....	<i>Pinus resinosa</i>	Japanese maple.....	<i>Acer palmatum</i>

¹ If a tree species does not appear on the list, insufficient information is available to rate it for this purpose.

STANDARD AND SPECIFICATIONS FOR SITE POLLUTION PREVENTION



Definition & Scope

A collection of management practices intended to control non-sediment pollutants associated with construction activities to prevent the generation of pollutants due to improper handling, storage, and spills and prevent the movement of toxic substances from the site into surface waters.

Conditions Where Practice Applies

On all construction sites where the earth disturbance exceeds 5,000 square feet, and involves the use of fertilizers, pesticides, petroleum based chemicals, fuels and lubricants, as well as sealers, paints, cleared woody vegetation, garbage, and sanitary wastes.

Design Criteria

The variety of pollutants on a particular site and the severity of their impacts depend on factors such as the nature of the construction activity, the physical characteristics of the construction site, and the proximity of water bodies and conveyances to the pollutant source.

1. All state and federal regulations shall be followed for the storage, handling, application, usage, and disposal of pesticides, fertilizers, and petroleum products.
2. Vehicle and construction equipment staging and maintenance areas will be located away from all drainage ways with their parking areas graded so the runoff from these areas is collected, contained and treated prior to discharge from the site.
3. Provide sanitary facilities for on-site personnel.
4. Store, cover, and isolate construction materials including topsoil, and chemicals, to prevent runoff of

pollutants and contamination of groundwater and surface waters.

5. Develop and implement a spill prevention and control plan. The plan should include NYSDEC's spill reporting and initial notification requirements.
6. Provide adequate disposal for solid waste including woody debris, stumps, and other construction waste and include these methods and directions in the construction details on the site construction drawings. Fill, woody debris, stumps and construction waste shall not be placed in regulated wetlands, streams or other surface waters.
7. Distribute or post informational material regarding proper handling, spill response, spill kit location, and emergency actions to be taken, to all construction personnel.
8. Refueling equipment shall be located at least 100 feet from all wetlands, streams and other surface waters.



STANDARD AND SPECIFICATIONS FOR STABILIZED CONSTRUCTION ACCESS



Definition & Scope

A stabilized pad of aggregate underlain with geotextile 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. The purpose of stabilized construction access is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets.

Conditions Where Practice Applies

A stabilized construction access shall be used at all points of construction ingress and egress.

Design Criteria

See Figure 2.1 on page 2.31 for details.

Aggregate Size: Use a matrix of 1-4 inch stone, or reclaimed or recycled concrete equivalent.

Thickness: Not less than six (6) inches.

Width: 12-foot minimum but not less than the full width of points where ingress or egress occurs. 24-foot minimum if there is only one access to the site.

Length: As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum would apply).

Geotextile: To be placed over the entire area to be covered with aggregate. Filter cloth will not be required on a single-family residence lot. Piping of surface water under entrance shall be provided as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.

Criteria for Geotextile: The geotextile shall be woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be

inert to commonly encountered chemicals, hydro-carbons, mildew, rot resistant, and conform to the fabric properties as shown:

Fabric Properties ³	Light Duty ¹ Roads Grade Sub-grade	Heavy Duty ² Haul Roads Rough Graded	Test Method
Grab Tensile Strength (lbs)	200	220	ASTM D1682
Elongation at Failure (%)	50	60	ASTM D1682
Mullen Burst Strength (lbs)	190	430	ASTM D3786
Puncture Strength (lbs)	40	125	ASTM D751 Modified
Equivalent	40-80	40-80	US Std Sieve
Opening Size			CW-02215
Aggregate Depth	6	10	-

¹Light Duty Road: Area sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Acceptable materials are Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.

²Heavy Duty Road: Area sites with only rough grading, and where most travel would be multi-axle vehicles. Acceptable materials are Trevira Spunbond 1135, Mirafi 600X, or equivalent.

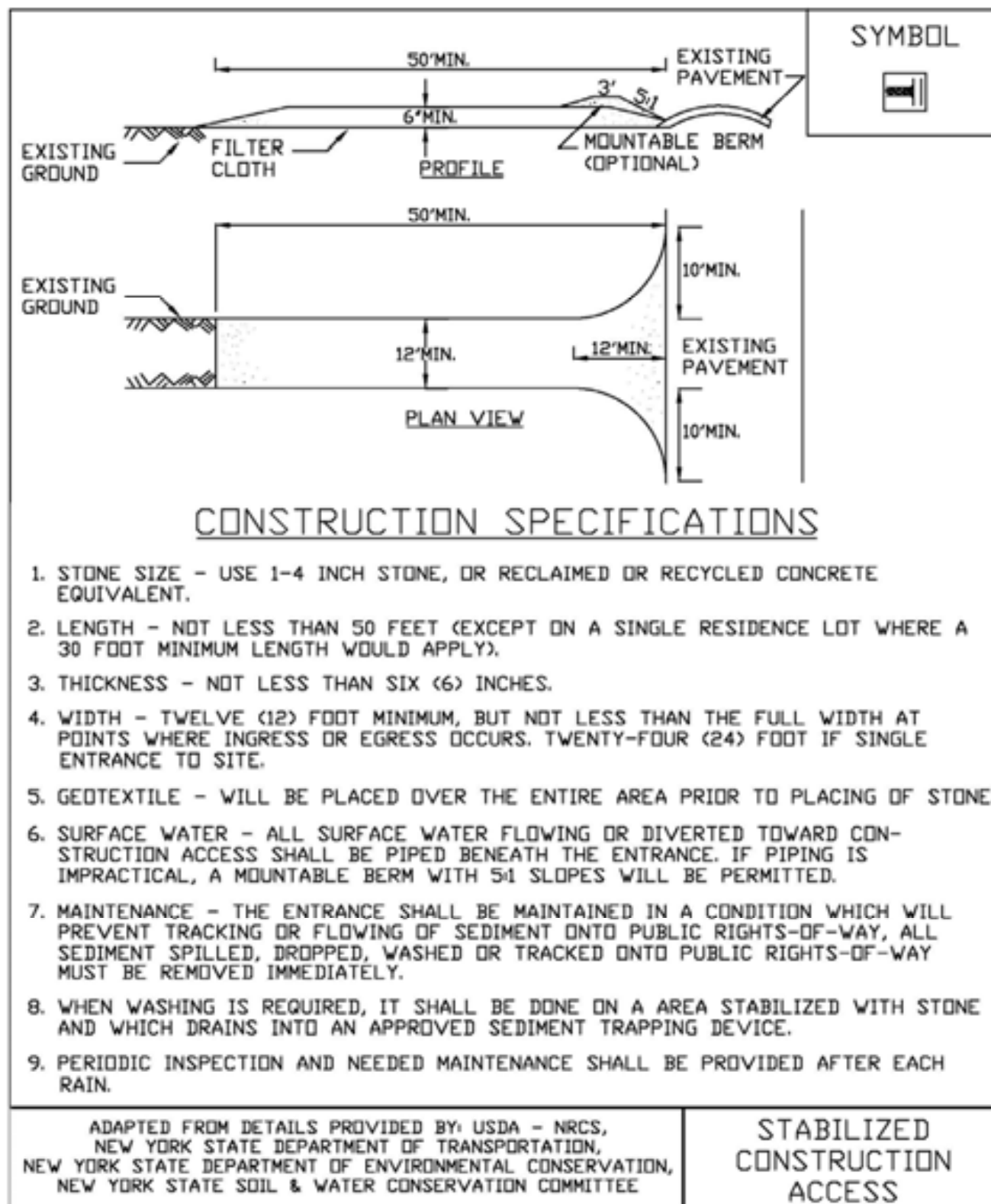
³Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

Maintenance

The access shall be maintained in a condition which will prevent tracking of sediment onto public rights-of-way or streets. This may require periodic top dressing with additional aggregate. All sediment spilled, dropped, or washed onto public rights-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment-trapping device. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

Figure 2.1
Stabilized Construction Access



STANDARD AND SPECIFICATIONS FOR TEMPORARY ACCESS WATERWAY CROSSING



Definition & Scope

A temporary access waterway crossing is a structure placed across a waterway to provide access for construction purposes for a period of less than one year. Consideration should be given to stream flow capacity and velocity anticipated during the period of time that the temporary structures will be in place. Temporary access crossings shall not be utilized to maintain traffic for the general public. The purpose of the temporary access waterway crossing is to provide safe, environmentally sound access across a waterway for construction equipment by establishing minimum standards and specifications for the design, construction, maintenance, and removal of the structure. This standard and specification may represent a channel constriction, thus, the temporary nature of waterway access crossing must be stressed. They should be planned to be in service for the shortest practical period of time and removed as soon as their function is completed.

Conditions Where Practice Applies

This standard and specification for temporary access waterway crossings is applicable in non-tidal waterways. It provides designs based on waterway geometry rather than the drainage area contributing to the point of crossing.

The principal consideration for development of the standard and specifications is concern for erosion and sediment control, tracking soil into waterways, blocking fish passage and destruction of aquatic habitat. Structural utility and safety must also be considered when designing temporary access waterway crossings to withstand expected loads.

The three types of standard temporary access

waterway crossings are bridges, culverts, and fords.

General Requirements

1. **In-Stream Excavation:** In-Stream excavation shall be limited to only that necessary to allow installation of the standard methods as presented in Subsection “Temporary Access Waterway Crossing Methods.”
2. **Elimination of Fish Migration Barriers:** Of the two basic methods presented in Subsection “Temporary Access Waterway Crossing Methods,” bridges pose the least potential for creating barriers to aquatic migration. The construction of any specific crossing method as presented in Subsection “Temporary Access Waterway Crossing Methods,” shall not cause a significant water level difference between the upstream and downstream water surface elevations. Fish spawning or migration within waterways generally occurs between October 1 to May 31 for water classified for trout and from March 15 to July 15 for other streams. Fish spawning or migration dates can vary across New York and restrictions imposed by the NYS Department of Environmental Conservation may vary and must be checked.
3. **Crossing Alignment:** The temporary waterway crossing shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary 15 degrees from a line drawn perpendicular to the centerline of the stream at the intended crossing location.
4. **Road Approaches:** The centerline of both roadway approaches shall coincide with the crossing alignment centerline for a minimum distance of 50 feet from each bank of the waterway being crossed. If physical or right-of-way restraints preclude the 50 feet minimum, a shorter distance may be provided. All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing flood plain elevation.
5. **Surface Water Diverting Structure:** A water diverting structure such as a swale shall be constructed (across the roadway on both roadway approaches) 50 feet (maximum) on either side of the waterway crossing. This will prevent roadway surface runoff from directly entering the waterway. The 50 feet is measured from the top of the waterway bank. Design criteria for this diverting structure shall be in accordance with the “Standard and Specification” for

the individual design standard of choice. If the roadway approach is constructed with a reverse grade away from the waterway, a separate diverting structure is not required.

6. Road Width: All crossings shall have one traffic lane. The minimum width shall be 12 feet with a maximum width of 20 feet.

7. Time of Operation: All temporary crossing shall be removed within 14 calendar days after the structure is no longer needed. Unless prior written approval is obtained, all structures shall be removed within one year from the date of the installation.

8. Materials

A. Aggregate: There shall be no earth or soil materials used for construction within the waterway channel. NYS DOT specifications for coarse aggregate designation No. 4 (2" to 4"), also referenced as AASHTO designation No. 1, shall be the minimum acceptable aggregate size for temporary crossings. Larger aggregates will be allowed.

B. Filter Cloth: Filter cloth is a fabric consisting of either woven or nonwoven plastic, polypropylene, or nylon used to distribute the load, retain fines, allow increased drainage of the aggregate and reduce mixing of the aggregate with the subgrade soil. The designer shall specify the appropriate filter fabric/cloth for a specific use.

Temporary Access Waterway Crossing Methods

The following criteria for erosion and sediment control shall be considered when selecting a specific temporary access waterway crossing standard method:

1. Site aesthetics: Select a standard design method that will least disrupt the existing terrain of the stream reach. Consider the effort that will be required to restore the area after the temporary crossing is removed.

2. Site location: Locate the temporary crossing where there will be the least disturbance to the soils of the existing waterway banks. When possible, locate the crossing at a point receiving minimal surface runoff.

3. Physical site constraints: The physical constraints of a site may preclude the selection of one or more of the standard methods.

4. Time of year: The time of year may preclude the selection of one or more of the standard methods due to fish spawning or migration restrictions.

5. Vehicular loads and traffic patterns: Vehicular loads, traffic patterns, and frequency of crossing should be considered in choosing a specific method.

6. Maintenance of crossing: The standard methods will require various amounts of maintenance. The bridge method should require the least maintenance, whereas the ford method will probably require more intensive maintenance.

7. Removal of the Structure: Ease of removal and subsequent damage to the waterway should be primary factors in considering the choice of a standard method.

Temporary Access Bridge (Figure 2.2 on page 2.36)

A temporary access bridge is a structure made of wood, metal, or other materials, which provides access across a stream or waterway.

Considerations:

1. This is the preferred method for temporary access waterway crossings. Normally, bridge construction causes the least disturbance to the waterway bed and banks when compared to the other access waterway crossings.

2. Most bridges can be quickly removed and reused.

3. Temporary access bridges pose the least chance for interference with fish migration when compared to the other temporary access waterway crossings.

4. Span width will be limited by the length of the bridging material and weight of equipment that will drive over the temporary bridge. Spans of over 10 feet are difficult to construct.

5. Restrictions and Permits: A permit from the New York State Department of Environmental Conservation, Division of Environmental Permits, Regional Permit Administrator, will be needed to install and remove temporary access culverts in streams with a classification of C(T) and higher. Installation and removal may not be permitted during the period of time from the start of trout spawning until the eggs have hatched. In some instances, restrictions may also be applied to bass spawning waters.

Construction Specifications:

1. Restriction: Construction, use, or removal of a temporary access bridge will not normally have any time of year restrictions if construction, use, or

removal does not disturb the stream or its banks.

2. **Bridge Placement:** A temporary bridge structure shall be constructed at or above bank elevation to prevent the entrapment of floating materials and debris.

3. **Abutments:** Abutments shall be placed parallel to and on stable banks.

4. **Bridge Span:** Bridges shall be constructed to span the entire channel. If a footing, pier, or bridge support is constructed within the waterway, a stream-disturbance permit may be required.

5. **Stringers:** Stringers shall either be logs, saw timber, pre-stressed concrete beams, metal beams, or other approved materials.

6. **Deck Material:** Decking shall be of sufficient strength to support the anticipated load. All decking members shall be placed perpendicular to the stringers, butted tightly, and securely fastened to the stringers. Decking materials must be butted tightly to prevent any soil material tracked onto the bridge from falling into the waterway below.

7. **Run Planks (optional):** Run planking shall be securely fastened to the length of the span. One run plank shall be provided for each track of the equipment wheels. Although run planks are optional, they may be necessary to properly distribute loads.

8. **Curbs or Fenders:** Curbs or fenders may be installed along the outer sides of the deck. Curbs or fenders are an option, which will provide additional safety.

9. **Bridge Anchors:** Bridges shall be securely anchored at only one end using steel cable or chain. Anchoring at only one end will prevent channel obstruction in the event that floodwaters float the bridge. Acceptable anchors are large trees, large boulders, or driven steel anchors. Anchoring shall be sufficient to prevent the bridge from floating downstream and possibly causing an obstruction to the flow.

10. **Stabilization:** All areas disturbed during installation shall be stabilized within 14 calendar days of that disturbance in accordance with the Standard and Specification for Temporary Construction Area Seeding on page 4.58.

Bridge Maintenance Requirements

1. **Inspection:** Periodic inspection shall be performed by the user to ensure that the bridge, streambed, and streambanks are maintained and not damaged.

2. **Maintenance:** Maintenance shall be performed, as needed to ensure that the structure complies with the standard and specifications. This shall include removal and disposal of any trapped sediment or debris. Sediment shall be disposed of outside of the floodplain and stabilized.

Bridge Removal and Clean-Up Requirements

1. **Removal:** When the temporary bridge is no longer needed, all structures including abutments and other bridging materials shall be removed within 14 calendar days. In all cases, the bridge materials shall be removed within one year of installation.

2. **Final Clean-Up:** Final clean-up shall consist of removal of the temporary bridge from the waterway, protection of banks from erosion, and removal of all construction materials. All removed materials shall be stored outside the waterway floodplain.

3. **Method:** Removal of the bridge and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

4. **Final Stabilization:** All areas disturbed during removal shall be stabilized within 14 calendar days of that disturbance in accordance with the Standard and Specifications for Permanent Construction Area Planting on page 4.42.

Temporary Access Culvert (Figure 2.3 on page 2.37)

A temporary access culvert is a structure consisting of a section(s) of circular pipe, pipe arches, or oval pipes of reinforcing concrete, corrugated metal, or structural plate, which is used to convey flowing water through the crossing.

Considerations

1. Temporary culverts are used where a) the channel is too wide for normal bridge construction, b) anticipated loading may prove unsafe for single span bridges, or c) access is not needed from bank to bank.

2. This temporary waterway crossing method is normally preferred over a ford type of crossing, since disturbance to the waterway is only during construction and removal of the culvert.

3. Temporary culverts can be salvaged and reused.

Construction Specifications

1. **Restrictions and Permits:** A permit from the New York State Department of Environmental

Conservation, Division of Environmental Permits, Regional Permit Administrator, will be needed to install and remove temporary access culverts in streams with a classification of C(T) and higher. Installation and removal may not be permitted during the period of time from the start of trout spawning until the eggs have hatched. In some instances, restrictions may also be applied to bass spawning waters.

2. Culvert Strength: All culverts shall be strong enough to support their cross sectional area under maximum expected loads.

3. Culvert Size: The size of the culvert pipe shall be the largest pipe diameter that will fit into the existing channel without major excavation of the waterway channel or without major approach fills. If a channel width exceeds 3 feet, additional pipes may be used until the cross sectional area of the pipes is greater than 60 percent of the cross sectional area of the existing channel. The minimum size culvert that may be used is 12-inch diameter pipe.

4. Culvert Length: The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.

5. Filter Cloth: Filter cloth shall be placed on the streambed and streambanks prior to placement of the pipe culvert(s) and aggregate. The filter cloth shall cover the streambed and extend a minimum six inches and a maximum one foot beyond the end of the culvert and bedding material. Filter cloth reduces settlement and improves crossing stability.

6. Culvert Placement: The invert elevation of the culvert shall be installed on the natural streambed grade to minimize interference with fish migration (free passage of fish).

7. Culvert Protection: The culvert(s) shall be covered with a minimum of one foot of aggregate. If multiple culverts are used, they shall be separated by at least 12 in. of compacted aggregate fill. At the minimum, the bedding and fill material used in the construction of the temporary access culvert crossings shall conform with the aggregate requirements cited in the General Requirements subsection.

8. Stabilization: All areas disturbed during culvert installation shall be stabilized within 14 calendar days of the disturbance in accordance with the Standard for Permanent Construction Area Plantings.

ensure that the culverts, streambed, and streambanks are not damaged, and that sediment is not entering the stream or blocking fish passage or migration.

2. Maintenance: Maintenance shall be performed, as needed in a timely manner to ensure that structures are in compliance with this standard and specification. This shall include removal and disposal of any trapped sediment or debris. Sediment shall be disposed of and stabilized outside the waterway flood plain.

Culvert Removal and Clean-Up Requirements

1. Removal: When the crossing has served its purpose, all structures, including culverts, bedding, and filter cloth materials shall be removed within 14 calendar days. In all cases, the culvert materials shall

be removed within one year of installation. No structure shall be removed during the spawning season (generally October 1 through May 31 for trout waters and March 15 through July 15 for other waters).

2. Final Clean-Up: Final clean-up shall consist of removal of the temporary structure from the waterway, removal of all construction materials, restoration of original stream channel cross section, and protection of the streambanks from erosion. Removed material shall be stored outside of the waterway floodplain.

3. Method: Removal of the structure and clean-up of the area shall be accomplished without construction equipment working in the waterway channel.

4. Final Stabilization: All areas disturbed during culvert removal shall be stabilized within 14 calendar days of the disturbance in accordance with the Standard for Permanent Construction Area Plantings.

NOTE: Any temporary access crossing shall conform to the technical requirements of this Standard and Specifications as well as any specific requirement imposed by the New York State Department of Environmental Conservation and the US Army Corps of Engineers. Permits may be required for streambank disturbance.

Culvert Maintenance Requirements

1. Inspection: Periodic inspection shall be performed to

Figure 2.2
Temporary Access Bridge

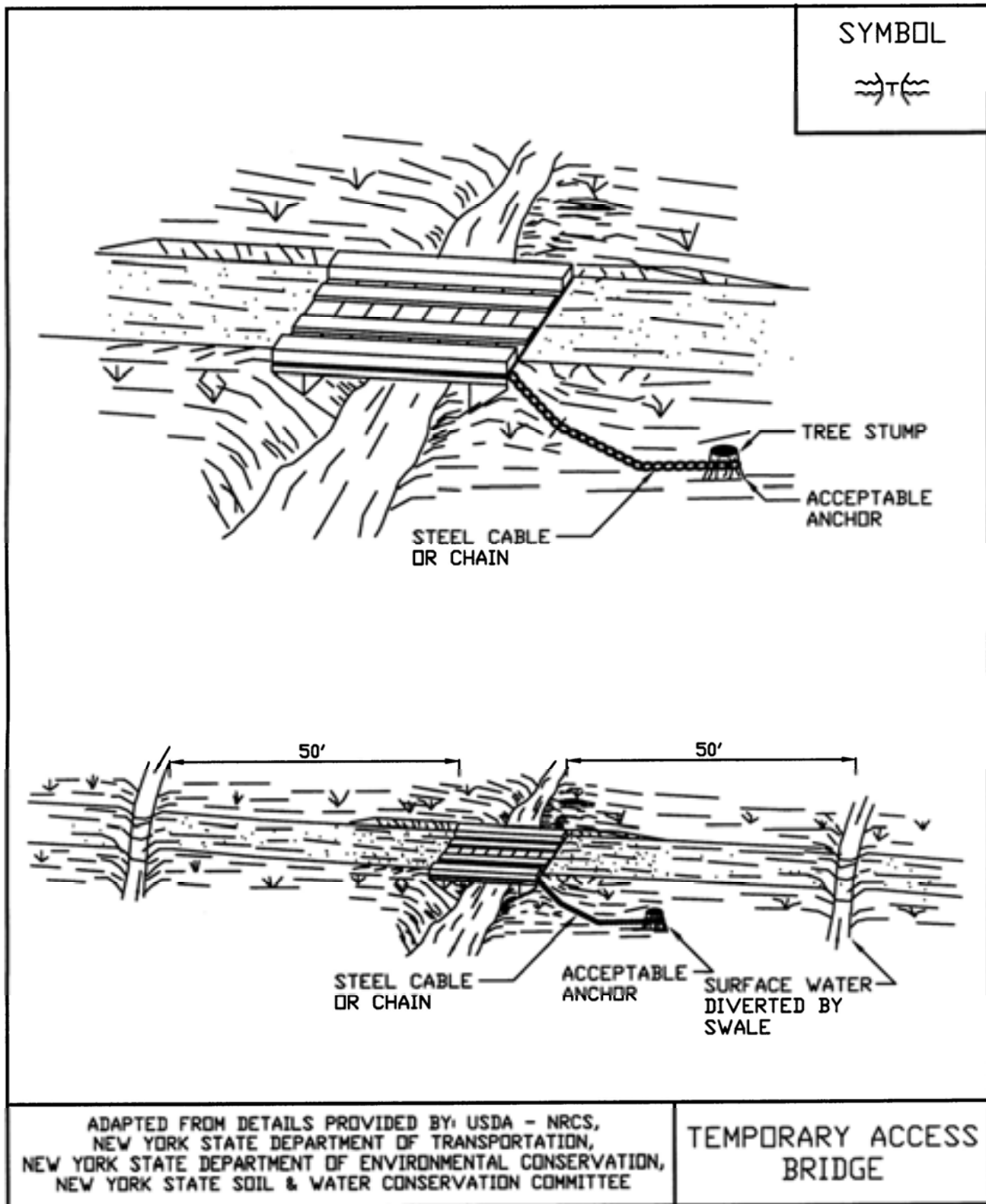
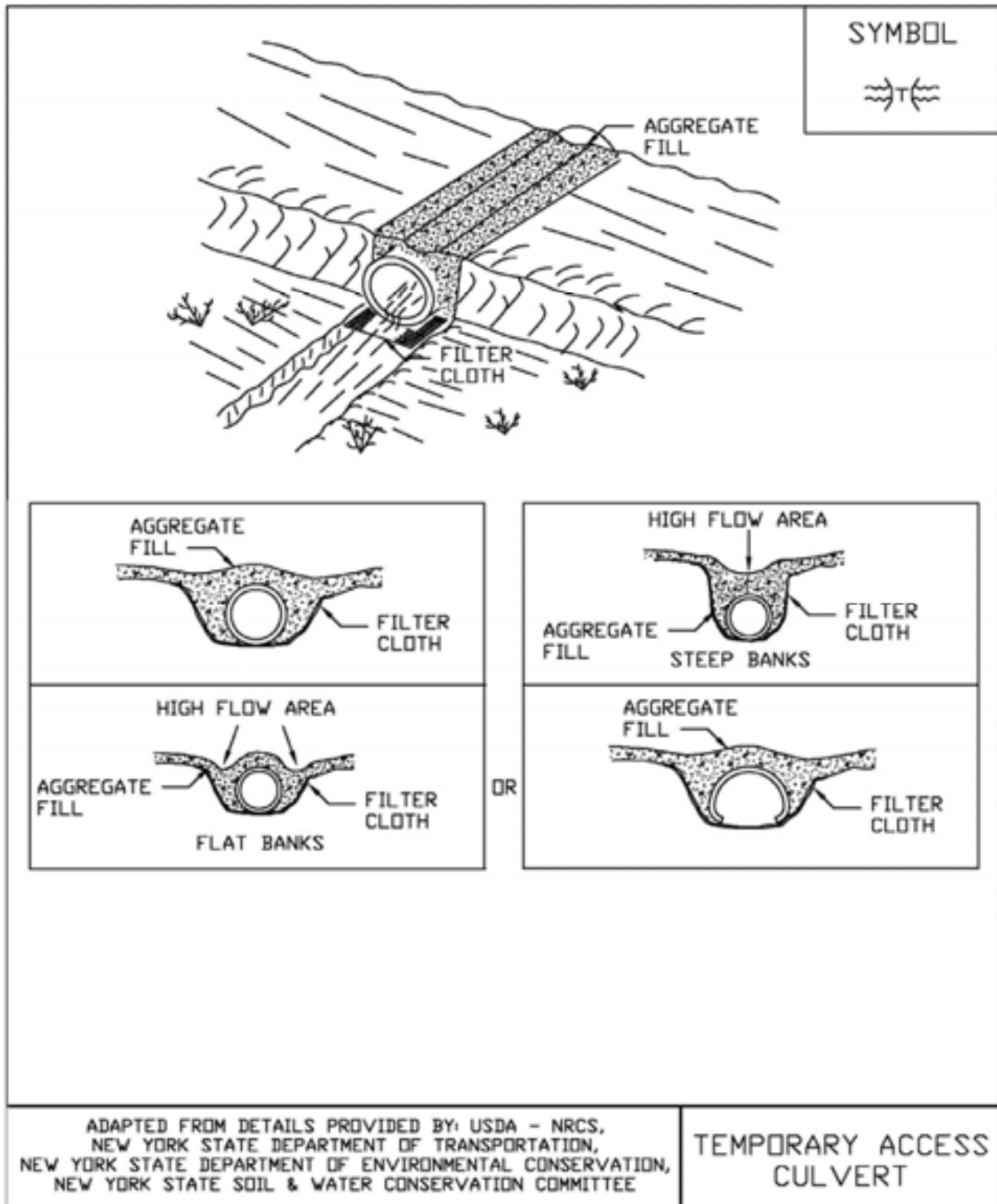


Figure 2.3
Temporary Access Culvert



STANDARD AND SPECIFICATIONS FOR WINTER STABILIZATION



Definition & Scope

A temporary site specific, enhanced erosion and sediment control plan to manage runoff and sediment at the site during construction activities in the winter months to protect off-site water resources.

Conditions Where Practice Applies

This standard applies to all construction activities involved with ongoing land disturbance and exposure between November 15th to the following April 1st.

Design Criteria

1. Prepare a snow management plan with adequate storage for snow and control of melt water, requiring cleared snow to be stored in a manner not affecting ongoing construction activities.
2. Enlarge and stabilize access points to provide for snow management and stockpiling. Snow management activities must not destroy or degrade installed erosion and sediment control practices.
3. A minimum 25 foot buffer shall be maintained from all perimeter controls such as silt fence. Mark silt fence with tall stakes that are visible above the snow pack.
4. Edges of disturbed areas that drain to a waterbody within 100 feet will have 2 rows of silt fence, 5 feet apart, installed on the contour.
5. Drainage structures must be kept open and free of snow and ice dams. All debris, ice dams, or debris from plowing operations, that restrict the flow of runoff and meltwater, shall be removed.
6. Sediment barriers must be installed at all appropriate

perimeter and sensitive locations. Silt fence and other practices requiring earth disturbance must be installed before the ground freezes.

7. Soil stockpiles must be protected by the use of established vegetation, anchored straw mulch, rolled stabilization matting, or other durable covering. A barrier must be installed at least 15 feet from the toe of the stockpile to prevent soil migration and to capture loose soil.
8. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures should be initiated by the end of the next business day and completed within three (3) days. Rolled erosion control blankets must be used on all slopes 3 horizontal to 1 vertical or steeper.
9. If straw mulch alone is used for temporary stabilization, it shall be applied at double the standard rate of 2 tons per acre, making the application rate 4 tons per acre. Other manufactured mulches should be applied at double the manufacturer's recommended rate.
10. To ensure adequate stabilization of disturbed soil in advance of a melt event, areas of disturbed soil should be stabilized at the end of each work day unless:
 - a. work will resume within 24 hours in the same area and no precipitation is forecast or;
 - b. the work is in disturbed areas that collect and retain runoff, such as open utility trenches, foundation excavations, or water management areas.
11. Use stone paths to stabilize access perimeters of buildings under construction and areas where construction vehicle traffic is anticipated. Stone paths should be a minimum 10 feet in width but wider as necessary to accommodate equipment.

Maintenance

The site shall be inspected frequently to ensure that the erosion and sediment control plan is performing its winter stabilization function. If the site will not have earth disturbing activities ongoing during the "winter season", all bare exposed soil must be stabilized by established vegetation, straw or other acceptable mulch, matting, rock, or other approved material such as rolled erosion control products. Seeding of areas with mulch cover is preferred but seeding alone is not acceptable for proper stabilization.

Compliance inspections must be performed and reports filed properly in accordance with the SWPPP for all sites under a winter shutdown.

References

1. Northeastern Illinois Soil and Sedimentation Control Steering Committee. October 1981. Procedures and Standards for Urban Soil Erosion and Sediment Control in Illinois.
2. J.F. Rushing, V.M. Moore, J.S. Tingle, Q. Mason, and T. McCaffery, 2005. Dust Abatement Methods for Lines of Communication and Base Camps in Temperate Climates. ERDC/GSL TR-05-23, October 2005.

SECTION 3

EROSION CONTROL - PART 1

RUNOFF CONTROL

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EROSION CONTROL - PART 1

RUNOFF CONTROL

Scope and Discussion

Water management on and above potentially eroding sites is extremely important and is the first step in controlling potential erosion on construction sites or disturbed, exposed soil areas. Large watersheds above a site may require extensive water control measures. Water flow paths must be controlled to allow safe delivery of water to an outlet at the side or bottom of a slope. Shallow ditches or diversions across the slope and above the area to be disturbed is an effective method of avoiding rills and gullies in disturbed areas and wash-out of the seed and soil. Diversions may be constructed at a point where surface runoff water is intercepted and carried away from the slope to a safe outlet.

Within the construction area, surface runoff and groundwater must be managed to protect both the site condition and offsite resources. Conveyances such as swales, waterways, slope drains, dewatering methods and flow bypass systems need to be evaluated to meet design objectives. These include both the management of clean water as well as sediment laden water. **In all cases, water management practices should take into account potential impacts to receiving waters and include stable discharge elements.** This may include armored or fabric lined conveyances, rock outlet aprons, flow dissipation, or excavated plunge pools.

On large slopes benching may be necessary for drainage and/or future maintenance access (see standard for Land Grading). Subsurface drainage is frequently included to prevent long term saturated soil conditions and sloughing.

Structural erosion control practices are generally considered as temporary or permanent depending on how they are used. Some are both. Temporary structural practices are used during construction to prevent onsite erosion and offsite migration of sediment. The length of time that temporary practices are functional varies from project to project, since the sediment control strategy may change as construction activity progresses. Permanent structural practices are used to convey surface water runoff to a safe outlet. They will remain in place and continue to function after the completion of construction and final stabilization.

Regardless of whether the practices are temporary or permanent, runoff control measures should be the first practices constructed when grading begins, and be completely functional before downslope land disturbance takes place. Earthen structures such as diversions, dikes, and swales must be stabilized before being considered functional. Only after runoff control structures are operational and sediment control measures in place, should clearing and grading on the rest of the construction site begin.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

STANDARD AND SPECIFICATIONS FOR CHECK DAM



Definition & Scope

Small barriers or dams constructed of stone, bagged sand or gravel, or other durable materials across a drainageway to reduce erosion in a drainage channel by reducing the velocity of flow in the channel.

Conditions Where Practice Applies

This practice is used as a **temporary** and, in some cases, a **permanent** measure to limit erosion by reducing velocities in open channels that are degrading or subject to erosion or where permanent stabilization is impractical due to short period of usefulness and time constraints of construction.

Design Criteria

Drainage Area: Maximum drainage area above the check dam shall not exceed two (2) acres.

Height: Not greater than 2 feet. Center shall be maintained 9 inches lower than abutments at natural ground elevation.

Side Slopes: Shall be 2:1 or flatter.

Spacing: The check dams shall be spaced as necessary in the channel so that the crest of the downstream dam is at the elevation of the toe of the upstream dam. This spacing is equal to the height of the check dam divided by the channel slope.

Therefore:

$$S = \frac{h}{s}$$

Where:
 S = spacing interval (ft.)
 h = height of check dam (ft.)
 s = channel slope (ft./ft.)

Example:

For a channel with
 and 2 ft. high stone
 they are spaced as

$$S = \frac{2 \text{ ft}}{0.04 \frac{\text{ft}}{\text{ft}}} = 50 \text{ ft}$$

a 4% slope
 check dams,
 follows:

For stone check dams: Use a well graded stone matrix 2 to 9 inches in size (NYS – DOT Light Stone Fill meets these requirements).

The overflow of the check dams will be stabilized to resist erosion that might be caused by the check dam. See Figure 3.1 on page 3.3 for details.

Check dams should be anchored in the channel by a cutoff trench 1.5 ft. wide and 0.5 ft. deep and lined with filter fabric to prevent soil migration.

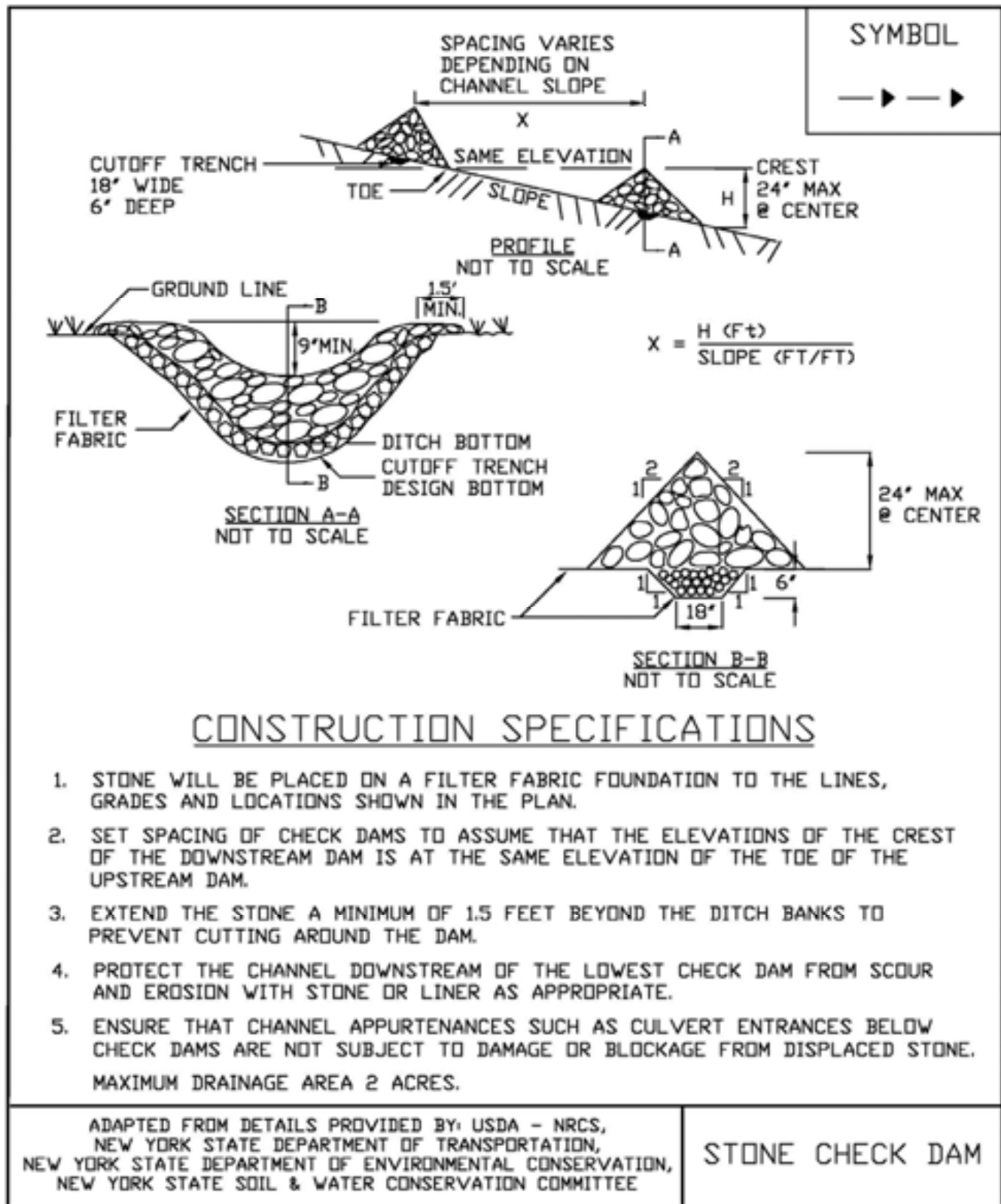
For filter sock or fiber roll check dams: The check dams will be anchored by staking the dam to the earth contact surface. The dam will extend to the top of the bank. The check dam will have a splash apron of NYS DOT #2 crushed stone extending a minimum 3 feet downstream from the dam and 1 foot up the sides of the channel. The compost and materials for a filter sock check dam shall meet the requirements shown in the standard for Compost Filter Sock on page 5.7.

Maintenance

The check dams should be inspected after each runoff event. Correct all damage immediately. If significant erosion has occurred between structures, a liner of stone or other suitable material should be installed in that portion of the channel or additional check dams added.

Remove sediment accumulated behind the dam as needed to allow channel to drain through the stone check dam and prevent large flows from carrying sediment over the dam.

Figure 3.1
Stone Check Dam Detail



STANDARD AND SPECIFICATIONS FOR CONSTRUCTION DITCH



Definition & Scope

A **temporary** excavated drainage way to intercept sediment laden water and divert it to a sediment trapping device or to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet.

Conditions Where Practice Applies

Construction ditches are constructed:

1. to divert flows from entering a disturbed area.
2. intermittently across disturbed areas to shorten over-land flow distances.
3. to direct sediment laden water along the base of slopes to a trapping device.
4. to transport offsite flows across disturbed areas such as rights-of-way.

Ditches collecting runoff from disturbed areas shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.2 on page 3.6 for details.

General

	Ditch A	Ditch B
Drainage Area	<5 Ac	5-10 Ac
Bottom Width of Flow Channel	4 ft.	6 ft.
Depth of Flow Channel	1 ft.	1 ft.
Side Slopes	2:1 or flatter	2:1 or flatter
Grade	0.5% Min. 10% Max.	0.5% Min. 10% Max.

For drainage areas larger than 10 acres, refer to the Standard and Specification for Grassed Waterways on page 3.23 and 3.24.

Stabilization

Stabilization of the ditch shall be completed within 2 days of installation in accordance with the appropriate standard and specifications for vegetative stabilization or stabilization with mulch as determined by the time of year. The flow channel shall be stabilized as per the following criteria:

The seeding for vegetative stabilization shall be in accordance with the standard on Page 4.78. The seeded area will be mulched in accordance with the standard on Page 4.39.

Type of Treatment	Channel Grade ¹	Flow Channel	
		A (<5 Ac.)	B (5-10 Ac.)
1	0.5-3.0%	Seed & Straw Mulch	Seed & Straw Mulch
2	3.1-5.0%	Seed & Straw Mulch	Seed and cover with RECP ² , Sod, or lined with plastic or 2" stone
3	5.1-8.0%	Seed and cover with RECP ² , Sod, or line with plastic or 2 in. stone	Line with 4-8 in. rip-rap or, geotextile
4	8.1-10%	Line with 4-8 in. rip-rap or geotextile	Site Specific Design
¹ In highly erodible soils, as defined by the local approving agency, refer to the next higher slope grade for type of stabilization. ² Rolled Erosion Control Product.			

Outlet

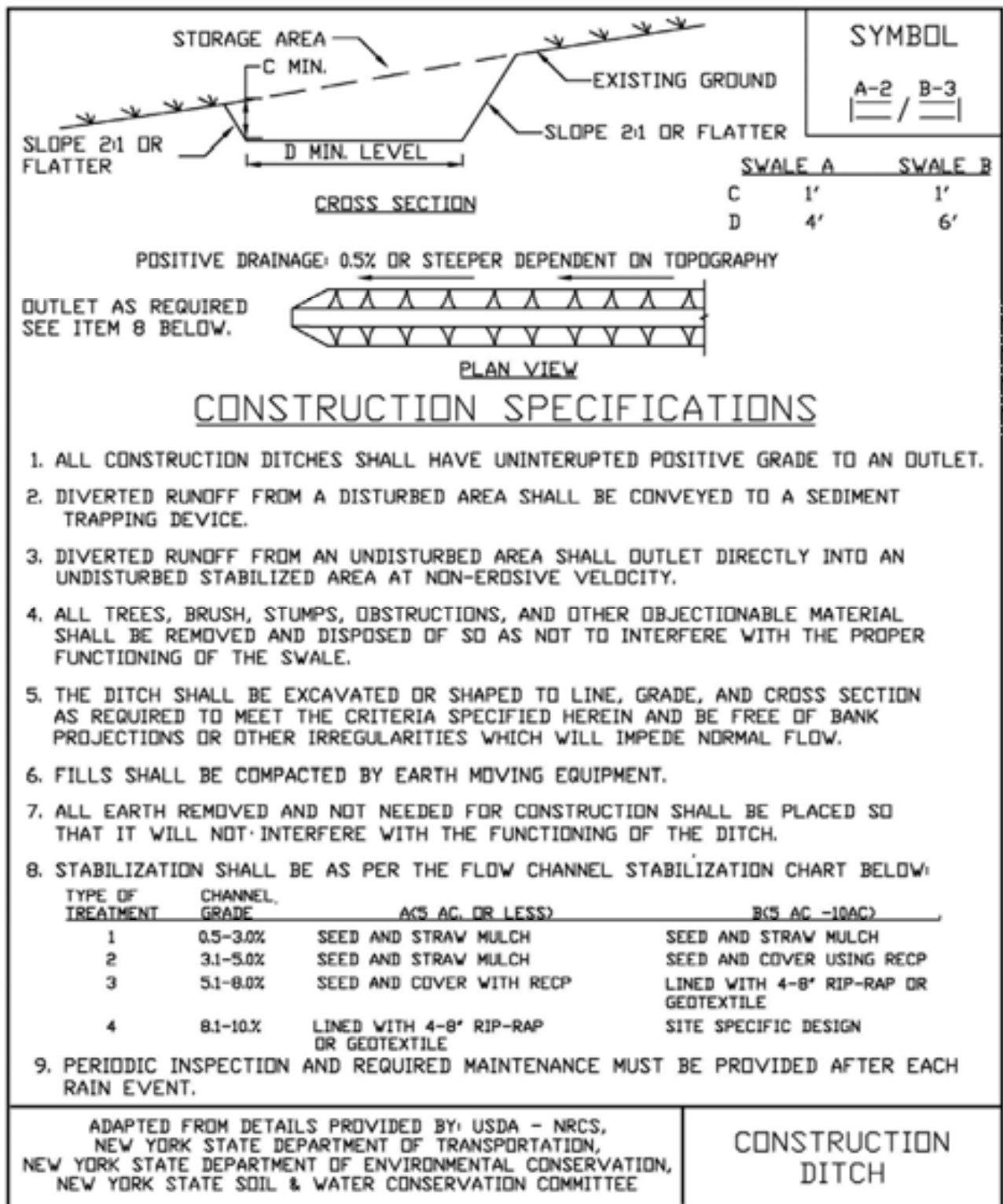
Ditch shall have an outlet that functions with a minimum of erosion, and dissipates runoff velocity prior to discharge off the site.

Runoff shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin until the drainage area above the ditch is adequately stabilized.

The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet condition.

If a ditch is used to divert clean water flows from entering a disturbed area, a sediment trapping device may not be needed.

**Figure 3.2
Construction Ditch Detail**



STANDARD AND SPECIFICATIONS FOR DEWATERING SUMP PIT



Discharge of turbid water pumped from the standpipe should be to a sediment trap, sediment basin, filter bag or stabilized area, such as a filter strip. If water from the sump pit will be pumped directly to a storm drain system, filter cloth with an equivalent sieve size between 40-80 should be wrapped around the standpipe to ensure clean water discharge. It is recommended that $\frac{1}{4}$ to $\frac{1}{2}$ inch hardware cloth be wrapped around and secured to the standpipe prior to attaching the filter cloth. This will increase the rate of water seepage into the standpipe.

Definition & Scope

A **temporary** pit which is constructed using pipe and stone for pumping excessive water from excavations to a suitable discharge area.

Conditions Where Practice Applies

Sump pits are constructed when water collects during the excavation phase of construction. This practice is particularly useful in urban areas during excavation for building foundations. It may also be necessary during construction activities that encounter high ground water tables in floodplain locations.

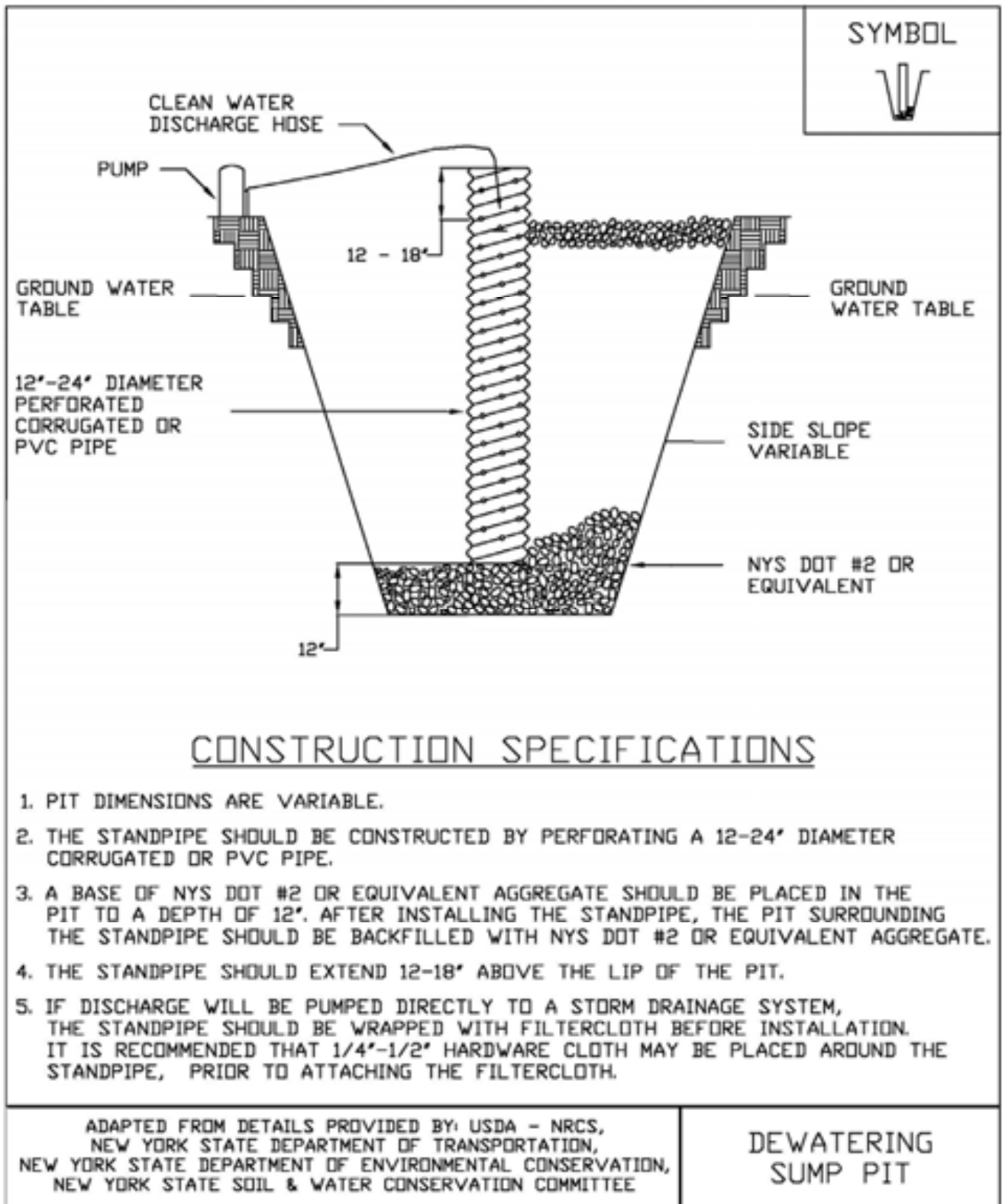
Design Criteria

The number of sump pits and their locations shall be determined by the contractor/engineer. A design is not required, but construction should conform to the general criteria outlined on Figure 3.3 on page 3.8.

A perforated vertical standpipe is placed in the center of the pit and surrounded with a stone screening material to collect filtered water. Water is then pumped from the center of the pipe to a suitable discharge area.



Figure 3.3
Dewatering Sump Pit Detail



STANDARD AND SPECIFICATIONS FOR DIVERSION



Definition & Scope

A drainage way of parabolic or trapezoidal cross-section with a supporting ridge on the lower side that is constructed across the slope to intercept and convey runoff to stable outlets at non-erosive velocities.

Conditions Where Practice Applies

Diversions are used where:

1. Runoff from higher areas has potential for damaging properties, causing erosion, 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 slopes needs to be reduced so that soil loss will be kept 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 shall be in compliance with state and local drainage and water 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 rates of runoff values used in determining the capacity requirements shall be calculated using the most current hydrologic data from the Northeast Regional Climate Center in an appropriate model.

The constructed diversion shall have capacity to carry, as a minimum, the peak discharge from a 10 year frequency rainfall event with freeboard of not less than 0.3 feet.

Diversions designed to protect homes, schools, industrial buildings, roads, parking lots, 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.

Cross Section

The diversion channel shall be parabolic or trapezoidal in shape. Parabolic Diversion design charts are provided in Tables 3.2, 3.3 and 3.4 on pages 3.10, 3.12 and 3.13. The diversion shall be designed to have stable side slopes. The side slopes shall not be steeper than 2:1 and shall be flat enough to ensure ease of maintenance of the diversion and its protective vegetative cover.

The ridge shall have a minimum width of four feet at the design water elevation; a minimum of 0.3 feet freeboard and a reasonable settlement factor shall be provided.

Velocity and Grade

The permissible velocity for the specified method of stabilization will determine the maximum grade. Maximum permissible velocities of flow for the stated conditions of stabilization shall be as shown in Table 3.1 on page 3.10 of this standard.

Diversions are not usually applicable below high sediment producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with, or before, the diversions.

Outlets

Each diversion must have an adequate outlet. The outlet may be a grassed waterway, vegetated or paved area, grade stabilization structure, flow spreader, flow diffuser, stable watercourse, or subsurface drain outlet. In all cases, the outlet must convey runoff to a point where outflow will not cause damage. Vegetated outlets shall be installed before diversion construction, if needed, to ensure establishment of

vegetative cover in the outlet channel.

Stabilization

The design elevation of the water surface in the diversion shall not be lower than the design elevation of the water surface in the outlet at their junction when both are operating at design flow.

Vegetated diversions shall be stabilized in accordance with the following tables.

Table 3.1
Diversion Maximum Permissible Design Velocities Table

Soil Texture	Retardance and Cover	Permissible Velocity (ft / second) for Selected Channel Vegetation
Sand, Silt, Sandy loam, silty loam, loamy sand (ML, SM, SP, SW)	C-Kentucky 31 tall fescue and Kentucky bluegrass	3.0
	D-Annuals ¹ Small grain (rye, oats, barley, millet) Ryegrass	2.5
Silty clay loam, Sandy clay loam (ML-CL, SC)	C-Kentucky 31 tall fescue and Kentucky bluegrass	4.0
	D-Annuals ¹ Small grain (rye, oats, barley, millet) Ryegrass	3.5
Clay (CL)	C-Kentucky 31 tall fescue and Kentucky bluegrass	5.0
	D-Annuals ¹ Small grain (rye, oats, barley, millet) Ryegrass	4.0
¹ Annuals—Use only as temporary protection until permanent vegetation is established.		

Table 3.2 - Retardance Factors for Various Grasses and Legumes Table

Retardance	Cover	Condition
A	Reed canarygrass	Excellent stand, tall (average 36 inches)
B	Smooth brome grass	Good stand, mowed (average 12 to 15 inches)
	Tall fescue	Good stand, unmowed (average 18 inches)
	Grass-legume mixture—Timothy, smooth brome grass, or Orchard grass with birdsfoot trefoil	Good stand, uncut (average 20 inches)
	Reed canarygrass	Good stand, mowed (average 12 to 15 inches)
	Tall fescue, with birdsfoot trefoil or ladino clover	Good stand, uncut (average 18 inches)
C	Redtop	Good stand, headed (15 to 20 inches)
	Grass-legume mixture—summer (Orchard grass, redtop, Annual ryegrass, and ladino or white clover)	Good stand, uncut (6 to 8 inches)
	Kentucky bluegrass	Good stand, headed (6 to 12 inches)
D	Red fescue	Good stand, headed (12 to 18 inches)
	Grass-legume mixture—fall, spring (Orchard grass, redtop, Annual ryegrass, and white or ladino clover)	Good stand, uncut (4 to 5 inches)

Figure 3.4
Diversion Detail

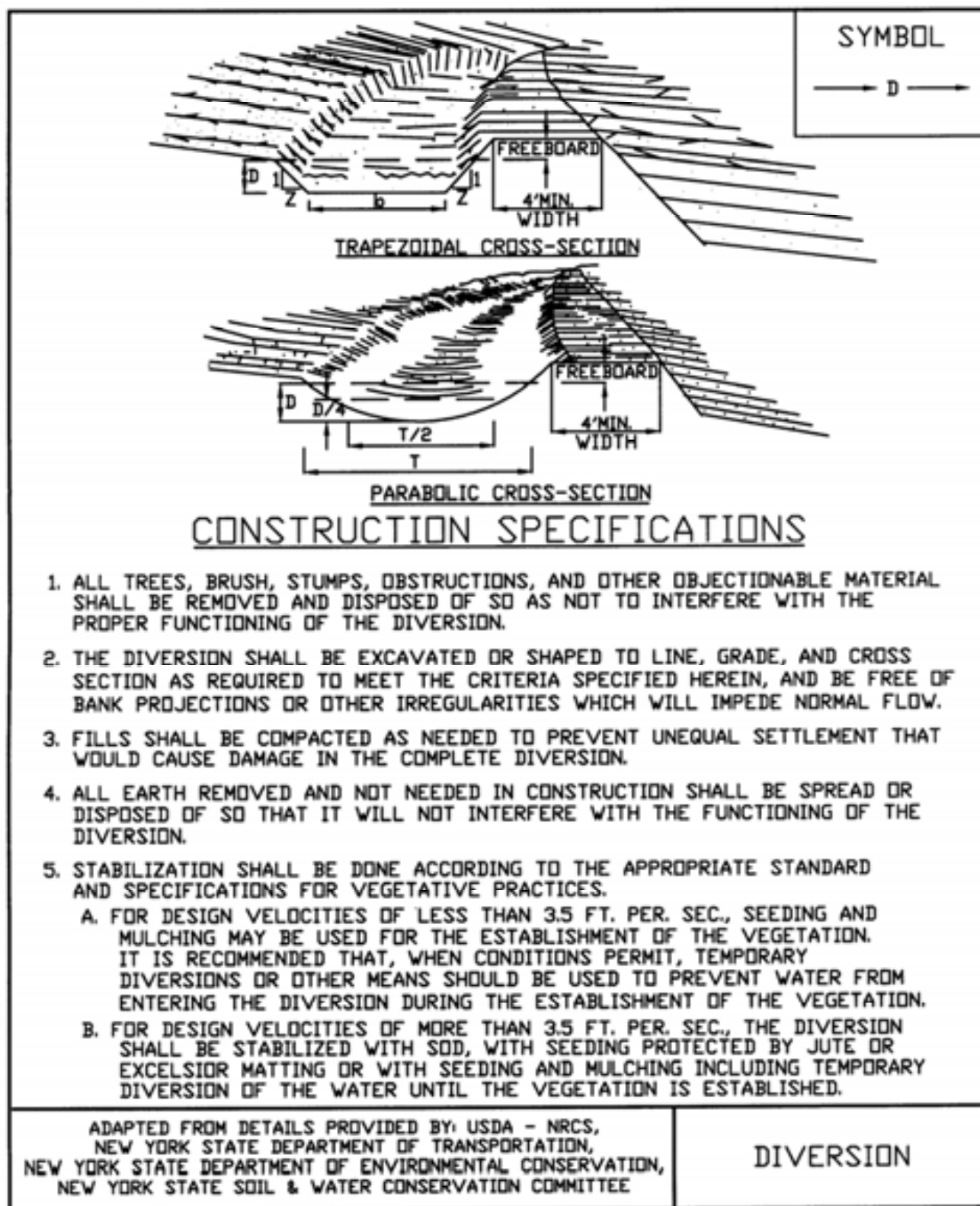


Table 3.3
Parabolic Diversion Design, Without Freeboard Tables - 1 (USDA- NRCS)

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD										RETARDANCE - D & C GRADE, %- 0.50
V ₁ Based on Permissible Velocity of the Soil With Retardance "D" Top Width, Depth & V ₂ Based on Retardance "C"										
Q	V ₁ = 2.0	V ₁ = 2.5	V ₁ = 3.0	V ₁ = 3.5	V ₁ = 4.0	V ₁ = 4.5	V ₁ = 5.0	V ₁ = 5.5	V ₁ = 6.0	
cfs	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂
15	9 1.6 1.6									
20	11 1.6 1.7									
25	14 1.6 1.7	9 1.9 2.1								
30	17 1.6 1.7	11 1.9 2.2								
35	20 1.6 1.7	12 1.9 2.3	8 2.2 2.5							
40	22 1.6 1.7	14 1.8 2.3	9 2.1 2.6							
45	25 1.5 1.7	16 1.8 2.3	11 2.1 2.7							
50	28 1.5 1.7	18 1.8 2.4	12 2.0 2.8							
55	31 1.5 1.7	19 1.8 2.4	13 2.0 2.8	10 2.4 3.2						
60	33 1.5 1.7	21 1.8 2.4	15 2.0 2.8	11 2.4 3.3						
65	36 1.5 1.8	23 1.8 2.4	16 2.0 2.8	12 2.4 3.3						
70	39 1.5 1.7	24 1.8 2.4	18 2.0 2.9	13 2.3 3.4						
75	42 1.5 1.8	26 1.8 2.4	19 2.0 2.9	14 2.3 3.4	11 2.7 3.7					
80	44 1.5 1.8	28 1.8 2.4	21 2.0 2.9	15 2.3 3.4	12 2.7 3.8					
90	50 1.5 1.8	31 1.8 2.4	24 2.0 2.9	17 2.3 3.4	13 2.7 3.8					
100	55 1.5 1.8	35 1.8 2.4	26 2.0 2.9	19 2.3 3.5	15 2.6 3.9	12 3.0 4.1				
...										

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD										RETARDANCE - D & C GRADE, %- 1.0
V ₁ Based on Permissible Velocity of the Soil With Retardance "D" Top Width, Depth & V ₂ Based on Retardance "C"										
Q	V ₁ = 2.0	V ₁ = 2.5	V ₁ = 3.0	V ₁ = 3.5	V ₁ = 4.0	V ₁ = 4.5	V ₁ = 5.0	V ₁ = 5.5	V ₁ = 6.0	
cfs	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂	T D V ₂
15	13 1.1 1.5	8 1.3 2.0								
20	18 1.1 1.5	11 1.3 2.1	8 1.5 2.6							
25	22 1.1 1.5	14 1.3 2.1	9 1.5 2.6	8 1.6 3.0						
30	27 1.1 1.5	17 1.3 2.1	11 1.5 2.7	9 1.6 3.0						
35	31 1.1 1.5	19 1.3 2.2	13 1.5 2.8	11 1.6 3.1	8 1.8 3.6					
40	35 1.1 1.5	22 1.3 2.1	15 1.6 2.8	12 1.6 3.1	9 1.8 3.7					
45	40 1.1 1.5	25 1.3 2.2	17 1.5 2.8	13 1.6 3.2	10 1.8 3.7					
50	44 1.1 1.5	28 1.3 2.2	19 1.6 2.8	15 1.6 3.2	11 1.8 3.7					
55	48 1.1 1.5	30 1.3 2.2	20 1.6 2.8	16 1.5 3.3	12 1.8 3.8					
60	53 1.1 1.5	33 1.3 2.2	22 1.6 2.8	18 1.5 3.3	14 1.7 3.8	9 2.0 4.2				
65	57 1.1 1.5	36 1.3 2.2	24 1.6 2.8	19 1.5 3.3	15 1.7 3.8	10 2.0 4.3				
70	61 1.1 1.5	38 1.3 2.2	26 1.6 2.9	21 1.5 3.3	16 1.7 3.9	11 2.0 4.3				
75	66 1.1 1.5	41 1.3 2.2	28 1.6 2.9	24 1.5 3.3	17 1.7 3.9	12 2.0 4.5				
80	70 1.1 1.5	44 1.3 2.2	29 1.6 2.9	26 1.5 3.3	18 1.7 3.9	13 2.0 4.5				
90	79 1.1 1.5	49 1.3 2.2	33 1.6 2.9	27 1.5 3.3	20 1.7 3.9	15 1.9 4.5				
100	87 1.1 1.5	55 1.3 2.2	37 1.6 2.9	29 1.5 3.3	22 1.7 3.9	17 1.9 4.5				
							9 2.2 4.7			
							10 2.2 4.7			
							11 2.2 4.7			
							12 2.2 4.9			
							13 2.2 4.9			
							14 2.2 4.9			
							15 2.4 5.2			
							16 2.4 5.3			

Table 3.4
Parabolic Diversion Design, Without Freeboard Tables - 2 (USDA– NRCS)

[illegible]

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD															RETARDANCE - D & C GRADE, % - 2.0			
V ₁ Based on Permissible Velocity of the Soil With Retardance "D" Top Width, Depth & V ₂ based on Retardance "C"																		
Q	V ₁ = 2.0		V ₁ = 2.5		V ₁ = 3.0		V ₁ = 3.5		V ₁ = 4.0		V ₁ = 4.5		V ₁ = 5.0		V ₁ = 5.5		V ₁ = 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	1.3	13	0.9	1.9	9	1.0	2.4	7	1.2	2.9						
20	28	0.8	1.3	17	0.9	1.9	12	1.0	2.4	9	1.1	3.0	7	1.3	3.5	5	1.4	3.8
25	35	0.8	1.3	21	0.9	1.9	15	1.0	2.4	11	1.1	3.0	8	1.3	3.7	7	1.4	4.0
30	41	0.8	1.3	26	0.9	1.9	18	1.0	2.5	13	1.1	3.0	10	1.2	3.7	8	1.3	4.2
35	48	0.8	1.4	30	0.9	1.9	22	1.0	2.4	15	1.1	3.1	11	1.2	3.8	9	1.3	4.2
40	55	0.8	1.3	34	0.9	1.9	25	1.0	2.5	18	1.1	3.1	13	1.2	3.8	11	1.3	4.3
45	62	0.8	1.4	38	0.9	1.9	28	1.0	2.5	20	1.1	3.1	14	1.2	3.8	12	1.3	4.3
50	68	0.8	1.4	42	0.9	1.9	31	1.0	2.5	22	1.1	3.1	15	1.2	3.9	13	1.3	4.3
55	75	0.8	1.4	46	0.9	1.9	34	1.0	2.5	24	1.1	3.1	17	1.2	3.8	14	1.3	4.3
60	82	0.8	1.4	51	0.9	1.9	37	1.0	2.5	26	1.1	3.1	19	1.2	3.9	16	1.3	4.4
65	88	0.8	1.4	55	0.9	1.9	40	1.0	2.5	28	1.1	3.1	21	1.2	3.9	17	1.3	4.4
70	95	0.8	1.4	59	0.9	1.9	43	1.0	2.5	30	1.1	3.1	22	1.2	3.9	18	1.3	4.4
75				63	0.9	1.9	46	1.0	2.5	32	1.1	3.2	24	1.2	3.9	20	1.3	4.4
80				67	0.9	2.0	48	1.0	2.5	35	1.1	3.1	25	1.2	3.9	21	1.3	4.4
90				75	0.9	2.0	54	1.0	2.5	39	1.1	3.2	28	1.2	3.9	23	1.3	4.4
100				83	0.9	2.0	60	1.0	2.5	43	1.1	3.2	31	1.2	3.9	26	1.3	4.4

STANDARD AND SPECIFICATIONS FOR EARTH DIKE



Definition & Scope

A **temporary** berm or ridge of compacted soil, located in such a manner as to channel water to a desired location. Its purpose is to direct runoff to a sediment trapping device, thereby reducing the potential for erosion and off site sedimentation. Earth dikes can also be used for diverting clean water away from disturbed areas.

Conditions Where Practice Applies

Earth dikes are often constructed across disturbed areas and around construction sites such as graded parking lots and subdivisions. The dikes shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.5 on page 3.15 for details.

General

	Dike A	Dike B
Drainage Area	<5 Ac	5-10 Ac
Dike Height	18 in.	36 in.
Dike Width	24 in.	36 in.
Flow Width	4 ft.	6 ft.
Flow Depth in Channel	8 in.	15 in.
Side Slopes	2:1 or flatter	2:1 or flatter
Grade	0.5% Min. 10% Max.	0.5% Min. 10% Max.

For drainage areas larger than 10 acres, refer to the Standard and Specifications for Diversion on page 3.9.

Stabilization

Stabilization of the dike shall be completed within 2 days of installation in accordance with the standard and specifications for seed and straw mulch or straw mulch only if not in seeding season. The flow channel shall be stabilized as per the following criteria:

Type of Treatment	Channel Grade ¹	Flow Channel	
		A (<5 Ac.)	B (5-10 Ac.)
1	0.5-3.0%	Seed & Straw Mulch	Seed & Straw Mulch
2	3.1-5.0%	Seed & Straw Mulch	Seed and cover with RECP, sod, or lined with plastic or 2" stone
3	5.1-8.0%	Seed and cover with RECP, Sod, or line with plastic or 2 in. stone	Line with 4-8 in. rip-rap or, geotextile
4	8.1-10%	Line with 4-8 in. rip-rap or geotextile	Site Specific Design

¹ In highly erodible soils, as defined by the local approving agency, refer to the next higher slope grade for type of stabilization.

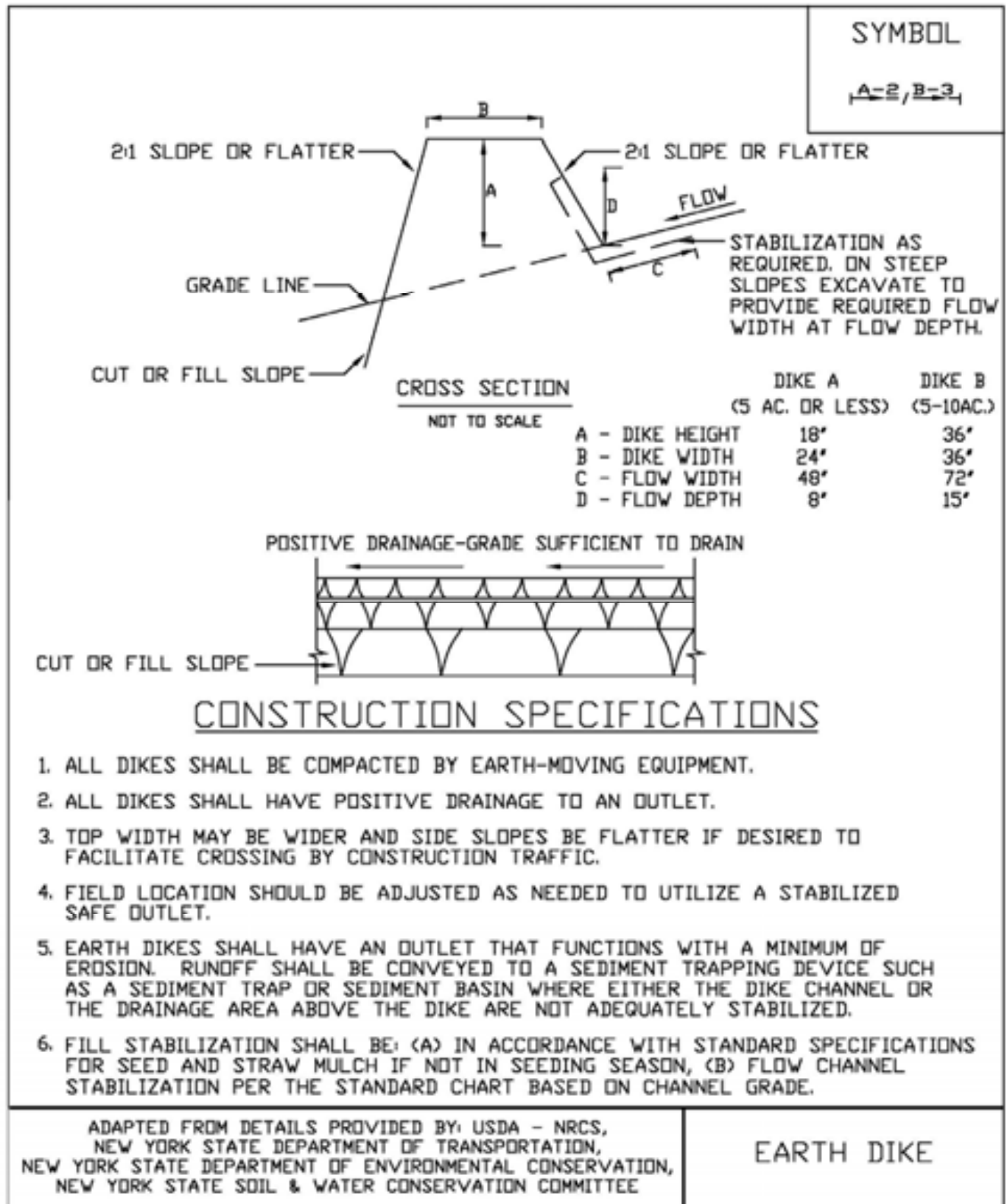
Outlet

Earth dikes shall have an outlet that functions with a minimum of erosion.

Runoff shall be conveyed to a sediment trapping device until the drainage area above the dike is adequately stabilized.

The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet.

Figure 3.5
Earth Dike Detail



STANDARD AND SPECIFICATIONS FOR FLOW DIFFUSER



Definition & Scope

A permanent non-erosive outlet for concentrated runoff constructed to diffuse flow uniformly through a stone matrix onto a stabilized area in the form of shallow, low velocity, sheet flow.

Conditions Where Practice Applies

Where sediment-free stormwater runoff can be released in low velocity sheet flow down stabilized areas without causing erosion; where the ground slope at the outlet of the diffuser is less than 30% and the runoff will not re-concentrate after release; and where construction of a flow spreader is not practicable.

Design Criteria

1. **Drainage area:** The maximum drainage area to the diffuser may not exceed 0.10 acre per foot length of the flow diffuser. The drainage area served by the diffuser discharging directly cannot be 10-20% more than half the size of the receiving buffer area.
2. **Discharge from diffuser onto receiving area:** The peak stormwater flow rate from a flow diffuser onto a receiving area from a 10-year 24-hour storm must be less than 0.25 cubic feet per second (0.25 cfs) per linear foot of weir crest length.
3. **Receiving area of buffer:** Each flow diffuser shall have a vegetated receiving area with a minimum continuous length of 150 feet and the capacity to pass the flow without erosion. The receiving area shall be stable prior to the construction of the flow diffuser. The receiving area shall have topography regular enough to

prevent undue flow concentration before entering a stable watercourse but it shall have a slope that is less than 30%. If the receiving area is not presently stable, then the receiving area shall be stabilized prior to construction of the flow diffuser. The receiving area below the flow diffuser shall be protected from harm during construction. Sodding and/or turf reinforcement mat (TRM) in combination with vegetative measures shall stabilize disturbed areas. The receiving area shall not be used by the flow diffuser until stabilization has been accomplished. A temporary diversion may be necessary in this case.

4. **Cross-section:** The minimum stone diffuser cross-section shall be trapezoidal with a height of 1 foot above natural ground; top width equal to 2 foot and side slope equal to 1 horizontal to 1 vertical. The storage area behind the diffuser shall be excavated to a depth of 1 foot and overall width of storage area equal to 6 feet minimum.
5. **Sizing the diffuser:** The length of the stone diffuser is governed by the size of the stone in the structure, the height of the diffuser, and the flow length through it. The following equation is used to establish the design of the diffuser:

$$Q_d = \frac{h^{3/4} W}{\left[\left(\frac{L}{D}\right) + 2.5 + L^2\right]^{0.5}}$$

Where:

Q_d = Outflow through the stone diffuser (cfs)

h = Ponding depth behind the diffuser (ft.)

W = Linear length of the diffuser along centerline (ft.)

L = Average horizontal flow length through the diffuser perpendicular to the centerline (ft.)

D = Average stone diameter (d_{50}) in the structure (ft.)

The maximum d_{50} size shall be 9" or 0.75'.

The designer shall calculate the length of diffuser needed depending on the geometry of the cross-section and rock size to be used recognizing that the maximum allowable discharge through the diffuser shall be 0.25 cfs per foot of length.

Once the discharge is calculated for the 10 year storm for the drainage area to the diffuser (Q_{10}) it can be divided by the design discharge of the diffuser to determine the diffuser length as follows:

$$W = \frac{Q_{10}}{Q_d}$$

Where:

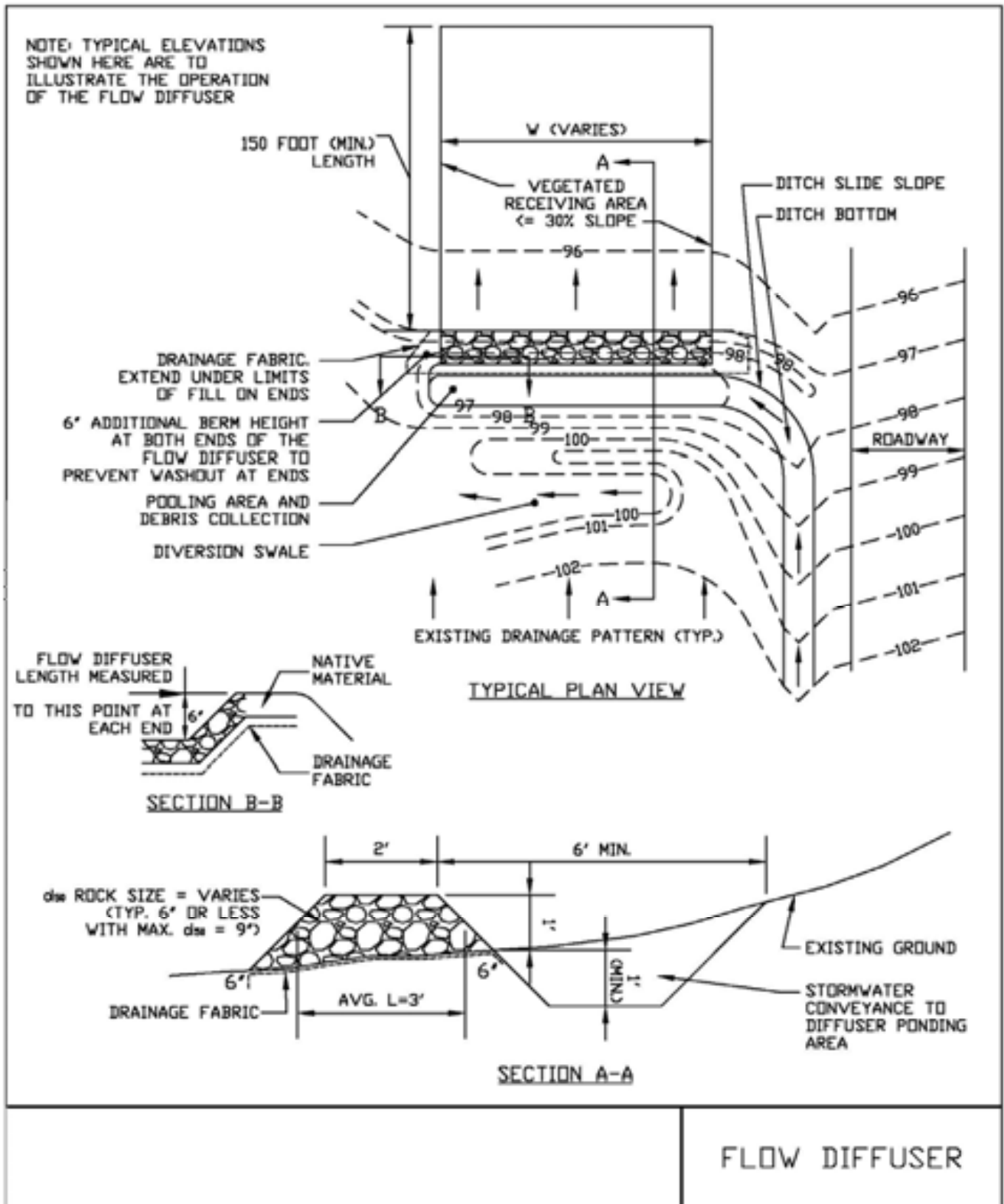
Q_d = Outflow through the stone diffuser (cfs/ft)

Q_{10} = Discharge rate for the 10 year storm (cfs)

W = Linear length of the diffuser along centerline (ft.)

Design examples are shown in Appendix B.

Figure 3.6
Flow Diffuser Detail



STANDARD AND SPECIFICATIONS FOR FLOW SPREADER



Definition & Scope

A **permanent or temporary**, non-erosive outlet for concentrated runoff, constructed to disperse concentrated flow uniformly over a hardened weir into a stabilized area as shallow, low velocity, sheet flow.

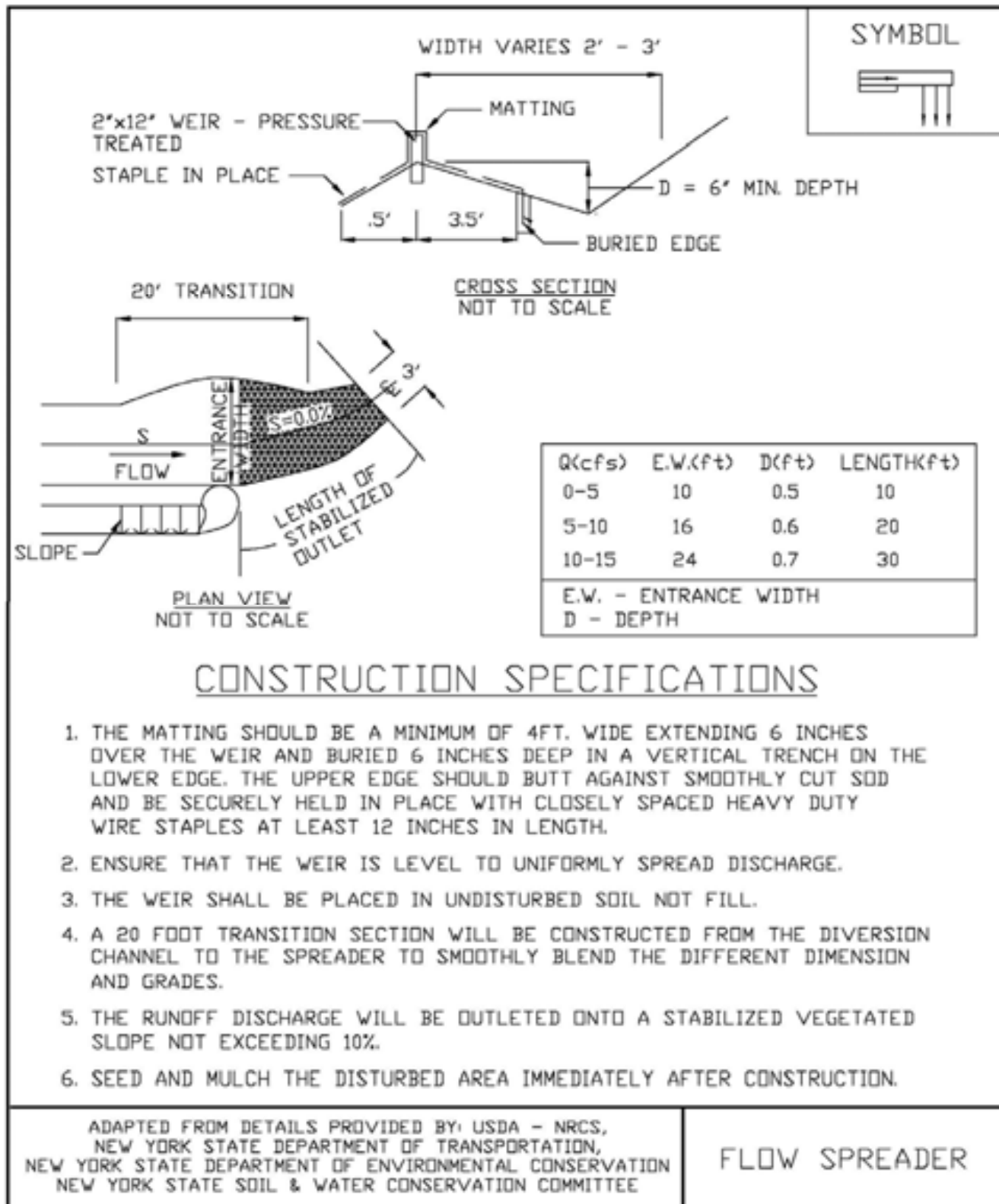
Conditions Where Practice Applies

Where sediment-free storm runoff can be released in sheet flow down a stabilized slope without causing erosion; where a hardened level weir can be constructed without filling; where the area below the weir is uniform with a slope of 10% or less and the runoff will not re-concentrate after release; and where no traffic will disturb the flow spreader.

Design Criteria

1. **Drainage area:** The maximum drainage area to the spreader may not exceed 5 acres.
2. **Discharge to a flow spreader:** The peak stormwater flow rate to a flow spreader due to runoff from a 10-year 24-hour storm must be less than 0.5 cubic feet per second (0.5 cfs) per foot length of flow spreader lip.
3. **Length of flow spreader:** The flow spreader length may not be more than 30 feet if flow is entering from one end of the spreader. Longer lengths require flow to split evenly from the center of the spreader.
4. **Receiving area of buffer:** Each flow spreader shall have a vegetated receiving area with the capacity to pass the flow without erosion. The receiving area shall be stable prior to the construction of the flow spreader. The receiving area shall have topography regular enough to prevent undue flow concentration before entering a stable watercourse but it shall have a slope that is less than 10%. If the receiving area is not presently stable, then the receiving area shall be stabilized prior to construction of the flow spreader. The receiving area below the flow spreader shall be protected from harm during construction. Sodding and/or turf reinforced mat in combination with vegetative measures shall stabilize disturbed areas. The receiving area shall not be used by the flow spreader until stabilization has been accomplished. A temporary diversion may be necessary in this case.
5. **Weir:** The weir of the flow spreader should consist of a pressure treated 2"x12" timber plank laid on edge and set at level elevation perpendicular to flow. Alternate hardened weir structures may be used as long as a hard, durable, continuous weir is maintained.
6. **Channel:** The flow spreader entrance channel shall be a minimum of 1 foot deep with a minimum 2 foot bottom width to trap sediment and reduce lateral flow velocities. Side slopes shall be 2:1 or flatter. The channel shall be constructed with a 0% grade to ensure uniform flow distribution. Velocity entering the channel shall be reduced to ensure non-erosive low approach velocity in the weir.
7. **Maintenance:** Long term maintenance of the flow spreader is essential to ensure its continued effectiveness. The following provisions should be followed. In the first year the flow spreader should be inspected semi annually and following major storm events for any signs of channelization and should be immediately repaired. After the first year, annual inspection should be sufficient. Spreaders constructed of wood, asphalt, stone or concrete curbing require periodic inspection to check for damage and to be repaired as needed.
 - A. **Inspections:** At least once a year, the spreader pool should be inspected for sand accumulation and debris that may reduce capacity.
 - B. **Maintenance Access:** Flow spreaders should be sited to provide easy access for removal of accumulated sediment and rehabilitation of the berm.
 - C. **Debris Removal:** Debris buildup within the channel should be removed when it has accumulated to approximately 10 to 20% of design volume or channel capacity. Remove debris such as leaf litter, branches, tree growth and any sediment build-up from the spreader and dispose of appropriately.
 - D. **Mowing:** Vegetated spreaders may require mowing.

Figure 3.7
Flow Spreader Detail



STANDARD AND SPECIFICATIONS FOR GRADE STABILIZATION STRUCTURE



Definition & Scope

A **permanent** structure to stabilize the grade or to control head cutting in artificial channels by reduction of velocities and grade in the watercourse or by providing channel linings or structures that can withstand the higher velocities.

Conditions Where Practice Applies

This practice applies to sites where the capability of earth and vegetative measures is exceeded in the safe handling of water at permissible velocities, where excessive grades or overfall conditions are encountered, or where water is to be lowered structurally from one elevation to another. These structures should generally be planned and installed along with, or as a part of, other practices in an overall surface water management system.

Design Criteria

Compliance with Laws and Regulations

Design and construction shall be in compliance with state and local laws and regulations. Such compliance is the responsibility of the landowner or developer.

General

Designs and specifications shall be prepared for each structure on an individual job basis depending on its purpose, site conditions, and the basic criteria of the conservation practice with which the structure is planned. Typical structures are as follows:

1. Channel linings of concrete, asphalt, half round metal pipe or other suitable lining materials. These linings should generally be used where channel velocities ex-

ceed safe velocities for vegetated channels due to increased grade or a change in channel cross section or where durability of vegetative lining is adversely affected by seasonal changes. Adequate protection will be provided to prevent erosion or scour of both ends of the channel lining.

2. Overfall structures of concrete, metal, rock riprap, or other suitable material is used to lower water from one elevation to another. These structures are applicable where it is desirable to drop the watercourse elevation over a very short horizontal distance. Adequate protection will be provided to prevent erosion or scour upstream, downstream and along sides of overfall structures. Structures should be located on straight sections of channel with a minimum of 100 feet of straight channel each way.
3. Pipe drops of metal pipe with suitable inlet and outlet structures. The inlet structure may consist of a vertical section of pipe or similar material, an embankment, or a combination of both. The outlet structure will provide adequate protection against erosion or scour at the pipe outlet.

Capacity

Structures that are designed to operate in conjunction with other erosion control practices shall have, as a minimum, capacity equal to the bankfull capacity of the channel delivering water to the structures. The minimum design capacity for structures that are not designed to perform in conjunction with other practices shall be that required to handle the peak rate of flow from a 10-year, 24-hour frequency storm or bankfull, whichever is greater. Peak rates of runoff used in determining the capacity requirements shall be determined by appropriate methods.

Set the rest of the structure at an elevation that will stabilize the grade of the upstream channel. The outlet should be set at an elevation to assure stability. Outlet velocities should be kept within the allowable limits for the receiving stream. Structural drop spillways need to include a foundation drainage system to reduce hydrostatic loads.

Permanent structures which involve the retarding of floodwater or the impoundment of water shall be designed using the criteria set forth in the New York State DEC Guidelines for the Design of Dams.

Construction Specifications

Structures shall be installed according to lines and grades shown on the plan. The foundation for structures shall be cleared of all undesirable materials prior to the installation of the structure. Materials used in construction shall be in conformance with the design frequency and life expectancy of the practice. Earth fill, when used as a part of the structure, shall be placed in 4-inch lifts and hand compacted within 2 feet of the structure.

Seeding, fertilizing, and mulching shall conform to the applicable standards and specifications in Section 4.

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

Locate emergency bypass areas so that floods in excess of structural capacity enter the channel far enough downstream so as not to cause damage to the structure.

Maintenance

Once properly installed, the maintenance for the grade stabilization structure should be minimal. Inspect the structure periodically and after major storm events. Check fill for piping or extreme settlement. Ensure a good vegetative cover. Check the channel for scour or debris and loss of rock from aprons. Repair or replace failing structures immediately.

STANDARD AND SPECIFICATIONS FOR GRASSED WATERWAY



Definition & Scope

A natural or **permanent** man-made channel of parabolic or trapezoidal cross-section that is below adjacent ground level and is stabilized by suitable vegetation. The flow channel is normally wide and shallow and conveys the runoff down the slope without causing damage by erosion.

Conditions Where Practice Applies

Grass waterways are used where added vegetative protection is needed to control erosion resulting from concentrated runoff.

Design Criteria

Capacity

The minimum capacity shall be that required to confine the peak rate of runoff expected from a 10-year 24 hour frequency rainfall event or a higher frequency corresponding to the hazard involved. This requirement for confinement may be waived on slopes of less than one (1) percent where out-of-bank flow will not cause erosion or property damage.

Peak rates of runoff values used in determining the capacity requirements shall be computed by appropriate methods. Where there is base flow, it shall be handled by a stone center, subsurface drain, or other suitable means since sustained wetness usually prevents adequate vegetative cover. The cross-sectional area of the stone center or subsurface drain size to be provided shall be determined by using a flow rate of 0.1 cfs/acre or by actual measurement of the maximum base flow.

Velocity

Please see Table 3.1, Diversion Maximum Permissible Design Velocities on page 3.10, for seed, soil, and velocity variables.

Cross Section

The design water surface elevation of a grassed waterway receiving water from diversions or other tributary channels shall be equal to or less than the design water surface elevation in the diversion or other tributary channels.

The top width of parabolic waterways shall not exceed 30 feet and the bottom width of trapezoidal waterways shall not exceed 15 feet unless multiple or divided waterways, stone center, or other means are provided to control meandering of low flows.

Structural Measures

In cases where grade or erosion problems exist, special control measures may be needed such as lined waterways (see page 3.27), or grade stabilization measures (see page 3.21). Where needed, these measures will be supported by adequate design computations. For typical cross sections of waterways with riprap sections or stone centers, refer to Figure 3.8 on page 3.24.

The design procedures for parabolic and trapezoidal channels are available in the NRCS Engineering Field Handbook. Figure 3.9 on page 3.25 also provides a design chart for parabolic waterway.

Outlets

Each waterway shall have a stable outlet. The outlet may be another waterway, a stabilized open channel, grade stabilization structure, etc. In all cases, the outlet must discharge in such a manner as not to cause erosion. Outlets shall be constructed and stabilized prior to the operation of the waterway.

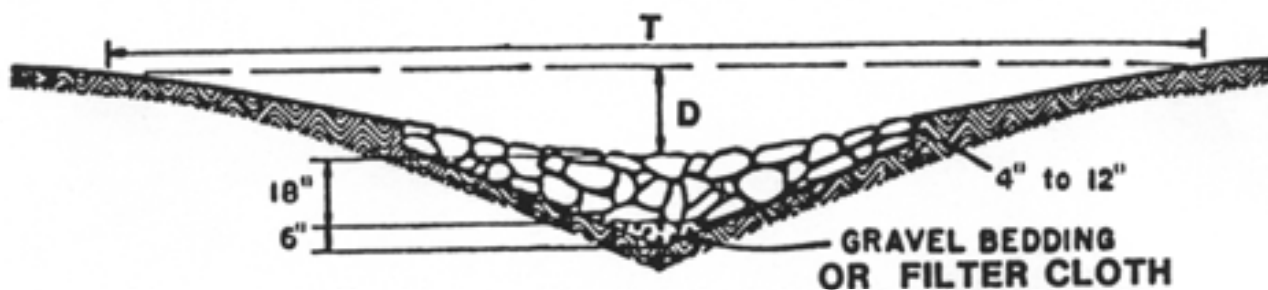
Stabilization

Waterways shall be stabilized in accordance with the appropriate vegetative stabilization standard and specifications, and will be dependent on such factors as slope, soil class, etc. See standard for Vegetating Waterways on Page 4.78.

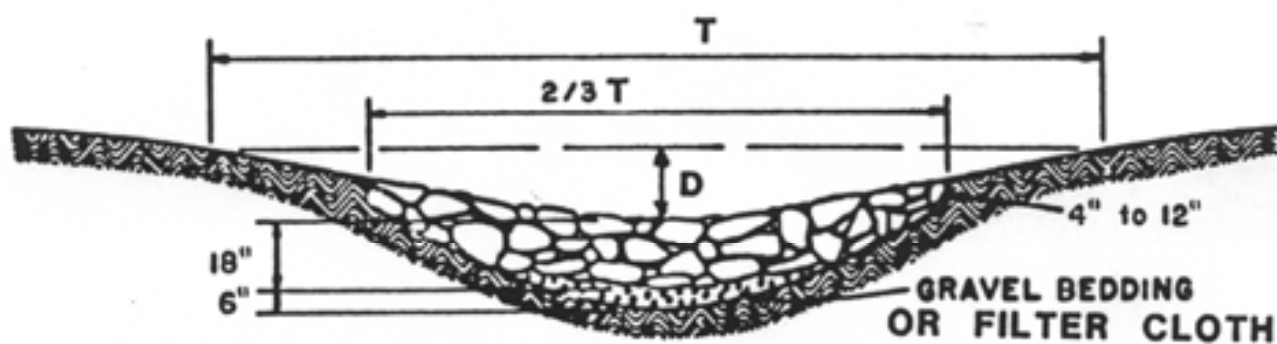
Construction Specifications

See Figure 3.10 on page 3.26 for details.

Figure 3.8
Typical Waterway Cross Sections Details



Waterway with stone center drain. "V"
 section shaped by motor grader.



Waterway with stone center drain.
 Rounded section shaped by bulldozer.

Figure 3.9
Parabolic Waterway Design Chart (USDA - NRCS)

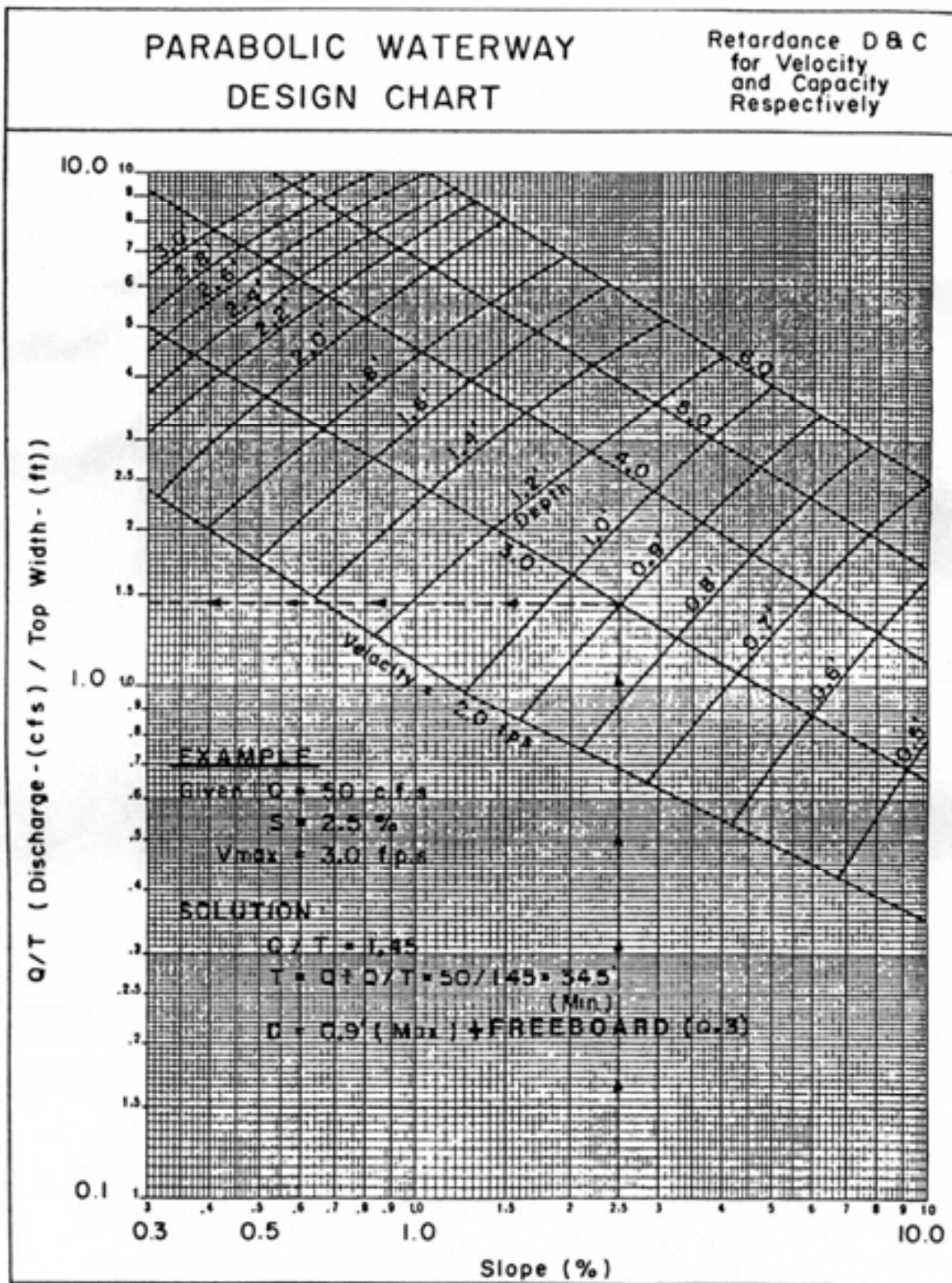
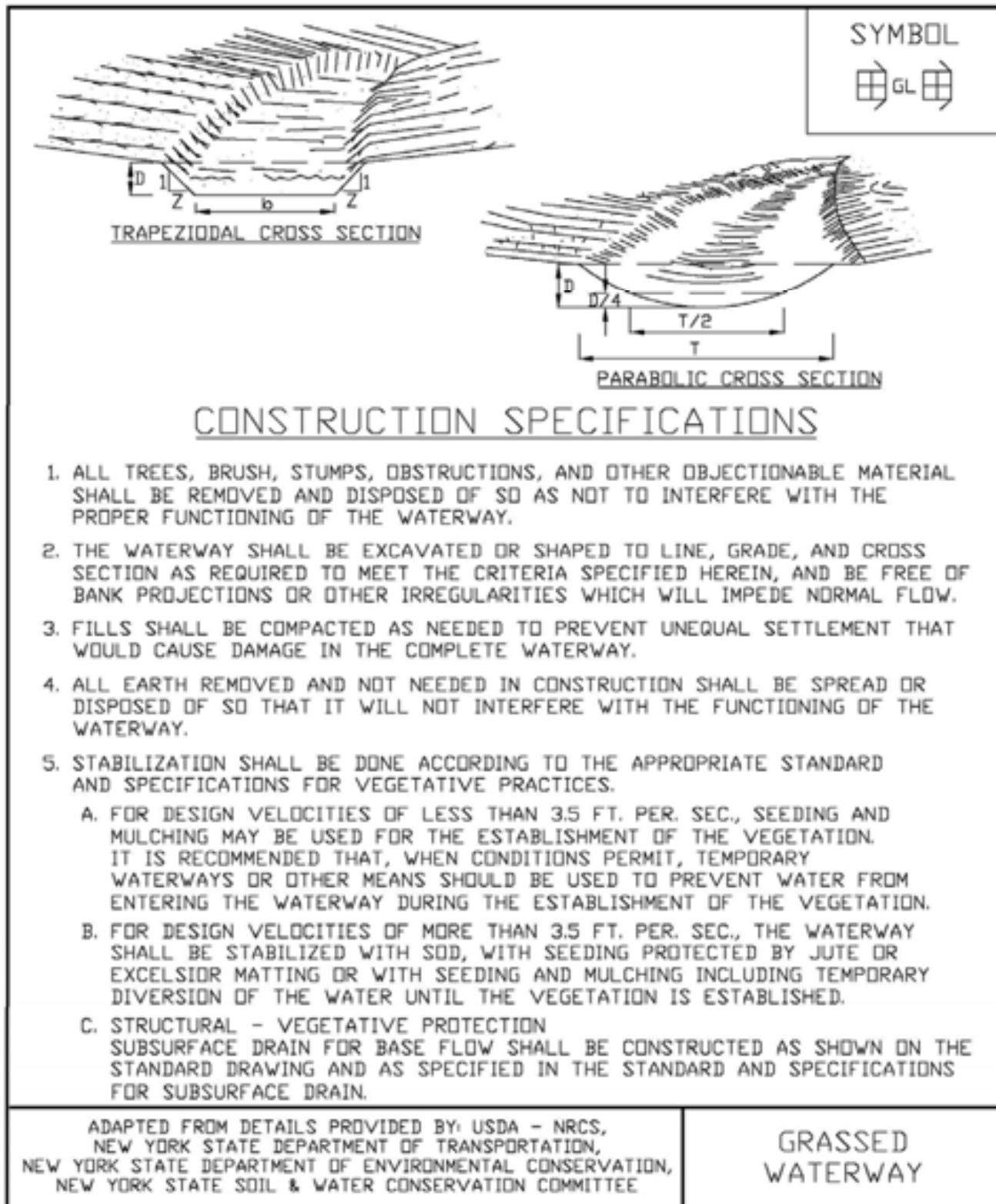


Figure 3.10
Grassed Waterway Detail



STANDARD AND SPECIFICATIONS FOR LINED WATERWAY



Definition & Scope

A **permanent** waterway or outlet with a lining of concrete, stone, or other durable, hardened material. The lined section extends up the side slopes to the designed depth. The earth above the permanent lining may be vegetated or otherwise protected.

The lined waterway is constructed to provide for the disposal of concentrated runoff without damage from erosion or flooding, where grassed waterways would be inadequate due to high velocities.

Conditions Where Practice Applies

This standard applies to waterways or outlets with linings of cast-in-place concrete, flagstone mortared in place, rock riprap, gabions, or similar permanent linings. It does not apply to irrigation ditch or canal linings, grassed waterways with stone centers or small lined sections that carry prolonged low flows, or to reinforced concrete channels. Lined waterways should not be used if they are directly discharging to C(T) or higher streams unless thermal impacts are mitigated by biotechnical practices (Section 4). The maximum capacity of the waterway flowing at design depth shall not exceed 100 cubic feet per second.

This practice applies where the following or similar conditions exist:

1. Concentrated runoff is such that a lining is required to control erosion.
2. Steep grades, wetness, prolonged base flow, seepage, or piping that would cause erosion.
3. The location is such that damage from use by people or animals precludes use of vegetated waterways or out-

lets.

4. Soils are highly erosive or other soil and climate conditions preclude using vegetation.
5. High value property or adjacent facilities warrant the extra cost to contain design runoff in a limited space.

Design Criteria

Capacity

1. The minimum capacity shall be adequate to carry the peak rate of runoff from a 10-year, 24-hour storm. Velocity shall be computed using Manning's equation with a coefficient of roughness "n" as follows:

Lined Material	"n"
Concrete (Type):	
Trowel Finish	0.015
Float Finish	0.019
Gunitite	0.019
Flagstone	0.022
Riprap	Determine from Figure 3.11 on page 3.30
Gabion	0.030

2. Riprap gradation and filter (bedding) are generally designed in accordance with criteria set forth in the National Cooperative Highway Research Program Report 108, available from the University Microfilm International, 300 N. Zeeb Road, Ann Arbor, Michigan 48106, Publication No. PB-00839; or the Hydraulic Engineering Circular No. 11, prepared by the U.S. Bureau of Public Roads, available from Federal Highway Administration, 400 7th Street, S.W., Washington, D.C. 20590, HNG-31, or the procedure in the USDA-NRCS's Engineering Field Manual, Chapter 16.

Velocity

1. Maximum design velocity shall be as shown below. Except for short transition sections, flow with a channel gradient within the range of 0.7 to 1.3 of this flow's critical slope must be avoided unless the channel is straight. Velocities exceeding critical will be restricted to straight reaches.

Design Flow Depth (ft.)	Maximum Velocity (ft./sec.)
0.0 - 0.5	25
0.5 - 1.0	15
Greater than 1.0	10

- Waterways or outlets with velocities exceeding critical shall discharge into an energy dissipater to reduce velocity to less than critical, or to a velocity the downstream soil and vegetative conditions will allow.

Cross Section

The cross section shall be triangular, parabolic, or trapezoidal. Monolithic concrete or gabions may be rectangular.

Freeboard

The minimum freeboard for lined waterways or outlets shall be 0.25 feet above design high water in areas where erosion resistant vegetation cannot be grown adjacent to the paved side slopes. No freeboard is required where good vegetation can be grown and is maintained.

Side Slope

Steepest permissible side slopes, horizontal to vertical will be as follows:

- Non-Reinforced Concrete
 - Hand-placed, formed concrete
 - Height of lining, 1.5 ft or less Vertical
 - Hand placed screened concrete or mortared
 - In-place flagstone
 - Height of lining, less than 2 ft 1 to 1
 - Height of lining, more than 2 ft 2 to 1
- Slip form concrete:
 - Height of lining, less than 3 ft 1 to 1
- Rock Riprap 2 to 1
- Gabions Vertical
- Pre-cast Concrete Sections Vertical

Lining Thickness

Minimum lining thickness shall be as follows:

- Concrete 4 in. (In most problem areas, shall be 5 in. with welded wire fabric reinforcing)
- Rock Riprap 1.5 x maximum stone size plus thickness of filter or bedding.
- Flagstone 4 in. including mortar bed.

Related Structures

Side inlets, drop structures, and energy dissipaters shall meet the hydraulic and structural requirements of the site.

Filters or Bedding

Filters or bedding to prevent piping, reduce uplift pressure, and collect water will be used as required and will be designed in accordance with sound engineering principles. Weep holes and drains should be provided as needed.

Concrete

Concrete used for lining shall be so proportioned that it is plastic enough for thorough consolidation and stiff enough to stay in place on side slopes. A dense product will be required. A mix that can be certified as suitable to produce a minimum strength of at least 3,000 pounds per square inch will be required. Cement used shall be Portland Cement, Type I, II, IV, or V. Aggregate used shall have a maximum diameter of 1 ½ inches.

Weep holes should be provided in concrete footings and retaining walls to allow free drainage of water. Pipe used for weep holes shall be non-corrosive.

Mortar

Mortar used for mortared in-place flagstone shall consist of a mix of cement, sand, and water. Follow directions on the bag of mortar for proper mixing of mortar and water.

Contraction Joints

Contraction joints in concrete linings, where required, shall be formed transversely to a depth of about one third the thickness of the lining at a uniform spacing in the range of 10 to 15 feet.

Rock Riprap or Flagstone

Stone used for riprap or gabions shall be dense and hard enough to withstand exposure to air, water, freezing, and thawing. Flagstone shall be flat for ease of placement and have the strength to resist exposure and breaking. Rock riprap maximum size shall be as follows:

Velocity (f.p.s.)	d _{max} (in.)
5.0	6
8.5	12
10	18
12	24
15	36

A complete listing riprap gradations is provided in Table 4.1, page 4.9.

Cutoff Walls

Cutoff walls shall be used at the beginning and ending of concrete lining. For rock riprap lining, cutoff walls shall be keyed into the channel bottom and at both ends of the lining.

Construction Specifications

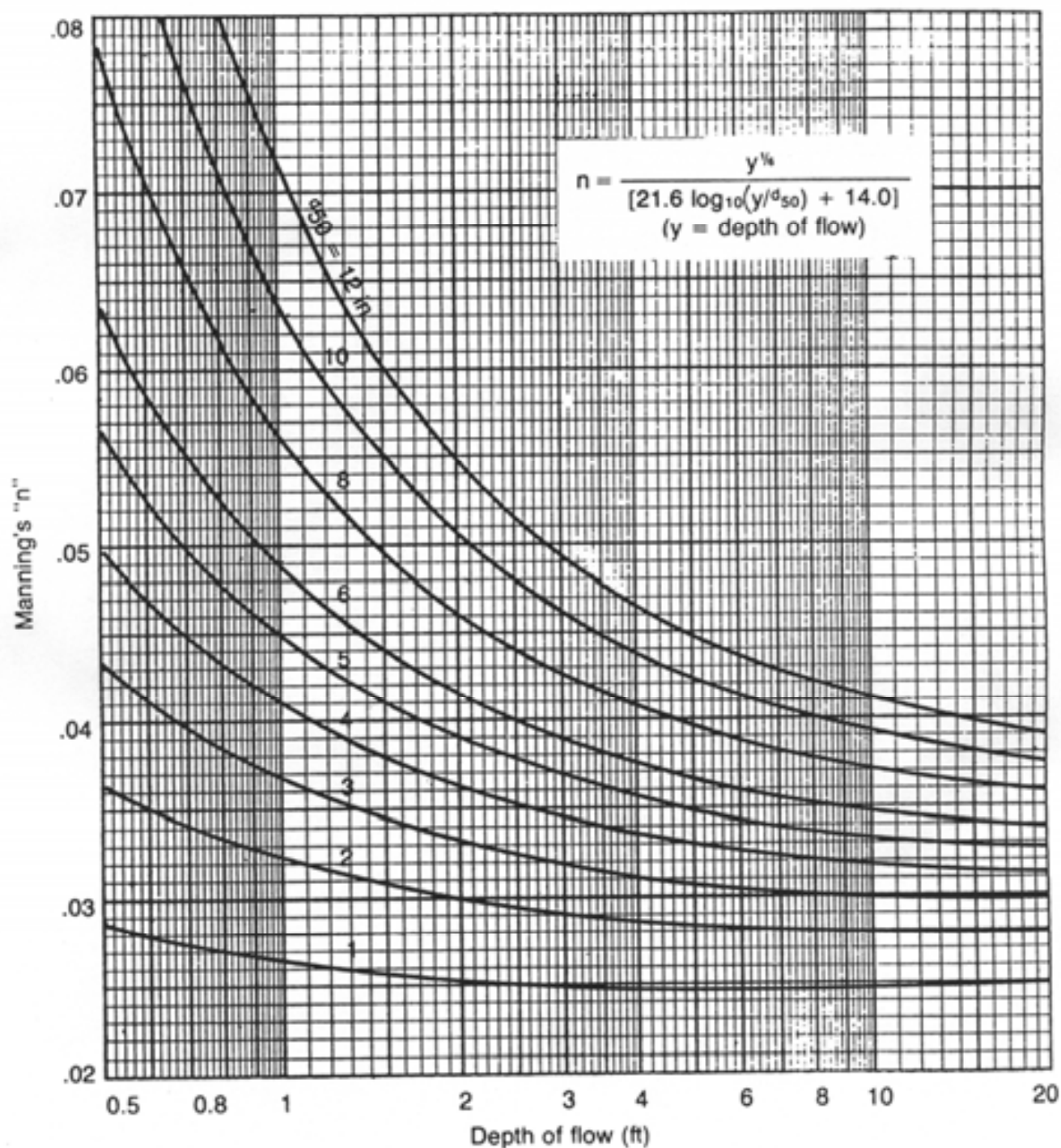
1. The foundation area shall be cleared of trees, stumps, roots, sod, loose rock, or other objectionable material.
2. The cross-section shall be excavated to the neat lines and grades as shown on the plans. Over-excavated areas shall be backfilled with moist soil compacted to the density of the surrounding material.
3. No abrupt deviations from design grade or horizontal alignment shall be permitted.
4. Concrete linings shall be placed to the thickness shown on the plans and trowel finished. Adequate precautions shall be taken to protect freshly placed concrete from extreme (hot or cold) temperatures, to ensure proper curing.
5. Filter bedding and rock riprap shall be placed to line and grade in the manner specified.
6. Construction operation shall be done in such a manner that erosion, air pollution, and water pollution will be minimized and held within legal limits. The completed job shall meet all design requirements for the appropriate finish. All disturbed areas shall be vegetated or otherwise protected against soil erosion.

Maintenance

Pavement or lining should be maintained as built to prevent undermining and deterioration. Existing trees next to pavements should be removed, as roots can cause uplift damage.

Vegetation next to pavement should be maintained in good condition to prevent scouring if the pavement is overtopped. See Standard and Specifications for Permanent Construction Area Planting on page 4.42.

Figure 3.11
Determining “n” for Riprap Lined Channel using Depth of Flow Chart
 (USDA - NRCS)



STANDARD AND SPECIFICATIONS FOR PAVED FLUME



Definition & Scope

A **permanent** small concrete-lined channel to convey water from a higher to a lower elevation in a short distance such as down the face of a cut or fill slope without causing erosion. Due to potential thermal impacts and the creation of fish migration barriers, paved flumes shall not be used for direct discharges to C(T) or higher streams.

Condition Where Practice Applies

Where concentrated storm runoff must be conveyed down a cut or fill slope as part of a permanent erosion control system. Paved flumes serve as stable outlets for diversions, drainage channels, or natural drainageways, that are located above relatively steep slopes. Paved flumes should be used on slopes of 1.5 to 1 or flatter.

Design Criteria

Capacity – Minimum capacity should be the 10-year frequency storm. Freeboard or enough bypass capacity should be provided to safeguard the structure from peak flows expected for the life of the structure.

Slope – The slope should not be steeper than 1.5:1 (67%).

Cutoff Walls – Install cutoff walls at the beginning and end of paved flumes. The cutoff should extend a minimum of 18 inches into the soil and across the full width of the flume and be 6 inches thick. Cutoff walls should be reinforced with #3 reinforcing bars (3/8") placed on a 6-inch grid in the center of the wall.

Anchor Lugs – Space anchor lugs a minimum of 10 feet on centers for the length of the flume. They will extend the width of the flume, extend 1 foot into subsoil, be a minimum of 6 inches thick, and be reinforced with #3 reinforcing

ing bars placed on a 6-inch grid.

Concrete – Minimum strength of design mix shall be 3000 psi. Concrete thickness shall be a minimum of 6 inches reinforced with #3 reinforcing bars. Mix shall be dense, durable, stiff enough to stay in place on steep slopes, and sufficiently plastic for consolidation. Concrete mix should include an air-entraining admixture to resist freeze-thaw cycles.

Cross Section – Flumes shall have minimum depth of 1 foot with 1.5:1 side slopes. Bottom widths shall be based on maximum flow capacity. Chutes will be maintained in a straight alignment because of supercritical flow velocities.

Drainage filters – Use a drainage filter with all paved flumes to prevent piping and reduce uplift pressures. Size of the filter material will be dependent on the soil material the flume is located in.

Inlet Section – Design the inlet to the following minimum dimensions: side walls 2 feet high, length 6 feet, width equal to the flume channel bottom, and side slopes the same as the flume channel side slopes.

Outlet Section – Outlets must be protected from erosion. Usually an energy dissipater is used to reduce the high chute velocities to lower non-erosive velocities. Rock riprap should be placed at the end of the dissipater to spread flow evenly to the receiving channel.

See Figure 3.12 on page 3.33 for examples of outlet structures.

Invert – Precast concrete sections may be used in lieu of cast in place concrete. The sections should be designed at the joint to be overlapped to prevent displacement between sections. Joint sealing compound should be used to prevent migration of soil through a joint. Cutoff walls and anchor lugs should be cast in the appropriate sections to accommodate the design criteria.

Small Flumes – Where the drainage area is 10 acres or less, the design dimensions for concrete flumes may be selected from those shown in the table on the following page:

	Drainage Area (Acres)	
	<u>5</u>	<u>10</u>
Min. Bottom Width (ft.)	4	8
Min. Inlet Depth (ft.)	2	2
Min. Channel Depth (ft.)	1.3	1.3
Max. Channel Slope	1.5:1	1.5:1
Max. Side Slope	1.5:1	1.5:1

See Figure 3.13 on page 3.34 for details.

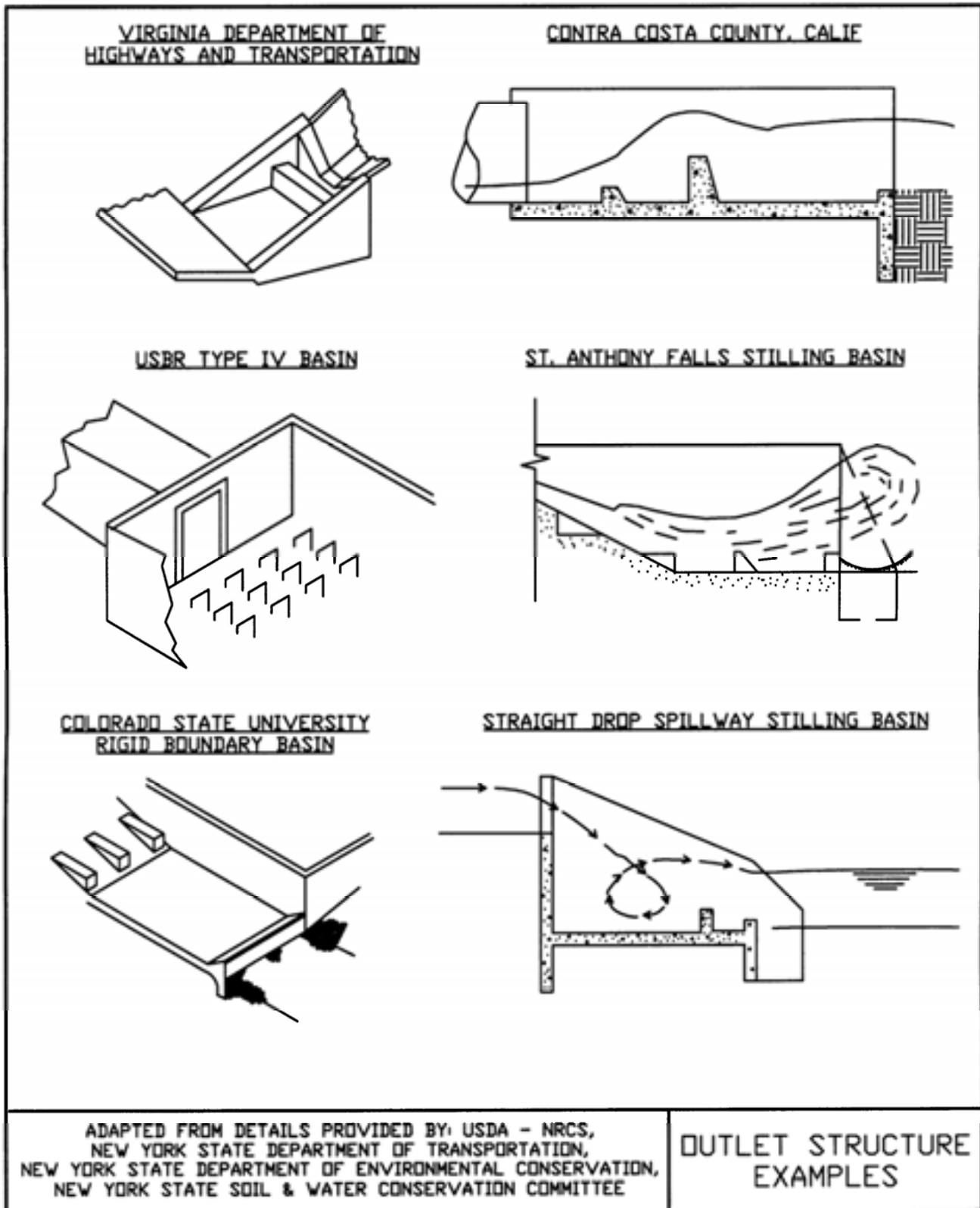
Construction Specifications

1. The subgrade shall be constructed to the lines and grades shown on the plans. Remove all unsuitable material and replace them if necessary with compacted stable fill materials. Shape subgrade to uniform surface. Where concrete is poured directly on subsoil, maintain it in a moist condition.
2. On fill slopes, the soil adjacent to the chute, for a minimum of 5 feet, must be well compacted.
3. Where drainage filters are placed under the structure, the concrete will not be poured on the filter. A plastic liner, a minimum of 4 mils thick, will be placed to prevent contamination of filter layer.
4. Place concrete for the flume to the thickness shown on the plans and finish according to details. Protect freshly poured concrete from extreme temperatures (hot or cold) and ensure proper curing.
5. Form, reinforce, and pour together cutoff walls, anchor lugs and channel linings. Provide traverse joints to control cracking at 20-foot intervals. Joints can be formed by using a 1/8 inch thick removable template or by sawing to a minimum depth of 1 inch. Flumes longer than 50 feet shall have preformed expansion joints installed.
6. Immediately after construction, all disturbed areas will be final graded and seeded.

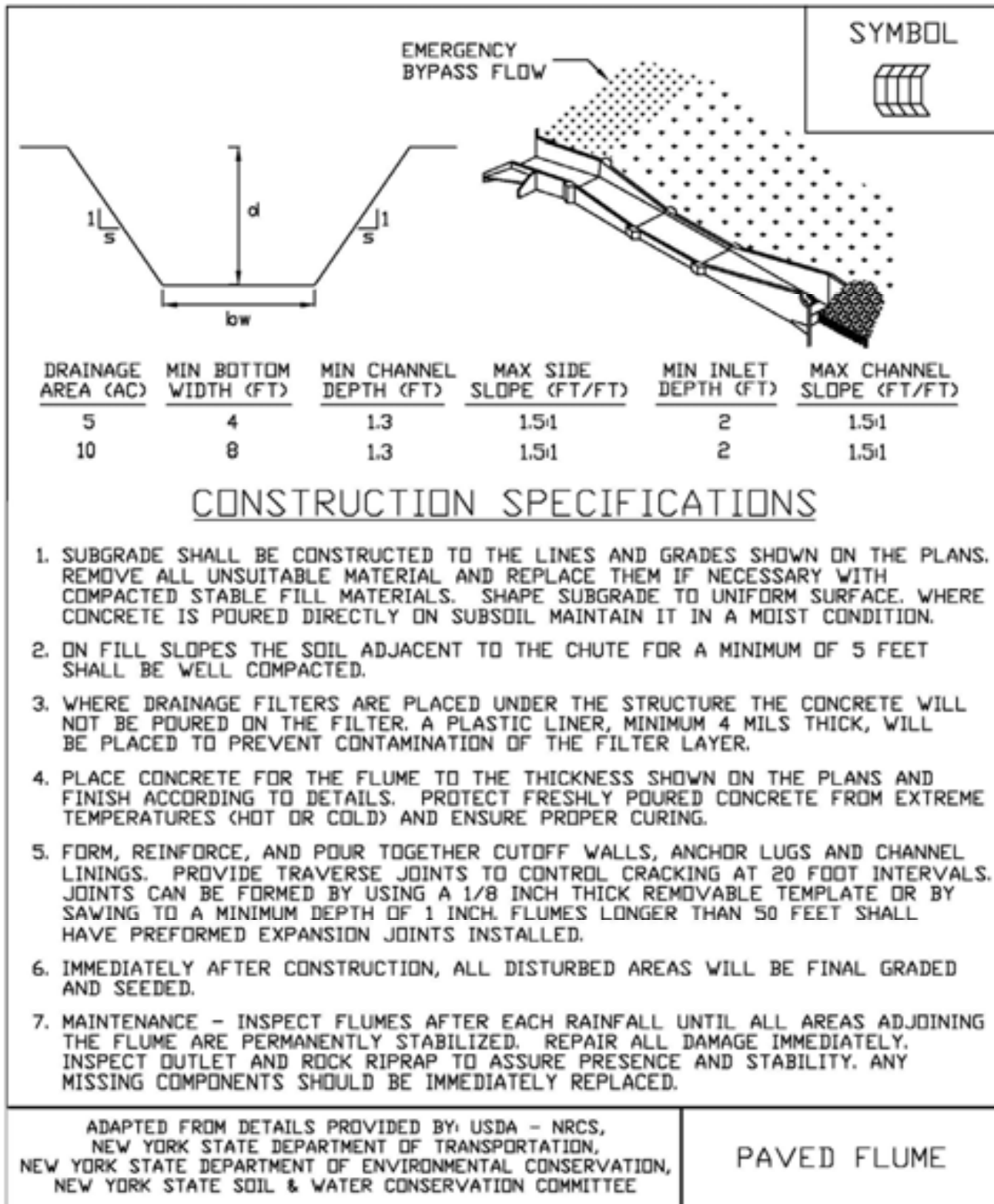
Maintenance

Inspect flumes after each rainfall until all areas adjoining the flume are permanently stabilized. Repair all damage immediately. Inspect outlet and rock riprap to assure presence and stability. Any missing components should be immediately replaced.

Figure 3.12
Examples of Outlet Structures



**Figure 3.13
Paved Flume Detail**



STANDARD AND SPECIFICATIONS FOR PERIMETER DIKE/SWALE



Definition & Scope

A **temporary** ridge of soil formed by excavating an adjoining swale located along the perimeter of the site or disturbed area. Its purpose is to prevent off site storm runoff from entering a disturbed area and to prevent sediment laden storm runoff from leaving the construction site or disturbed area.

Conditions Where Practice Applies

Perimeter dike/swale is constructed to divert flows from entering a disturbed area, or along tops of slopes to prevent flows from eroding the slope, or along base of slopes to direct sediment laden flows to a trapping device.

The perimeter dike/swale shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.14 on page 3.36 for details.

The perimeter dike/swale shall not be constructed outside property lines or setbacks without obtaining legal easements from affected adjacent property owners. A design is not required for perimeter dike/swale. The following criteria shall be used:

Drainage area – Less than 2 acres (for drainage areas larger than 2 acres but less than 10 acres, see earth dike or construction ditch; for drainage areas larger than 10 acres, see standard and specifications for diversion).

Height – 18 inches minimum from bottom of swale to top of dike evenly divided between dike height and swale depth.

Bottom width of dike – 2 feet minimum.

Width of swale – 2 feet minimum.

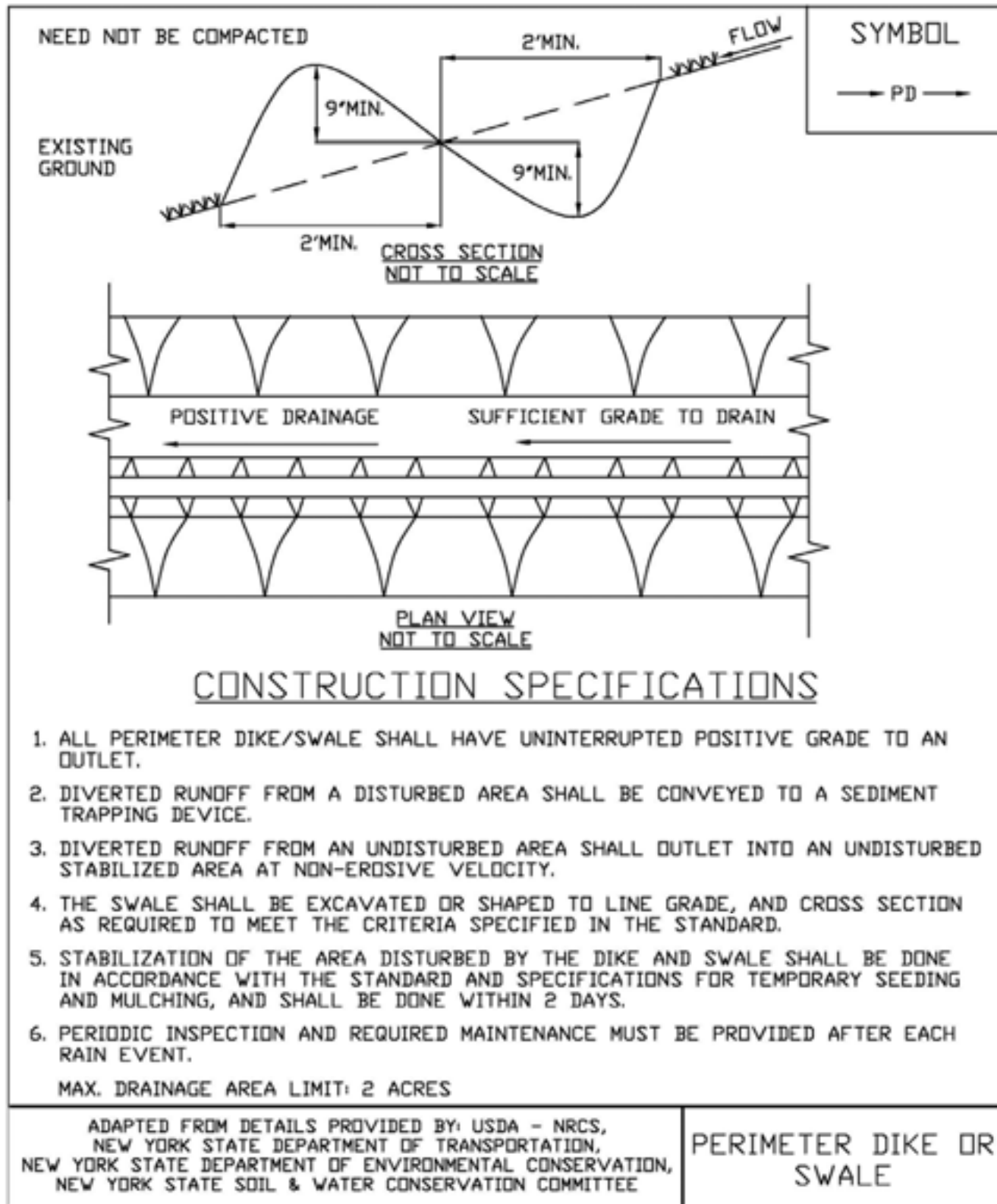
Grade – Dependent upon topography, but shall have positive drainage (sufficient grade to drain) to an adequate outlet. Maximum allowable grade not to exceed 8 percent.

Stabilization – The disturbed area of the dike and swale shall be stabilized within 2 days of installation, in accordance with the standard and specifications for construction ditch (page 3.4).

Outlet

1. Perimeter dike/swale shall have a stabilized outlet.
2. Diverted runoff from a protected or stabilized upland area shall outlet directly onto an undisturbed stabilized area.
3. Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment trapping device such as a sediment trap, sediment basin, or to an area protected by any of these practices.
4. The on-site location may need to be adjusted to meet field conditions in order to utilize the most suitable outlet.

Figure 3.14
Perimeter Dike/Swale Detail



STANDARD AND SPECIFICATIONS FOR PIPE SLOPE DRAIN



Definition & Scope

A **temporary** structure placed from the top of a slope to the bottom of a slope to convey surface runoff down slopes without causing erosion.

Conditions Where Practice Applies

Pipe slope drains are used where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion. The maximum allowable drainage area shall be 3.5 acres.

Design Criteria

See Figure 3.15 on page 3.38 for details.

General

Size	Pipe/Tubing Diameter (in.)	Maximum Drainage Area (Ac.)
PSD-12	12	0.5
PSD-18	18	1.5
PSD-21	21	2.5
PSD-24	24	3.5

Inlet

The minimum height of the containment dike at the entrance to the pipe slope drain shall be the diameter of the pipe (D) plus 12 inches.

Outlet

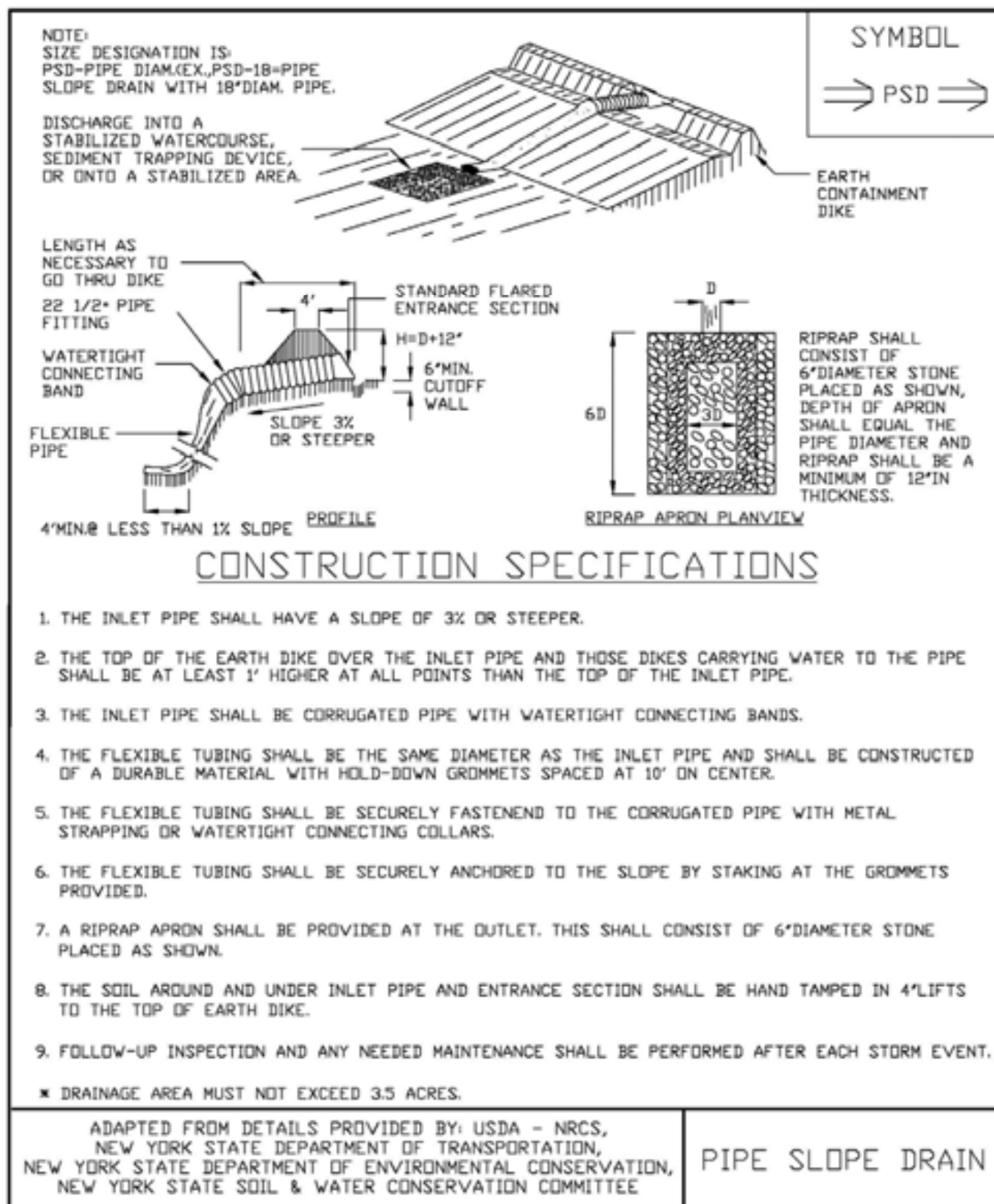
The pipe slope drain shall outlet into a sediment trapping

device when the drainage area is disturbed. A riprap apron shall be installed at all pipe outlet locations where water is being discharged.

Construction Specifications

1. The pipe slope drain shall have a slope of 3 percent or steeper.
2. The top of the containment dike over the inlet pipe, and those dikes carrying water to the pipe, shall be at least one (1) foot higher at all points than the top of the inlet pipe.
3. Corrugated plastic pipe or equivalent shall be used with watertight connecting bands.
4. A flared end section shall be attached to the inlet end of pipe with a watertight connection.
5. The soil around and under the pipe and end section shall be hand tamped in 4 in. lifts to the top of the earth dike.
6. Where flexible tubing is used, it shall be the same diameter as the inlet pipe and shall be constructed of a durable material with hold down grommets spaced 10 ft. on centers.
7. The flexible tubing shall be securely fastened to the corrugated plastic pipe with metal strapping or watertight connecting collars.
8. The flexible tubing shall be securely anchored to the slope by staking at the grommets provided.
9. Where a pipe slope drain outlets into a sediment trapping device, it shall discharge at the riser crest or weir elevation.
10. A riprap apron shall be used at all pipe outlet locations. See Figure 3.15 on page 3.38 .
11. Inspection and any needed maintenance shall be performed after each storm event.

Figure 3.15
Pipe Slope Drain Detail



STANDARD AND SPECIFICATIONS FOR ROCK OUTLET PROTECTION



Definition & Scope

A **permanent** section of rock protection placed at the outlet end of the culverts, conduits, or channels to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.

Conditions Where Practice Applies

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

1. Culvert outlets of all types.
2. Pipe conduits from all sediment basins, dry storm water ponds, and permanent type ponds.
3. New channels constructed as outlets for culverts and conduits.

Design Criteria

The design of rock outlet protection depends entirely on the location. Pipe outlet at the top of cuts or on slopes steeper than 10 percent, cannot be protected by rock aprons or riprap sections due to re-concentration of flows and high velocities encountered after the flow leaves the apron.

Many counties and state agencies have regulations and design procedures already established for dimensions, type and size of materials, and locations where outlet protection is required. Where these requirements exist, they shall be followed.

Tailwater Depth

The depth of tailwater immediately below the pipe outlet

must be determined for the design capacity of the pipe. If the tailwater depth is less than half the diameter of the outlet pipe, and the receiving stream is wide enough to accept divergence of the flow, it shall be classified as a Minimum Tailwater Condition; see Figure 3.16 on page 3.42 as an example. If the tailwater depth is greater than half the pipe diameter and the receiving stream will continue to confine the flow, it shall be classified as a Maximum Tailwater Condition; see Figure 3.17 on page 3.43 as an example. Pipes which outlet onto flat areas with no defined channel may be assumed to have a Minimum Tailwater Condition; see Figure 3.16 on page 3.42 as an example.

Apron Size

The apron length and width shall be determined from the curves according to the tailwater conditions:

Minimum Tailwater – Use Figure 3.16 on page 3.42

Maximum Tailwater – Use Figure 3.17 on page 3.43

If the pipe discharges directly into a well defined channel, the apron shall extend across the channel bottom and up the channel banks to an elevation one foot above the maximum tailwater depth or to the top of the bank, whichever is less.

The upstream end of the apron, adjacent to the pipe, shall have a width two (2) times the diameter of the outlet pipe, or conform to pipe end section if used.

Bottom Grade

The outlet protection apron shall be constructed with no slope along its length. There shall be no overfall at the end of the apron. The elevation of the downstream end of the apron shall be equal to the elevation of the receiving channel or adjacent ground.

Alignment

The outlet protection apron shall be located so that there are no bends in the horizontal alignment.

Materials

The outlet protection may be done using rock riprap, grouted riprap, or gabions. Outlets constructed on the bank of a stream or wetland shall not use grouted rip-rap, gabions or concrete.

Riprap shall be composed of a well-graded mixture of rock size so that 50 percent of the pieces, by weight, shall be larger than the d_{50} size determined by using the charts. A

well-graded mixture, as used herein, is defined as a mixture composed primarily of larger rock sizes, but with a sufficient mixture of other sizes to fill the smaller voids between the rocks. The diameter of the largest rock size in such a mixture shall be 1.5 times the d_{50} size.

Thickness

The minimum thickness of the riprap layer shall be 1.5 times the maximum rock diameter for d_{50} of 15 inches or less; and 1.2 times the maximum rock size for d_{50} greater than 15 inches. The following chart lists some examples:

D₅₀ (inches)	d_{max} (inches)	Minimum Blanket Thick- ness (inches)
4	6	9
6	9	14
9	14	20
12	18	27
15	22	32
18	27	32
21	32	38
24	36	43

Rock Quality

Rock for riprap shall consist of field rock or rough unhewn quarry rock. The rock shall be hard and angular and of a quality that will not disintegrate on exposure to water or weathering. The specific gravity of the individual rocks shall be at least 2.5.

Filter

A filter is a layer of material placed between the riprap and the underlying soil surface to prevent soil movement into and through the riprap. Riprap shall have a filter placed under it in all cases.

A filter can be of two general forms: a gravel layer or a plastic filter cloth. The plastic filter cloth can be woven or non-woven monofilament yarns, and shall meet these base requirements: thickness 20-60 mils, grab strength 90-120 lbs; and shall conform to ASTM D-1777 and ASTM D-1682.

Gravel filter blanket, when used, shall be designed by comparing particle sizes of the overlying material and the base material. Design criteria are available in Standard and Specification for Anchored Slope and Channel Stabilization on page 4.7.

Gabions

Gabions shall be made of hexagonal triple twist mesh with heavily galvanized steel wire. The maximum linear dimension of the mesh opening shall not exceed 4 ½ inches and the area of the mesh opening shall not exceed 10 square inches.

Gabions shall be fabricated in such a manner that the sides, ends, and lid can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single unit construction and shall be installed according to manufacturer's recommendations.

The area on which the gabion is to be installed shall be graded as shown on the drawings. Foundation conditions shall be the same as for placing rock riprap, and filter cloth shall be placed under all gabions. Where necessary, key, or tie, the structure into the bank to prevent undermining of the main gabion structure.

Maintenance

Once a riprap outlet has been installed, the maintenance needs are very low. It should be inspected after high flows for evidence of scour beneath the riprap or for dislodged rocks. Repairs should be made immediately.

Design Procedure

1. Investigate the downstream channel to assure that nonerosive velocities can be maintained.
2. Determine the tailwater condition at the outlet to establish which curve to use.
3. Use the appropriate chart with the design discharge to determine the riprap size and apron length required. It is noted that references to pipe diameters in the charts are based on full flow. For other than full pipe flow, the parameters of depth of flow and velocity must be used to adjust the design discharges.
4. Calculate apron width at the downstream end if a flare section is to be employed.

Design Examples are demonstrated in Appendix B.

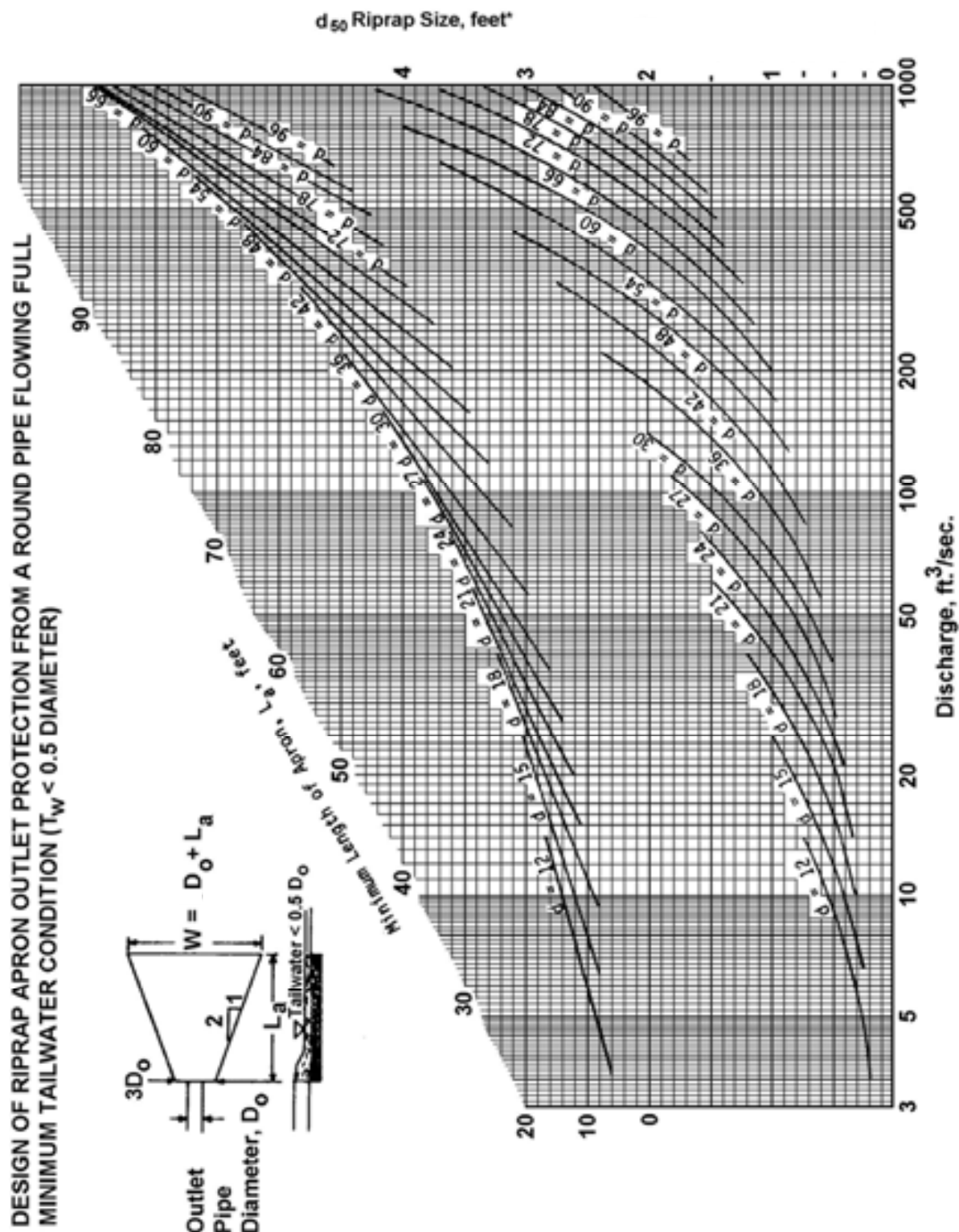
Construction Specifications

1. The subgrade for the filter, riprap, or gabion shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density of approximately that of the surrounding undisturbed material.
2. The rock or gravel shall conform to the specified grad-

ing limits when installed respectively in the riprap or filter.

3. Filter cloth shall be protected from punching, cutting, or tearing. Any damage other than an occasional small hole shall be repaired by placing another piece of cloth over the damaged part or by completely replacing the cloth. All overlaps, whether for repairs or for joining two pieces of cloth shall be a minimum of one foot.
4. Rock for the riprap or gabion outlets may be placed by equipment. Both shall each be constructed to the full course thickness in one operation and in such a manner as to avoid displacement of underlying materials. The rock for riprap or gabion outlets shall be delivered and placed in a manner that will ensure that it is reasonably homogenous 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 blanket or filter cloth. Hand placement will be required to the extent necessary to prevent damage to the permanent works.

Figure 3.16
Outlet Protection Design—Minimum Tailwater Condition Chart
(Design of Outlet Protection from a Round Pipe Flowing Full,
Minimum Tailwater Condition: $T_w < 0.5D_o$) (USDA - NRCS)



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Figure 3.17
Outlet Protection Design—Maximum Tailwater Condition Chart
(Design of Outlet Protection from a Round Pipe Flowing Full,
Maximum Tailwater Condition: $T_w \geq 0.5D_o$) (USDA - NRCS)

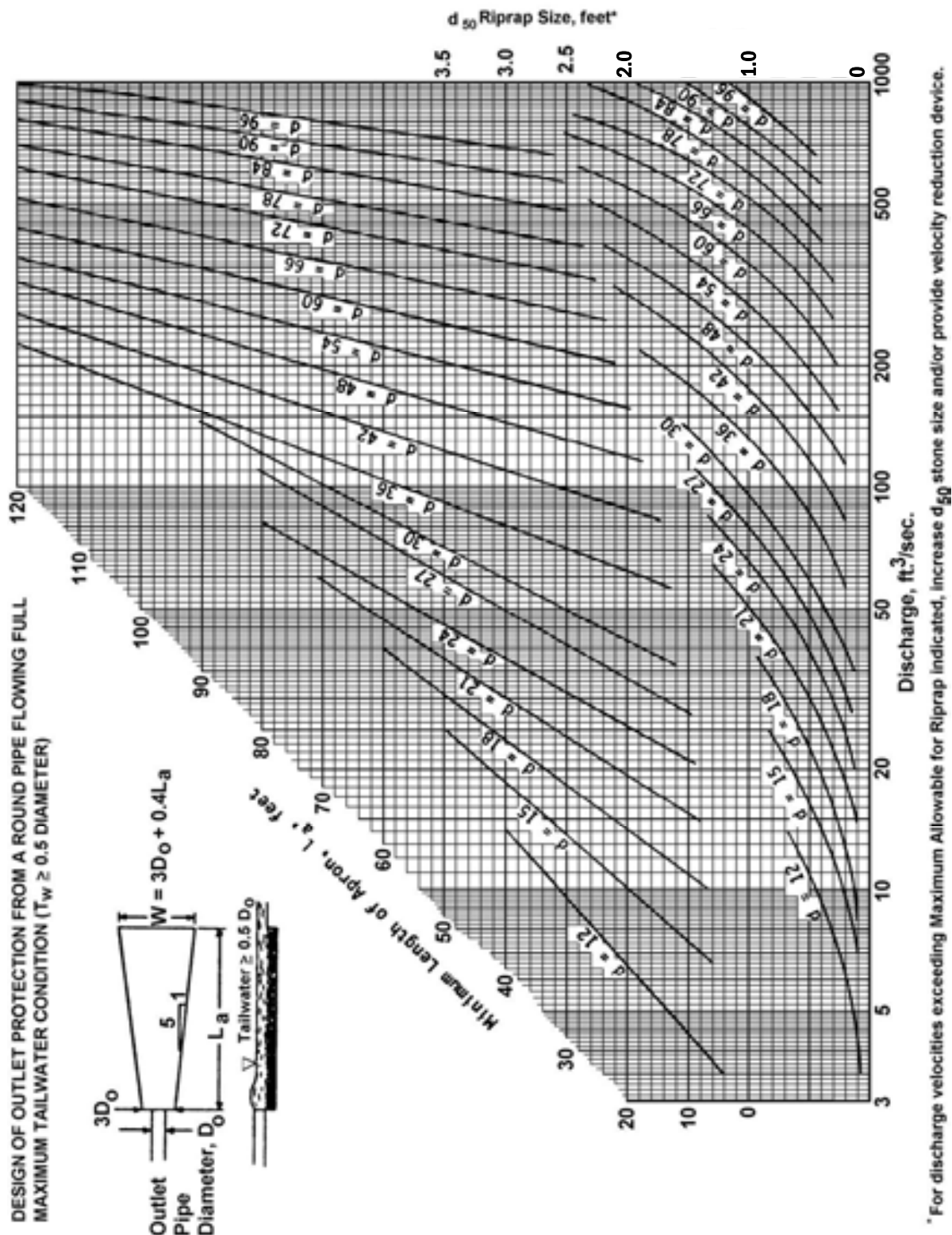


Figure 3.18
Riprap Outlet Protection Detail (1)

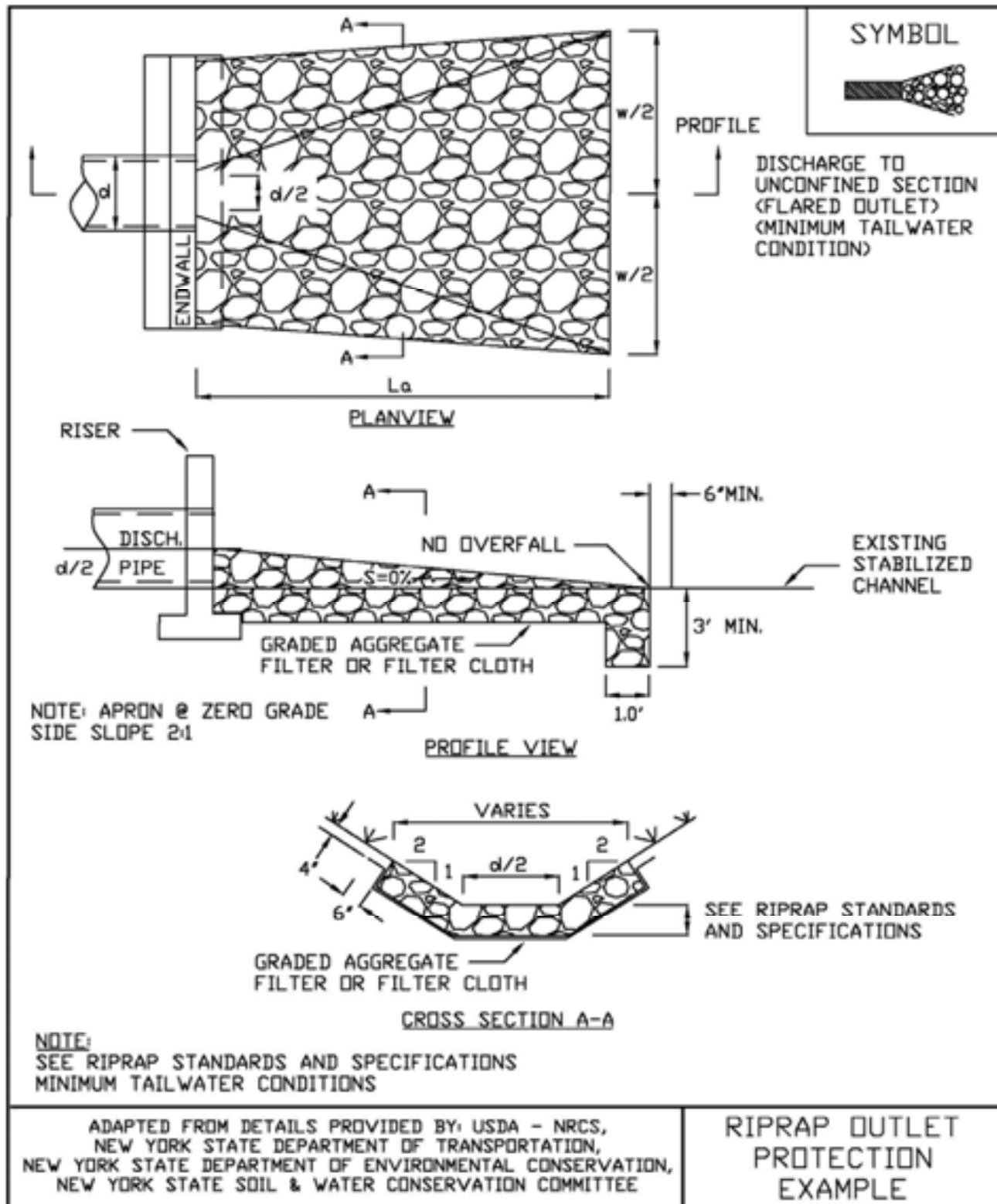


Figure 3.19
Riprap Outlet Protection Detail (2)

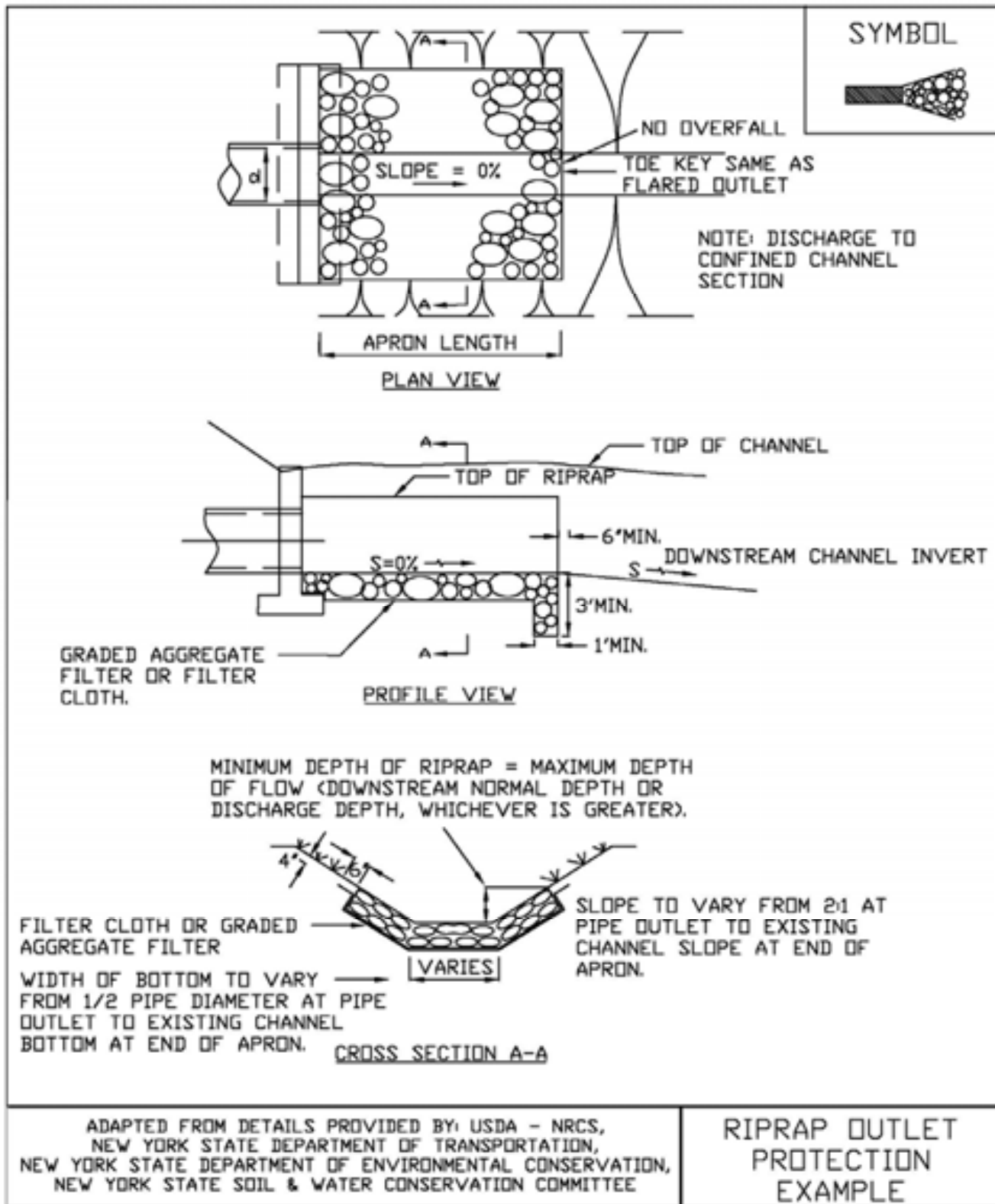
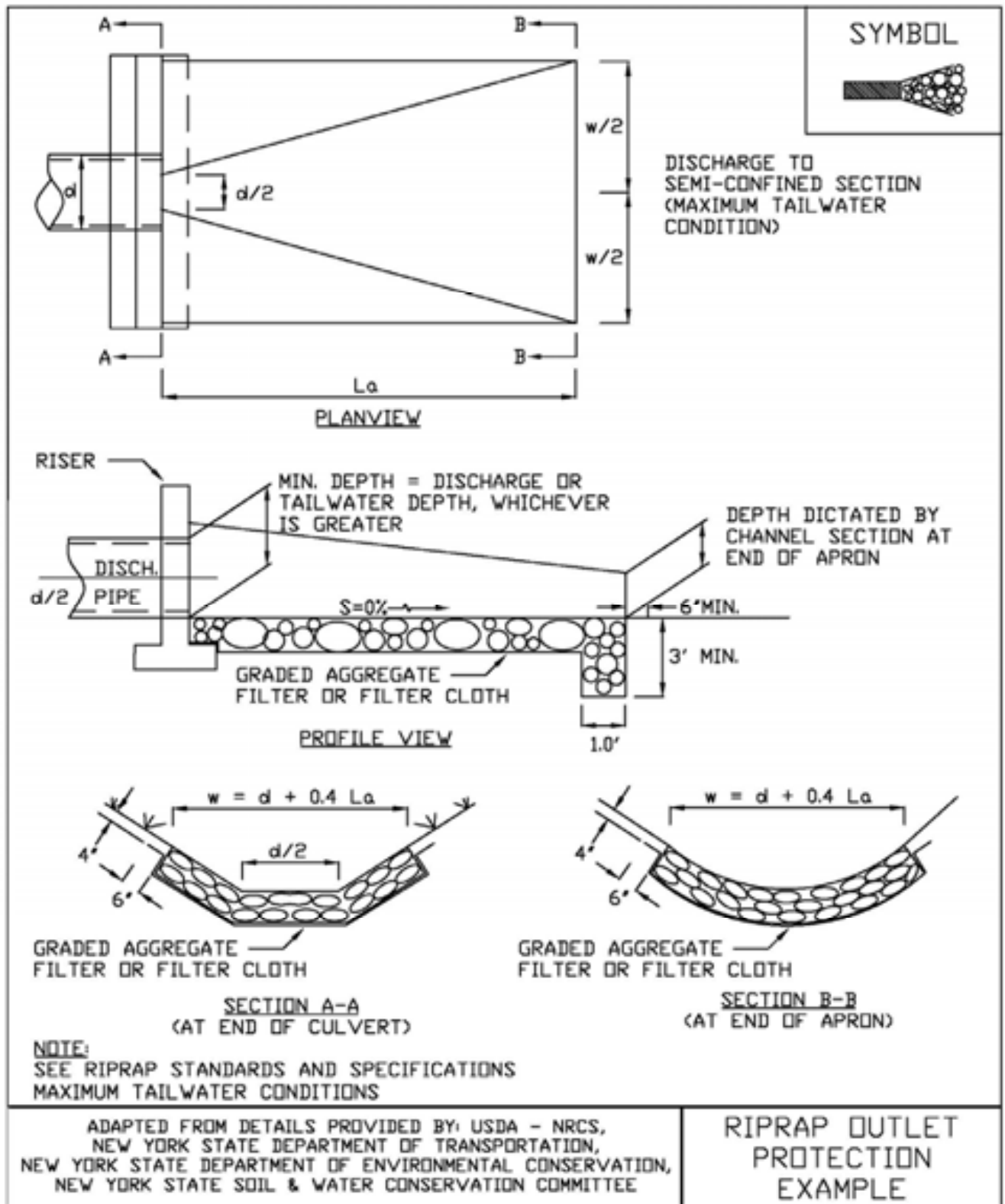


Figure 3.20
Riprap Outlet Protection Detail (3)



STANDARD AND SPECIFICATIONS FOR STORM DRAIN DIVERSION



Definition & Scope

The **temporary** redirection of a storm drain line or outfall channel so that it may discharge into a sediment trapping device in order to prevent sediment laden water from entering a watercourse, public or private property through a storm drain system. This could either be above ground or an underground conveyance system to convey sediment laden water to a sediment trapping device.

Conditions Where Practice Applies

One of the following practices or procedures shall be used whenever the off-site drainage area is less than 50 percent of the on-site drainage area to that system. A special exception may be given, at the discretion of the local plan approval agency, where site conditions make this procedure impossible.

Method of Temporary Diversion

1. Construction of a sediment trap or basin below a permanent storm drain outfall. Temporarily diverts storm flow into the basin or trap constructed below permanent outfall channel.
2. In-line diversion of storm drain at an inlet or manhole, achieved by installing a pipe stub in the side of a manhole or inlet and temporarily blocking the permanent outfall pipe from that structure. A temporary outfall ditch or pipe may be used to convey storm flow from the stub to a sediment trap or basin. This method may be used just above a permanent outfall or prior to connecting into an existing storm drain system.

3. Delay completion of the permanent storm drain outfall and temporarily divert storm flow into a sediment basin or trap. Earth dike, swale or design diversion is used, depending on the drainage area, to direct flow into a sediment basin or trap. The basin or trap should be constructed to one side of the proposed permanent storm drain location whenever possible.
4. Installation of a stormwater management basin early in the construction sequence. Install temporary measures to allow use of this site as a sediment basin. Since these structures are designed to receive storm drain outfalls, diversion should not be necessary.

Completion and Disposition

When the areas contributing sediment to the system have been stabilized, procedures can be taken to restore the system to its planned use.

The following removal and restoration procedure is recommended:

1. Flush the storm drain system to remove any accumulated sediment.
2. Remove the sediment control devices, such as traps, basins, dikes, swales, etc.
3. For sites where an inlet was modified, brick and grout shut the temporary pipe stub and open the permanent outfall pipe.
4. Establish permanent stabilized outfall channel as noted on the plans.
5. Restore the area to grades shown on the plan and stabilize with vegetative measures.
6. For basins that will be incorporated into stormwater management facilities, remove the accumulated sediment, construct the stormwater facility as designed, and seed all disturbed areas to permanent vegetation.

STANDARD AND SPECIFICATIONS FOR SUBSURFACE DRAIN



Definition & Scope

A **permanent** conduit, such as tile, pipe, or tubing, installed beneath the ground surface, which intercepts, collects, and/or conveys drainage water to serve one or more of the following purposes:

1. Improve the environment for vegetative growth by regulating the water table and groundwater flow.
2. Intercept and prevent water movement into a wet area.
3. Relieve artesian pressures.
4. Remove surface runoff.
5. Provide internal drainage of slopes to improve their stability and reduce erosion.
6. Provide internal drainage behind bulkheads, retaining walls, etc.
7. Replace existing subsurface drains that are interrupted or destroyed by construction operations.
8. Provide subsurface drainage for dry storm water management structures.
9. Improve dewatering of sediment in sediment basins. (See Standard and Specification for Sediment Basins in Section 5).

Conditions Where Practice Applies

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

storm drainage systems or foundation drains. Regulatory restrictions may apply if wetlands are present.

An outlet for the drainage system shall be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity of water to be discharged without causing damage above or below the point of discharge and shall comply with all state and local laws.

Design Criteria

The design and installation shall be based on adequate surveys and on-site soils investigations.

Required Capacity of Drains

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

1. Where sub-surface drainage is to be uniform over an area through a systematic pattern of drains, a drainage coefficient of 1 inch to be removed in 24 hours shall be used; see Drain Chart, Figure 3.21 on page 3.51.
2. Where sub-surface drainage is to be by a random interceptor system, a minimum inflow rate of 0.5 cfs per 1,000 feet of line shall be used to determine the required capacity. If actual field tests and measurements of flow amounts are available, they may be used for determining capacity.

For interceptor subsurface drains on sloping land, increase the inflow rate as follows:

Land Slope	Increase Inflow Rate By
2-5 percent	10 percent
5-12 percent	20 percent
Over 12 percent	30 percent

3. Additional design capacity must be provided if surface water is allowed to enter the system.

Size of Subsurface Drain

The size of subsurface drains shall be determined from the drain chart found on Figures 3.21 on page 3.51. All subsurface drains shall have a nominal diameter, which equals or exceeds four (4) inches.

Depth and Spacing

The minimum depth of cover of subsurface drains shall be 24 inches where possible. The minimum depth of cover may be reduced to 15 inches where it is not possible to attain the 24 inch depth and where the drain is not subject to equipment loading or frost action. Roots from some types of vegetation can plug drains, as the drains get closer to the surface.

The spacing of drain laterals will be dependent on the permeability of the soil, the depth of installation of the drains and degree of drainage required. Generally, drains installed 36 inches deep and spaced 50 feet center-to-center will be adequate. For more specific information, see the [New York Drainage Guide \(USDA-NRCS\)](#).

Minimum Velocity and Grade

The minimum grade for subsurface drains shall be 0.10 percent. Where surface water enters the system a velocity of not less than 2 feet per second shall be used to establish the minimum grades. Provisions shall be made for preventing debris or sediment from entering the system by means of filters or collection and periodic removal of sediment from installed traps.

Materials for Subsurface Drains

Acceptable subsurface drain materials include perforated, continuous closed joint conduits of polyethylene plastic, concrete, corrugated metal, polyvinyl chloride, and clay tile.

The conduit shall meet strength and durability requirements of the site.

Loading

The allowable loads on subsurface drain conduits shall be based on the trench and bedding conditions specified for the job. A factor of safety of not less than 1.5 shall be used in computing the maximum allowable depth of cover for a particular type of conduit.

Envelopes and Envelope Materials

Envelopes shall be used around subsurface drains for proper bedding and to provide better flow into the conduit. Not less than three inches of envelope material shall be used for sand/gravel envelopes. Where necessary to improve the characteristics of flow of groundwater into the conduit, more envelope material may be required.

Where county regulations do not allow sand/gravel envelopes, but require a special type and size of envelope material, they shall be followed. Envelope material shall be placed to the height of the upper-

most seepage strata. Behind bulkheads and retaining walls, it shall go to within twelve inches of the top of the structure. This standard does not cover the design of filter materials where needed.

Materials used for envelopes shall not contain materials which will cause an accumulation of sediment in the conduit or render the envelope unsuitable for bedding of the conduit. Envelope materials shall consist of either filter cloth or sand/gravel material, which shall pass a 1 ½ inch sieve, 90 to 100 percent shall pass a ¾ inch sieve, and not more than 10 percent shall pass a No. 60 sieve.

Filter cloth envelope can be either woven or non-woven monofilament yarns and shall have a sieve opening ranging from 40 to 80. The envelope shall be placed in such a manner that once the conduit is installed, it shall completely encase the conduit.

The conduit shall be placed and bedded in a sand/gravel envelope. A minimum of three inches depth of envelope materials shall be placed on the bottom of a conventional trench. The conduit shall be placed on this and the trench completely filled with envelope material to minimum depth of 3 inches above the conduit.

Soft or yielding soils under the drain shall be stabilized where required and lines protected from settlement by adding gravel or other suitable material to the trench, by placing the conduit on plank or other rigid support, or by using long sections of perforated or watertight pipe with adequate strength to ensure satisfactory subsurface drain performance.

Use of Heavy Duty Corrugated Plastic Drainage Tubing

Heavy duty corrugated drainage tubing shall be specified where rocky or gravelly soils are expected to be encountered during installation operations. The quality of tubing will also be specified when cover over this tubing is expected to exceed 24 inches for 4, 5, 6, or 8 inch tubing. Larger size tubing designs will be handled on an individual job basis.

Auxiliary Structure and Subsurface Drain Protection

The outlet shall be protected against erosion and undermining of the conduit, against damaging periods of submergence, and against entry of rodents or other animals into the subsurface drain. An animal guard shall be installed on the outlet end of the pipe. A swinging animal guard shall be used if surface water enters the pipe.

A continuous 10-foot section of corrugated metal, cast iron, polyvinyl chloride, or steel pipe without perforations shall be used at the outlet end of the line and shall outlet 1.0 foot above the normal elevation of low flow in the outlet ditch or

above mean high tide in tidal areas. No envelope material shall be used around the 10-foot section of pipe. Two-thirds of the pipe shall be buried in the ditch bank and the cantilevered section shall extend to a point above the toe of the ditch side slope. If not possible, the side slope shall be protected from erosion.

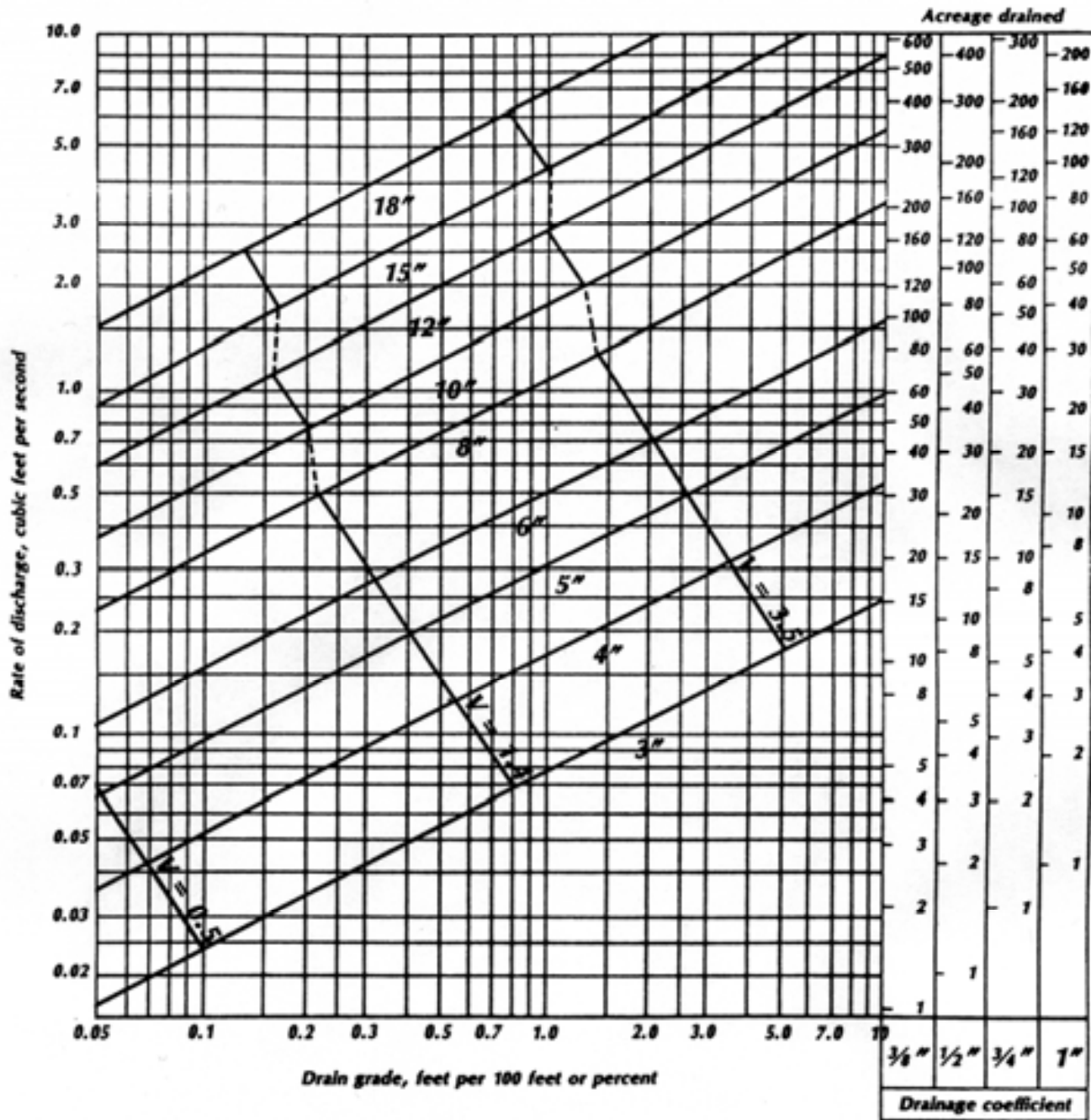
Conduits under roadways and embankments shall be water-tight and designed to exclude debris and prevent sediment from entering the conduit. Lines flowing under pressure shall be designed to withstand the resulting pressures and velocity of flow. Surface waterways shall be used where feasible.

The upper end of each subsurface drain line shall be capped with a tight fitting cap of the same material as the conduit or other durable material unless connected to a structure.

Construction Specifications

1. Deformed, warped, or otherwise damaged pipe or tubing shall not be used.
2. All subsurface drains shall be laid to a uniform line and covered with envelope material. The pipe or tubing shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Connections will be made with manufactured appurtenances comparable in strength with the specified pipe or tubing unless otherwise specified. The method of placement and bedding shall be as specified on the drawing.
3. Envelope material shall consist of filter cloth or a sand/gravel (which shall pass the 1 ½ inch sieve, 90 to 100 percent shall pass ¾ inch sieve, and not more than 10 percent shall pass the No. 60 sieve).
4. The upper end of each subsurface drain line shall be capped with a tight fittings cap of the same material as the conduit or other durable material unless connected to a structure.
5. A continuous 10-foot section of corrugated metal, cast iron, polyvinyl chloride, or steel pipe without perforations shall be used at the outlet end of the line. No envelope material shall be used around the 10-foot section of the pipe. An animal guard shall be installed on the outlet end of the pipe.
6. Earth backfill material shall be placed in the trench in such a manner that displacement of the drain will not occur.
7. Where surface water is entering the system, the pipe outlet section of the system shall contain a swing type trash and animal guard.

Figure 3.21
Drain Chart - Corrugated Plastic Drain Tubing (USDA-NRCS)



STANDARD AND SPECIFICATIONS FOR WATER BAR



Definition & Scope

A **permanent** or **temporary** ridge, ridge and channel, a structural channel, or flow deflector, constructed diagonally across a sloping road or utility right-of-way that is subject to erosion to limit the accumulation of erosive velocity of water by diverting surface runoff at pre-designed intervals.

Conditions Where Practice Applies

Where runoff protection is needed to prevent erosion from increased concentrated flow on narrow, steep access roads, driveways, and entrance ways to lot parcels as well as utility access right-of-ways generally up to 100 feet in width

Design Criteria

Design computations are not required.

1. The design height shall be minimum of 12 inches measured from channel bottom to ridge top.
2. The side slopes shall be 2:1 or flatter, a minimum of 4:1 where vehicles cross.
3. The base width of the ridge shall be six feet minimum.
4. The spacing of the water bars shall be as follows (Site spacing may need to be adjusted for field conditions to use the most suitable areas for water disposal):

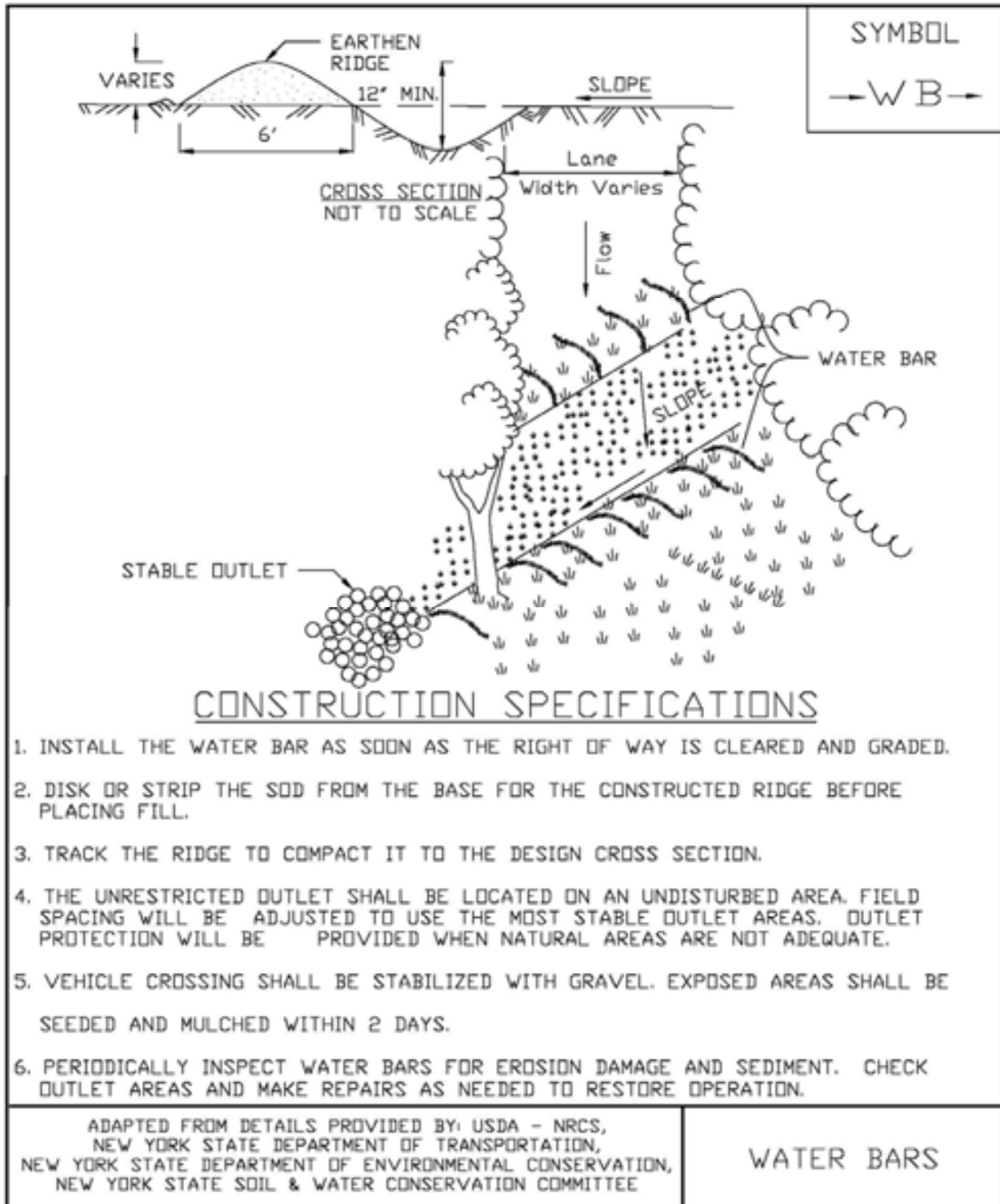
Slope (%)	Spacing (ft.)
<5	125
5 TO 10	100
10 TO 20	75
20 TO 35	50
>35	25

5. The positive grade of the water bar shall not exceed 2%. A crossing angle of approximately 60 degrees is preferred.
6. Once diverted, water must be conveyed to a stable system (i.e. vegetated swale or storm sewer system). Water bars should have stable, unrestricted outlets, either natural or constructed.

See Figure 3.22 on page 3.53 for details.



Figure 3.22
Water Bar Detail



SECTION 4

EROSION CONTROL - PART 2

SOIL STABILIZATION

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EROSION CONTROL - PART 2

SOIL STABILIZATION

Scope and Discussion

Soil stabilization is the second step in controlling erosion on a construction site or a disturbed area. Erosion is the gradual wearing away of the land surface as a result of uncontrolled wind and water energy. Sedimentation is the result of transport and delivery of eroded particles, deposited at some point. Erosion and sediment control is a complex interaction of soils, engineering water management, agronomic, and horticultural practices. Decisions for resolving erosion conditions, both on the site and within the upper watershed, are formulated based on surface and subsurface water, soil material, climatic conditions, and anticipated land use. Creating a stable slope is necessary prior to vegetating. Sloughing and slumping impede establishment of a uniform protective cover. Stabilizing onsite surfaces can be done with vegetation in the form of various seed mixes and mulch, land shaping, and using woody plants specifically selected for site specific applications, also known as a bio-technical stabilization approach.

General planning considerations for vegetating a steep slope will include evaluating the soil. Factors such as soil texture and steepness affect the stability of the slope. Texture also influences the permeability and water holding capacity of the soil. Many slopes are stripped of their topsoil during the construction phase, leaving an infertile, compacted soil surface, void of valuable organic matter. Topsoil must be reapplied. Overly compacted soil must be decompacted with appropriate equipment. Soil pH and nutrient level are determined by obtaining a representative soil sample for analysis from an accredited lab. Appropriate plant material is designed and selected to meet the final slope and soil conditions for the site. These same concerns and practices also apply to flatter slopes and level areas.

When specifying a fertilizer mix for an area, design the appropriate proportions to meet the nutrients needs for the specific site. Always apply as closely as possible the required amount of fertilizer to meet the needs for the site soils. Adding surplus nitrogen may cause pollution of drinking water and saltwater ecosystems. Excessive phosphorus may accelerate the aging process of freshwater ecosystems. Excessive amounts of Nitrogen (N) and Potassium Oxide (K₂O) may result in 'burning' the grass and killing it. **All fertilizer applications will be in accordance with the Nutrient Runoff Law – ECL Article 17, Title 21, January 1, 2012.**

Principles of Biotechnical Practices

The implementation of Biotechnical practices is the specialized use of woody plant materials to stabilize soil enhance structural practices, and provide added support to habitat. One of the factors that affects erosion is vegetative cover. The more cover soil has, the more protected it is from the attacking forces of rainfall and runoff. Also working to hold the soil in place is the root mass that vegetation produces. Biotechnical measures generally combine basic engineering principles with plant science to create a system of stability and resource management for critical areas such as streambanks, roadside slopes, and large exposed areas. These systems may combine with structural measures to effect a strengthening of the soil structure and improve vegetative cover to resist surface erosion.

There are many advantages to Biotechnical practices:

- they are often less expensive to install
- they do not require specialized skills to install
- generally, heavy equipment is not required
- they are environmentally compatible since the design selects natural and native plant materials
- they provide a natural aesthetic appearance
- they provide wildlife habitat and cover and provide a food source to many land and aquatic species
- they mitigate thermal impacts to structural stream stabilization practices such as rock riprap and retaining walls by providing shade
- they can be self repairing during and after stress

On the other hand, there are some disadvantages to these measures:

- requires planning to obtain sources of plant materials
- higher risk due to less control with vegetation compared to structural practices
- require higher maintenance attention
- need an establishment period
- more sensitive to seasonal changes and seasonal

restrictions on planting may apply

The use of Biotechnical practices is actually an old technology. These techniques have been practiced for centuries in Europe. The Natural Resource Conservation Service used and promoted this technology in the 1940's in Vermont on the Winooski River and also in New York on Buffalo Creek, where plant materials (willows) were used in combination with rock riprap, concrete slabs, pinned rock, and cellular modules to halt streambank erosion.

These biotechnical approaches have been “rediscovered” primarily due to their cost effectiveness over more traditional structural measures (hard armor) and for their environmental compatibility, aesthetics, and wildlife benefits. There are many areas in towns and counties in New York that experience erosion on streambanks or sloughs on roadside slopes that could be controlled with biotechnical protection measures. The low cost and ease of installation is very attractive to units of government and highway departments looking to maximize their budget dollars.

Generally a biotechnical slope protection system consists of both a structural or mechanical element and vegetative elements working together to stabilize a site-specific condition. Structural components are employed in such a way to allow establishment of vegetative elements, while at the same time providing a level of protection for stability. The vegetative components are not just landscaping plantings for a structural project; they also perform a functional role in preventing erosion by protecting the surface, while also stabilizing soil by preventing shallow mass movements. These practices also provide a food source to both land based animals as well as smaller aquatic species along streambank revetments. Once established, the plantings provide shade in areas where mitigation of thermal impacts is needed due to hardened structural practices.

Woody plant materials (usually dormant shrub willow branches) are placed into the soil in ways that provide an immediate degree of stability to the slope. As the branches take root and grow, the slope becomes more and more resistant to failure by shallow mass movements due to:

1. Mechanical reinforcement from the root system,
2. Soil moisture reduction through transpiration and plant uptake, and
3. Buttressing and soil arching action from embedded stems.

The vegetation also tends to prevent (surface) erosion by:

1. Binding and restraining soil particles in place,
2. Filtering soil particles from runoff,
3. Absorb raindrop energy prior to impact,
4. Retarding velocity of runoff, and
5. Maintaining infiltration.

As the stability improves, native vegetation will volunteer, helping to blend the site into the surroundings.

There are many techniques used in biotechnical work. Some of the most common are:

Vegetated Rock Gabions—This is a combination of vegetation and rock gabions generally used for slope stabilization. Live branch cuttings are layered through the rock gabion structure to anchor in select earthfill. The cuttings protrude beyond the face of the gabion. The gabion standard is covered in the “Standard Specifications for Retaining Walls”. See Figure 4.20 on page 4.67 for details.

Live Fascines—This technique uses bundles of branches which are staked into shallow trenches, then filled with soil. They are oriented along the contour and are placed in multiple rows to help stabilize a slope. See Standard and Specifications for Live Fascines.

Brush Mattress—This method uses hardwood brush layered along a streambank as a mattress and anchored in place with a grid of stakes and wire. The toe below the waterline is anchored by rock. This living blanket acts as a mulch for seedlings and plantings established in the bank. It also prevents erosion of sloped surfaces. See Standards and Specifications for Brush Mattress.

Live Staking—These are large stakes or poles sharpened at the bottom end and forced vertically into the soft earth along the waterline, usually about 1 foot apart. Depending on the size of the poles and the composition of the streambank, machinery may be required to force them into the ground or to prepare holes for planting. The poles will grow forming a very thick barrier to flow. See Figure 4.14 and Figure 4.15.

Brush Layering—This technique is generally used to stabilize slope areas above the flow line of streambanks as well as cut and fill slopes. It involves the use of long branches that are placed with cut ends into the slope on bulldozed terraces. The tops protrude outside the finished slope. A layer usually includes three layers of brush separated with a thin (3 in.) layer of soil. On this layer a “lift” of 3-5 feet of soil is placed to form the next terrace and so forth. See Figure 4.6.

Live Cribwall—This is a combination of vegetation and structural elements generally used along streams where flowing water is a hazard. Layers of logs are alternated with long branches protruding out between them. The logs are spiked together and anchored into the bank with earthfill behind them to create a wall. The live stems help tie the logs together and screen the wall. See Figure 4.12.

Tree Revetment—This method incorporates entire trees (without the root wad) for bank stabilization in areas that are eroded or undercut, but not flashy or in need of heavy maintenance. Trees are overlapped and anchored to the earth for the purpose of absorbing energy and reducing velocity, capturing sediment, and enhancing conditions for colonization of native species. See Figure 4.19.

Branchpacking—This technique alternates live branch cuttings with tamped backfill to repair small, localized slumps and holes in slopes. The alternating layers of branches and soil are placed between long posts driven in to the ground for support. This method is inappropriate for areas larger than 4-feet deep or 6-feet wide. See Figure 4.5.

Fiber Roll—A fiber roll is a coconut fiber, straw, or excelsior woven roll encased in netting of jute, nylon, or burlap used to dissipate energy along bodies of water and provide a good medium for the introduction of herbaceous vegetation. This technique works best where water levels are relatively constant. The roll is anchored into the bank and, after suitable backfill is placed behind the roll, herbaceous or woody vegetation can be planted. See Figure 4.8.

Properly designed structural measures may be necessary to help protect the toe or face of a slope against scour or erosion from moving water and against mass-moving of soil. These structures are generally capable of resisting much higher lateral earth pressures and higher shear values than vegetation. They can be natural, such as fieldstone, rock and timbers; or, they can be artificial like concrete and steel. Some structural measures can be a combination like gabions, which are wire baskets containing stone. Gabions can be used as retaining walls, grade stabilization structures and slope protection. Many of these types of structures can be planted or vegetated with materials to strengthen the system.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

Planning Considerations

There are many facets that need to be considered when designing a biotechnical system for a site:

Method – What is the appropriate method or practice for the particular problem encountered?

Materials – What type should be selected? How much is needed to do the job? Where can they be obtained?

Schedule – When is the best time to maximize the successful rooting or germination of materials?

Equipment – Since this process is somewhat labor intensive, it is necessary to make sure the proper type and amount of tools, such as shovels, pick axe, tile spade, hammers, etc. are available for proper installation of material.

Site characteristics – The need for engineering structures will depend on potential hazards, management of site water, soil conditions, and site access. Aesthetics and follow-up maintenance are also important considerations. Protection from livestock is mandatory.

Streambanks – Generally applicable where flows are less than 6 feet per second and the stream bottom is not subject to degradation and scour. Protection should be carried to the average high water elevation.

Plant Materials

Plant materials for biotechnical slope protection may be obtained in two basic ways. One method is to locate stands of appropriate species and obtain easements to harvest materials from these stands for incorporation into the project. Criteria for selecting native species are: easy rooting; long, straight, flexible whips; and plentiful supply near the site.

A second method is to grow and harvest materials from

managed production beds that are maintained for commercial distribution. This allows selection of cultivars that have proven performance records and high survival rates.

The most popular materials in use today are the shrub willows. Willows have a tremendous ability to sprout roots and stems when in contact with moist soil. Willows are found growing in all parts of the world, so biotechnical slope protection techniques employ them more than any other group of plants. Two of the tested, proven willow cultivars in the Northeast are:

- ‘Streamco’ purple osier willow (*Salix purpurea*)
- ‘Bankers’ dwarf willow (*Salix cottetii* – hybrid)

‘Streamco’ and ‘Bankers’ willow are both shrubs. ‘Streamco’ has an ultimate height of 15-20 feet, while ‘Bankers’ is limited to 6-8 feet. Commercial and state nurseries in the Northeast are producing supplies of both species.

In addition to willows, red osier dogwood and poplars are other groups of plants effective for use in biotechnical systems. Species such as elderberry or forsythia can also be used to add biodiversity to a site.

All plant materials should be installed on site within 8 hours of cutting, unless provisions for proper storage are made. Materials should be fresh, dormant, and non-desiccated when installed.

STANDARD AND SPECIFICATIONS FOR ANCHORED STABILIZATION MATTING



Definition and Scope

A **temporary** or **permanent** protective covering placed on a prepared, seeded planting area that is anchored in place by staples or other means to aid in controlling erosion by absorbing rain splash energy and withstand overland flow as well as provide a microclimate to protect and promote seed establishment.

Conditions Where Practice Applies

Anchored stabilization mats are required for seeded earthen slopes steeper than 3 horizontal to 1 vertical; in vegetated channels where the velocity of the design flow exceeds the allowable velocity for vegetation alone (usually greater than 5 feet per second); on streambanks and shorelines where moving water is likely to erode newly seeded or planted areas; and in areas where wind prevents standard mulching with straw. This standard does not apply to slopes stabilized with sod, rock riprap or hard armor material.

Design Criteria

Slope Applications - Anchored stabilization mats for use on slopes are primarily used as mulch blankets where the mesh material is within the blanket or as a netting over previously placed mulch. These stabilization mats are NOT effective in preventing slope failures.

1. Required on all slopes steeper than 3:1
2. Matting will be designed for proper longevity need and strength based on intended use.
3. All installation details and directions will be included on the site erosion and sediment control plan and will follow manufactures specifications.

Channel Applications - Anchored stabilization mats, for use in supporting vegetation in flow channels, are generally a non-degradable, three dimensional plastic structure which can be filled with soil prior to planting. This structure provides a medium for root growth where the matting and roots become intertwined forming a continuous anchor for the vegetated lining.

1. Channel stabilization shall be based on the tractive force method.
2. For maximum design shear stresses less than 2 pounds per square foot, a temporary or bio-degradable mat may be used.
3. The design of the final matting shall be based on the mats ability to resist the tractive shear stress at bank full flow.
4. The installation details and procedures shall be included on the site erosion and sediment control plan and will follow manufacturers specifications.



Construction Specifications

1. Prepare soil before installing matting by smoothing the surface, removing debris and large stone, and applying lime, fertilizer and seed. Refer to manufacturers installation details.
2. Begin at the top of the slope by anchoring the mat in a 6" deep x 6" wide trench. Backfill and compact the trench after stapling.
3. In channels or swales, begin at the downslope end, anchoring the mat at the bottom and top ends of the blanket. When another roll is needed, the upslope roll

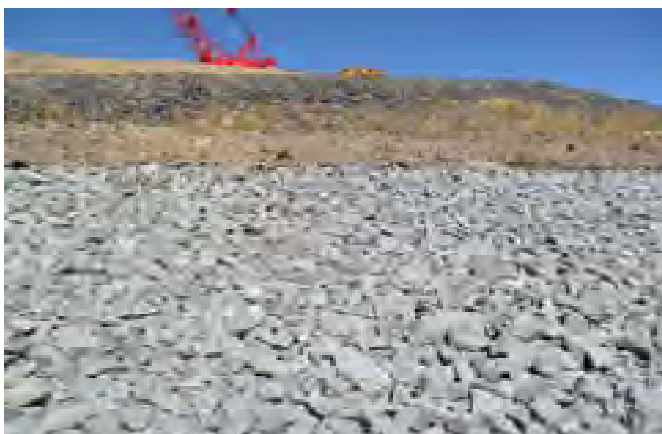
should overlay the lower layer, shingle style, so that channel flows do not peel back the material.

4. Roll the mats down a slope with a minimum 4" overlap. Roll center mat in a channel in direction of water flow on bottom of the channel. Do not stretch blankets. Blankets shall have good continuous contact with the underlying soil throughout its entire length.
5. Place mats end over end (shingle style) with a 6" overlap, use a double row of staggered staples 4" apart to secure mats.
6. Full length edge of mats at top of side slopes must be anchored in 6" deep x 6" wide trench; backfill and compact the trench after stapling.
7. Mats on side slopes of a channel must be overlapped 4" over the center mat and stapled.
8. In high flow channel applications, a staple check slot is recommended at 30 to 40 foot intervals. Use a row of staples 4" apart over entire width of the channel. Place a second row 4" below the first row in a staggered pattern.
9. The terminal end of the mats must be anchored in a 6"x6" wide trench. Backfill and compact the trench after stapling.
10. Stapling and anchoring of blanket shall be done in accordance with the manufactures recommendations.

Maintenance

Blanketed areas shall be inspected weekly and after each runoff event until perennial vegetation is established to a minimum uniform 80% coverage throughout the blanketed area. Damaged or displaced blankets shall be restored or replaced within 2 calendar days.

STANDARD AND SPECIFICATIONS FOR ARMORED SLOPE AND CHANNEL STABILIZATION



Definition & Scope

A **permanent** layer of stone designed to protect and stabilize areas subject to erosion by protecting the soil surface from rain splash, sheet flow, rill and gully erosion and channel erosion. It can also be used to improve the stability of soil slopes that are subject to seepage or have poor soil structure.

Conditions Where Practice Applies

Riprap is used for cut and fill slopes subject to seepage, erosion, or weathering, particularly where conditions prohibit the establishment of vegetation. Riprap is also used for channel side slopes and bottoms, temporary dewatering diversion channels where the flow velocities exceed 6 feet/second, grade sills, on shorelines subject to erosion, and at inlets and outlets to culverts, bridges, slope drains, grade stabilization structures, and storm drains.

Slope Stabilization Design Criteria

Gradation – Riprap shall be a well-graded mixture with 50% by weight larger than the specified design size. The diameter of the largest stone size in such a mixture should be 1.5 times the d_{50} size with smaller sizes grading down to 1 inch. The designer should select the size or sizes that equal or exceed that minimum size based on riprap gradations commercially available in the area.

Thickness – The minimum layer thickness shall be 1.5 times the maximum stone diameter, but in no case less than 6 inches.

Quality – Stone for riprap shall be hard, durable field or quarry materials. They shall be angular and not subject to breaking down when exposed to water or weathering. The specific gravity shall be at least 2.5.

Size – The sizes of stones used for riprap protection are determined by purpose and specific site conditions:

1. Slope Stabilization – Riprap stone for slope stabilization not subject to flowing water or wave action shall be sized for the proposed grade. The gradient of the slope to be stabilized shall be less than the natural angle of repose of the stone selected. Angles of repose of riprap stones may be estimated from Figure 4.1.

Riprap used for surface stabilization of slopes does not add significant resistance to sliding or slope failure and should not be considered a retaining wall. Slopes approaching 1.5:1 may require special stability analysis. The inherent stability of the soil must be satisfactory before riprap is used for surface stabilization.

2. Channel Stabilization - Design criteria for sizing stone for stability of channel side slopes are presented under Channel Stabilization Design Criteria on page 4.10.
2. Outlet Protection – Design criteria for sizing stone and determining dimensions of riprap aprons are presented in Standards and Specifications for Rock Outlet Protection on page 3.39.

Filter Blanket – A filter blanket is a layer of material placed between the riprap and the underlying soil to prevent soil movement into or through the riprap. A suitable filter may consist of a well-graded gravel or sand-gravel layer or a synthetic filter fabric manufactured for this purpose. The design of a gravel filter blanket is based on the ratio of particle size in the overlying filter material to that of the base material in accordance with the criteria below. Multiple layers may be designed to affect a proper filter if necessary.

A gravel filter blanket should have the following relationship for a stable design:

$$\frac{d_{15} \text{ filter}}{d_{85} \text{ base}} \leq 5$$

$$5 < \frac{d_{15} \text{ filter}}{d_{50} \text{ base}} \leq 40$$

and

$$\frac{d_{30} \text{ filter}}{d_{30} \text{ base}} \leq 40$$

Filter refers to the overlying material while base refers to the underlying material. These relationships must hold between the base and filter and the filter and riprap to prevent migration of material. In some cases, more than one filter may be needed. Each filter layer should be a minimum of 6 inches thick, unless an acceptable filter fabric is used.

A synthetic filter fabric may be used with or in place of gravel filters. The following particle size relationships should exist:

1. Filter fabric covering a base containing 50% or less by weight of fine particles (#200 sieve size):

A.
$$\frac{d_{85} \text{ base (mm)}}{\text{EOS} \times \text{filter fabric (mm)}} > 1$$

- B. total open area of filter fabric should not exceed 36%

2. Filter fabric covering other soils:

- A. EOS is no larger than 0.21 mm (#70 sieve size)

- B. total open area of filter fabric should not exceed 10%

*EOS – Equivalent opening size compared to a U.S. standard sieve size.

No filter fabric should have less than 4% open area or an EOS less than U.S. Standard Sieve #100 (0.15 mm). The permeability of the fabric must be greater than that of the soil. The fabric may be made of woven or nonwoven monofilament yarns and should meet the following minimum requirements:

Thickness 20-60 mils

grab strength 90-120 lbs.

conform to ASTM D-1682 or ASTM D-177

Filter blankets should always be provided where seepage is significant or where flow velocity and duration of flow or turbulence may cause underlying soil particles to move through the riprap.

Construction Specifications

Subgrade Preparation – Prepare the subgrade for riprap and filter to the required lines and grades shown on the plans. Compact any fill required in the subgrade to a density approximating that of the undisturbed material or overfill depressions with riprap. Remove brush, trees, stumps, and other objectionable material. Cut the subgrade sufficiently deep so that the finished grade of the riprap will be at the

elevation of the surrounding area. Channels shall be excavated sufficiently to allow placement of the riprap in a manner such that the finished inside dimensions and grade of the riprap meet design specifications.

Sand and gravel filter blanket – Place the filter blanket immediately after the ground foundation is prepared. For gravel, spread filter stone in a uniform layer to the specified depth. Where more than one layer of filter material is used, spread the layers with minimal mixing.

Synthetic filter fabric – Place the cloth directly on the prepared foundation. Overlap the edges by at least 2 feet, and space the anchor pins every 3 feet along the overlap. Bury the upper and lower ends of the cloth a minimum of 12 inches below ground. Take precautions not to damage the cloth by dropping the riprap. If damage occurs, remove the riprap and repair the sheet by adding another layer of filter fabric with a minimum overlap of 12 inches around the damaged area. Where large stones are to be placed, a 4-inch layer of fine sand or gravel is recommended to protect the filter cloth. Filter fabric is not recommended as a filter on slopes steeper than 2 horizontal to 1 vertical.

Stone placement – Placement of the riprap shall follow immediately after placement of the filter. Place riprap so that it forms dense, well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement. Place riprap to its full thickness in one operation. Do not place riprap by dumping through chutes or other methods that cause segregation of stone sizes. Be careful not to dislodge the underlying base or filter when placing the stones.

The toe of the riprap shall be keyed into a stable foundation at its base as shown in Figure 4.2 - Typical Riprap Slope Protection Detail. The toe should be excavated to a depth of 2.0 feet. The design thickness of the riprap shall extend a minimum of 3 feet horizontally from the slope. The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve proper distribution of stone sizes to produce a relatively smooth, uniform surface. The finished grade of the riprap should blend with the surrounding area.

Maintenance

Riprap shall be inspected periodically for scour or dislodged stones. Control weed and brush growth as needed.

Figure 4.1
Angles of Repose of Riprap Stones (FHWA)

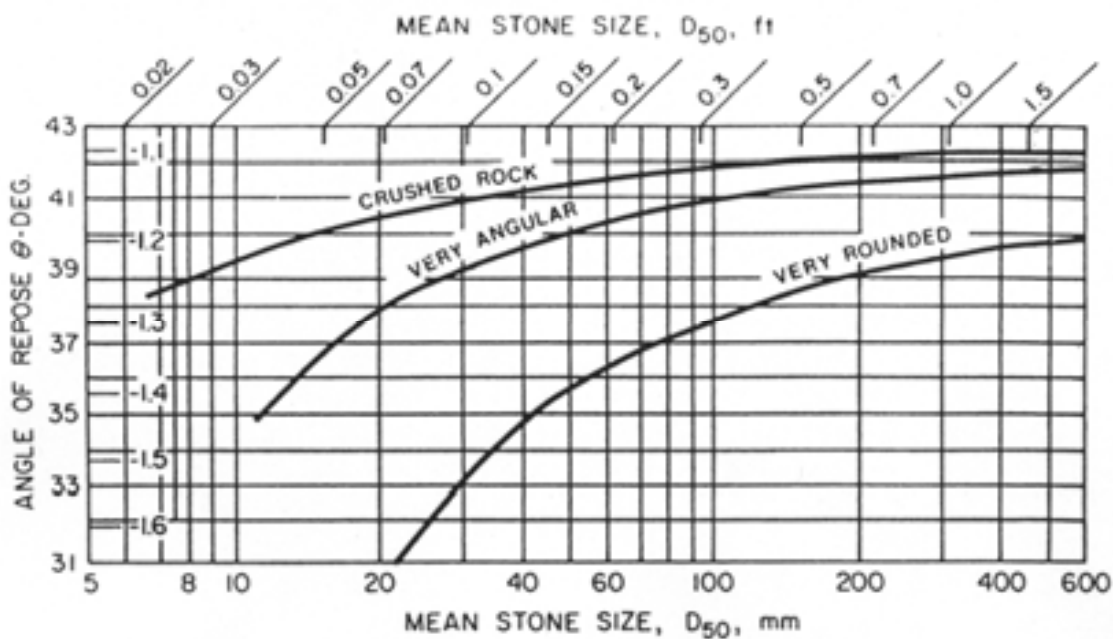
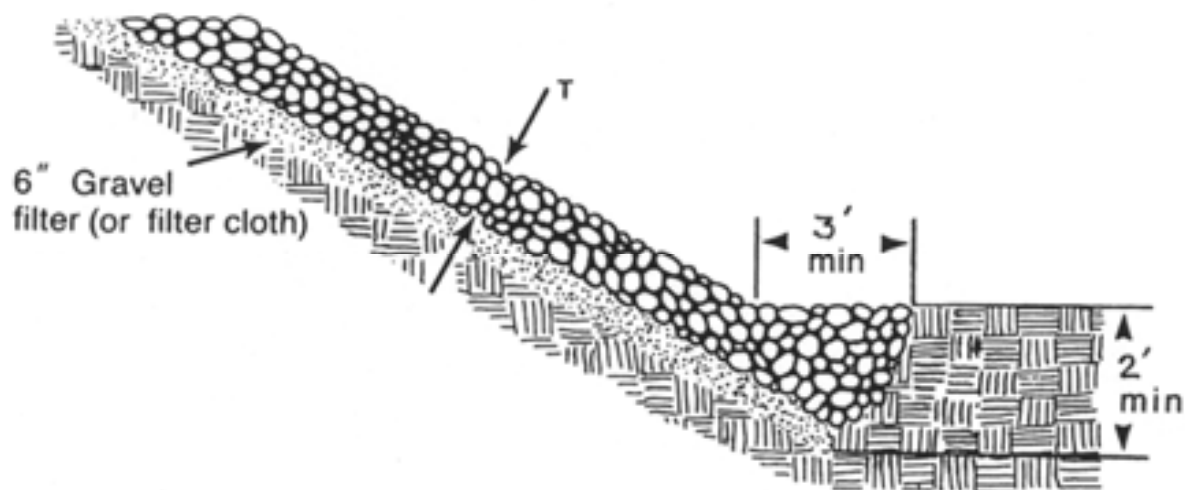


Figure 4.2
Typical Riprap Slope Protection Detail





Channel Stabilization Design Criteria

1. Since each channel is unique, measures for structural channel stabilization should be installed according to a design based on specific site conditions.
2. The plan and profile of the design reach should approximate a naturally stable channel from the project area, based on a stable “reference reach” for the subject channel type.
3. Develop designs according to the following principles:
 - Make protective measures compatible with other channel modifications planned or being carried out in the channel reaches.
 - Whenever excavation and re-shaping work is proposed within channels, the design should provide functional channel dimensions and geometry at each section. Work proposed within a stream channel may require permits from the NYS DEC and US Army Corps of Engineers.
 - Use the design velocity of the peak discharge of the 10-year storm or bankfull discharge, whichever is less. Structural measures should be capable of withstanding greater flows without serious damage.
 - Ensure that the channel bottom is stable or stabilized by structural means before installing any permanent slope protection.
 - Channel stabilization should begin at a stable location and end at a stable point along the bank.
 - Changes in alignment should not be done without a complete analysis of the environmental and stability effects on the entire system.
 - Provisions should be made to maintain and improve fish and wildlife habitat. For example, restoring lost vegetation will provide valuable shade, food, and/or cover.
 - Ensure that all requirements of state law and all permit requirements of local, state, and federal agencies are met.

Construction Specifications

Riprap – Riprap is the most commonly used material to structurally stabilize a channel. While riprap will provide the structural stabilization necessary, the side slope can be enhanced with vegetative material to slow the velocity of water, filter debris, and enhance habitat. See Principles of Biotechnical Practices on page 4.1, for more information.

1. Side slope – slopes shall be graded to 2:1 or flatter prior to placing bedding, filter fabric, or riprap.
2. Filter – filters should be placed between the base material and the riprap and meet the requirements of criteria listed pages 4.7 and 4.8.
3. Gradation – The gradation of the riprap is dependent on the velocity expected against the bank for the design conditions. See Table 4.1 on page 4.12. Once the velocity is known, gradation can be selected from the table for the appropriate class of rock. Note, this table was developed for a 2:1 slope; if the slope steepens to 1.5:1 the gradations should be increased 20%. The riprap should extend 2 feet below the channel bottom and be keyed into the side slope both at the upstream end and downstream end of the proposed work or reach.

See Figure 4.3 on page 4.13 for details.

Reinforced Concrete - Is often used to armor eroding sections of flow channel by constructing walls, bulk heads, or stabilize bank linings in urban areas for redevelopment work. Provide positive drainage behind these structures to relieve uplift pressures.



Grid Pavers – Modular concrete units with or without void areas can be used to stabilize flow channel. Units with void areas can allow the establishment of vegetation. These structures may be obtained in a variety of shapes (Figure 4.4) or they may be formed and poured in place. Maintain design and installation in accordance with manufacturer's instructions.



Revetment – Structural support or armoring to protect an embankment from erosion. Riprap and gabions are commonly used. Also used is a hollow fabric mattress with cells that receive a concrete mixture. Any revetment should be installed to a depth below the anticipated channel degradation and into the channel bed as necessary to provide stability.



Modular Pre-Cast Units – Interlocking modular precast units of different sizes, shapes, heights, and depths, have been developed for a wide variety of applications. They provide vertical support in tight areas as well as durability. Many types are available with textured surfaces. They also act as gravity retaining walls. They should be designed and installed in accordance with the manufacturer's recommendations (Figure 4.4). All areas disturbed by construction should be stabilized as soon as the structural measures are complete.



Maintenance

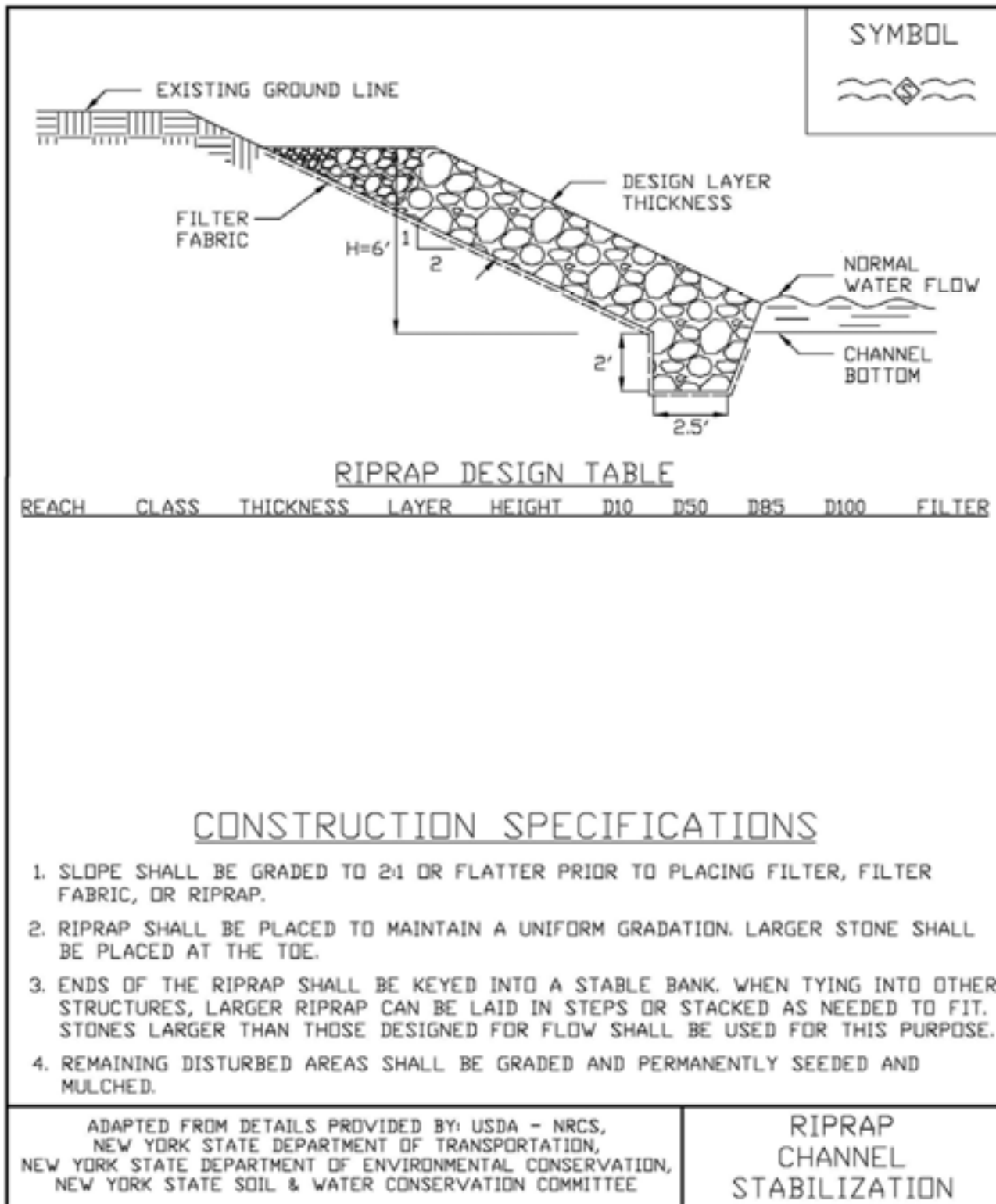
Check stabilized flow channel sections after every high-water event, and make any needed repairs immediately to prevent any further damage or unraveling of the existing work.

Table 4.1 - Riprap Gradations for Channel Stabilization

Class	Layer Thickness (in.)	Max. Velocity (ft/s)	Wave Height (ft.)		PERCENT FINER BY WEIGHT											
					D ₁₀			D ₅₀			D ₈₅			D ₁₀₀		
					Wt. (lbs.)	d _o (in.)	d _□ (in.)	Wt. (lbs.)	d _o (in.)	d _□ (in.)	Wt. (lbs.)	d _o (in.)	d _□ (in.)	Wt. (lbs.)	d _o (in.)	d _□ (in.)
I	18	8.5	-		5	5	4	50	10	8	100	13	10	150	15	12
II	18	10	-		17	7	6	170	15	12	340	19	15	500	22	18
III	24	12	2		46	10	8	460	21	17	920	26	21	1400	30	24
IV	36	14	3		150	15	12	1500	30	25	3000	39	32	4500	47	36
V	48	17	4.8		370	20	16	3700	42	34	7400	53	43	11,000	60	49

d_o = gravel material d_□ = angular rock riprap
Wt = weight in pounds

Figure 4.3
Riprap Channel Stabilization



The top section shows two methods of channel stabilization. On the left, a cross-section of a channel with a 'STABLE BOTTOM' and a 'GRID PAVERS' structure. The pavers are shown as a grid of blocks, with a '2 BLOCKS WIDE' dimension. A 'FILTER CLOTH' is shown beneath the pavers. On the right, a 3D perspective view of the 'GRID PAVERS' structure, showing a grid of blocks with a filter cloth underneath.

The bottom section shows a cross-section of a channel with a '10' HIGH WALL'. The wall is constructed from 'PRE-CAST MODULAR UNITS' (interlocking blocks) and 'BACKFILL MATERIAL'. The wall is shown with a '2' MIN.' dimension and a '1:1' slope. The 'EXISTING CHANNEL BOTTOM' is shown at the base of the wall. The 'EXCAVATION LINE' is shown at the top of the wall. The 'EST. 120 CY ROCK RIPRAP (MEDIUM STONE FILL)' is shown at the top of the wall. The 'Interlocking Blocks' are shown in a 3D perspective view on the right.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS,
NEW YORK STATE DEPARTMENT OF TRANSPORTATION,
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION,
NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE

CHANNEL
STABILIZATION
METHODS

STANDARD AND SPECIFICATIONS FOR BRANCHPACKING



Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability.

Definition & Scope

Branchpacking consists of alternate layers of live branch cuttings and tamped backfill to repair small, localized slumps and holes in slopes to provide repair to existing slopes that have small slips or slumps by filling in the failed area with plant materials and soil.

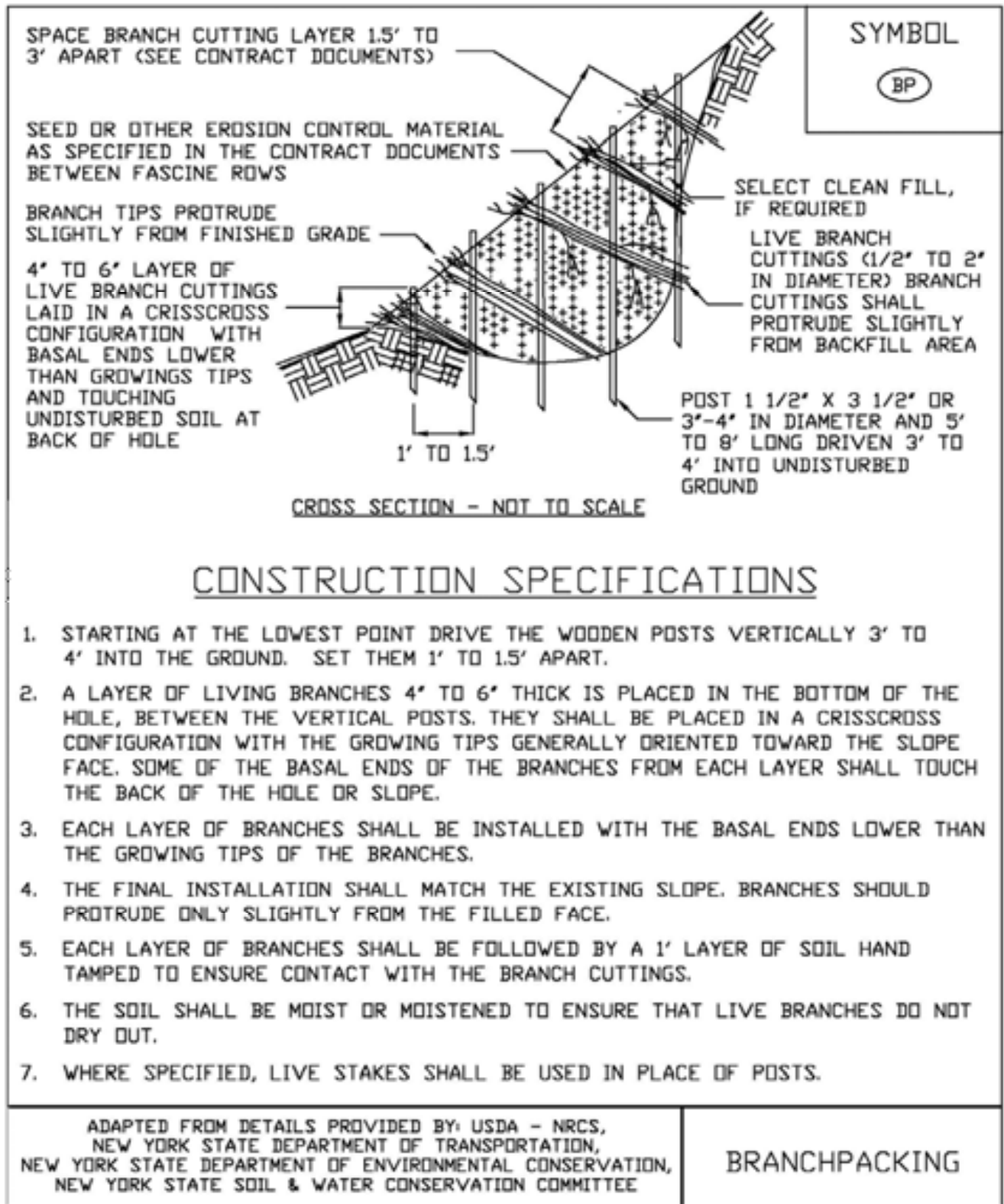
Conditions Where Practice Applies

This is an appropriate technique for repairing slip areas that do not exceed 4 feet deep or 6 feet wide. It should not be used as a slope stability measure if structural embankment support is needed.

Design Criteria

1. The live branch cuttings shall be 1/2 - 2 inches in diameter and long enough to touch the undisturbed soil at the back of the area to be repaired. They should extend 4 - 6 inches beyond the finished backfill grade.
2. Wooden posts should be used to secure the plant material in place. They should be 6 - 8 feet long and 3 - 4 inches in diameter. If lumber is used, it shall be a minimum standard two by four.
3. Wooden posts shall be driven vertically 3 feet deep and placed in a grid pattern 1 - 2 feet apart.
4. Beginning at the bottom of the slip area, 4 - 6 inch layers of live branch cuttings are placed in angled layers, 1.5 to 3 feet apart. Compacted moist soil is placed between the layers (see Figure 4.5).
5. Seasonal planting restriction may have to be considered.

**Figure 4.5
Branchpacking**



STANDARD AND SPECIFICATIONS FOR BRUSH LAYER



Definition & Scope

A brush layer is a horizontal row of live branch cuttings placed in soil with other similar rows, spaced a specific vertical distance apart to stabilize cut and fill slope areas by reinforcing the soil with uprooted branch stems, trapping debris on slope, drying excessively wet sites, and redirecting adverse slope seepage by acting as horizontal drains.

Conditions Where Practice Applies

Generally applicable to stabilize slope areas above the flow line of streambanks as well as cut and fill slopes. Brush layers can be used on slopes up to 2:1 in steepness and 20 feet in height.

Design Criteria

The spacing requirements for brush layer rows is dependent on the slope steepness and moisture content. Spacing shall conform with the following table.

Slope Distance Between Layers (feet)			
Slope H : V	Wet Slope	Dry Slope	Max Slope Length
2 to 2.5:1	3'	3'	15'
2.5 to 3.5:1	3'	4'	15'
3.5 to 4.0:1	4'	5'	25'

Brush layer cuttings shall be 1/2 to 2 inches in diameter and be from dormant plants. No leaf buds shall have initiated growth beyond 1/4" and the cambium layer shall be moist, green, and healthy. The cuttings shall be long

enough to contact the back of the bench with the growing tips protruding out of the slope face.

Care shall be taken not to severely damage the live branch cuttings during installation. Damaged cuttings will be replaced prior to backfilling.

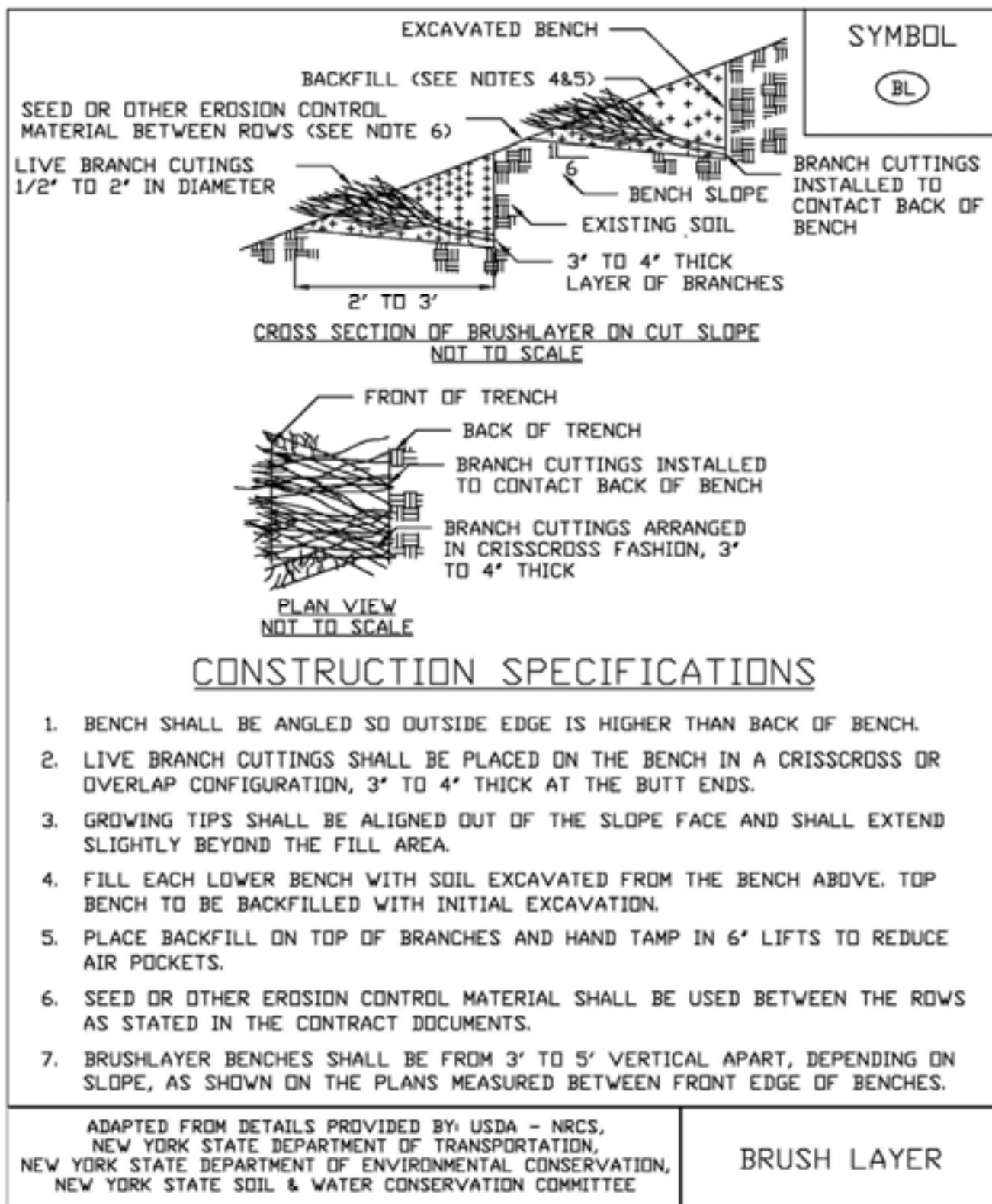
Starting at the toe of the slope, excavate benches along the contour of the slope. The benches shall range from 2 to 3 feet wide and the surface of the bench shall be angled so the front edge is higher than the back of the bench (See Figure 4.6). The benches shall be spaced according to the previous table, Slope Distance Between Layers (ft).

Live branch cuttings shall be placed on the bench in a crisscross or overlapping configuration in layers 3 - 4 inches thick at the butt ends. Backfill shall be placed on top of the live branch cuttings and tamped in 6 inch lifts. Small plate compactors may be used to settle the soil. Areas between the rows of brush layers shall be stabilized by seeding or other appropriate erosion control method.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability. The brush layer may need to be watered periodically during the first year if installation is done during the summer months.

Figure 4.6
Brush Layer



STANDARD AND SPECIFICATIONS FOR BRUSH MATTRESS



Definition & Scope

A mulch or mattress of living brush laid on a slope and fastened down with stakes and wire to protect the soil surface on slopes from erosive forces through the generation of a dense stand of woody vegetation.

Conditions Where Practice Applies

Brush mattresses are used primarily on streambanks where the velocity is less than 6 feet per second and excessive streamflow has created erosive conditions. This practice can resist temporary inundation, but not scour or undercutting.

Design Criteria

Layer Thickness—The brush shall be a minimum of 3 inches thick (excluding top soil layer).

Height—The mattress shall be placed up the bank to the bankfull elevation. The toe of the mattress should be located in a fascine trench.

Slope—The maximum slope shall be 1.5:1.

Anchoring—The mattress shall be anchored on the slope by a grid of 3-foot stakes driven on 3-foot centers each way. No. 9 wire is then wound between the stakes, which are driven to secure the mattress. The upstream edge of the mattress should be keyed into the bank 2 feet.

Materials—The plant materials should be willow or dogwood brush placed as shown in Figure 4.7.

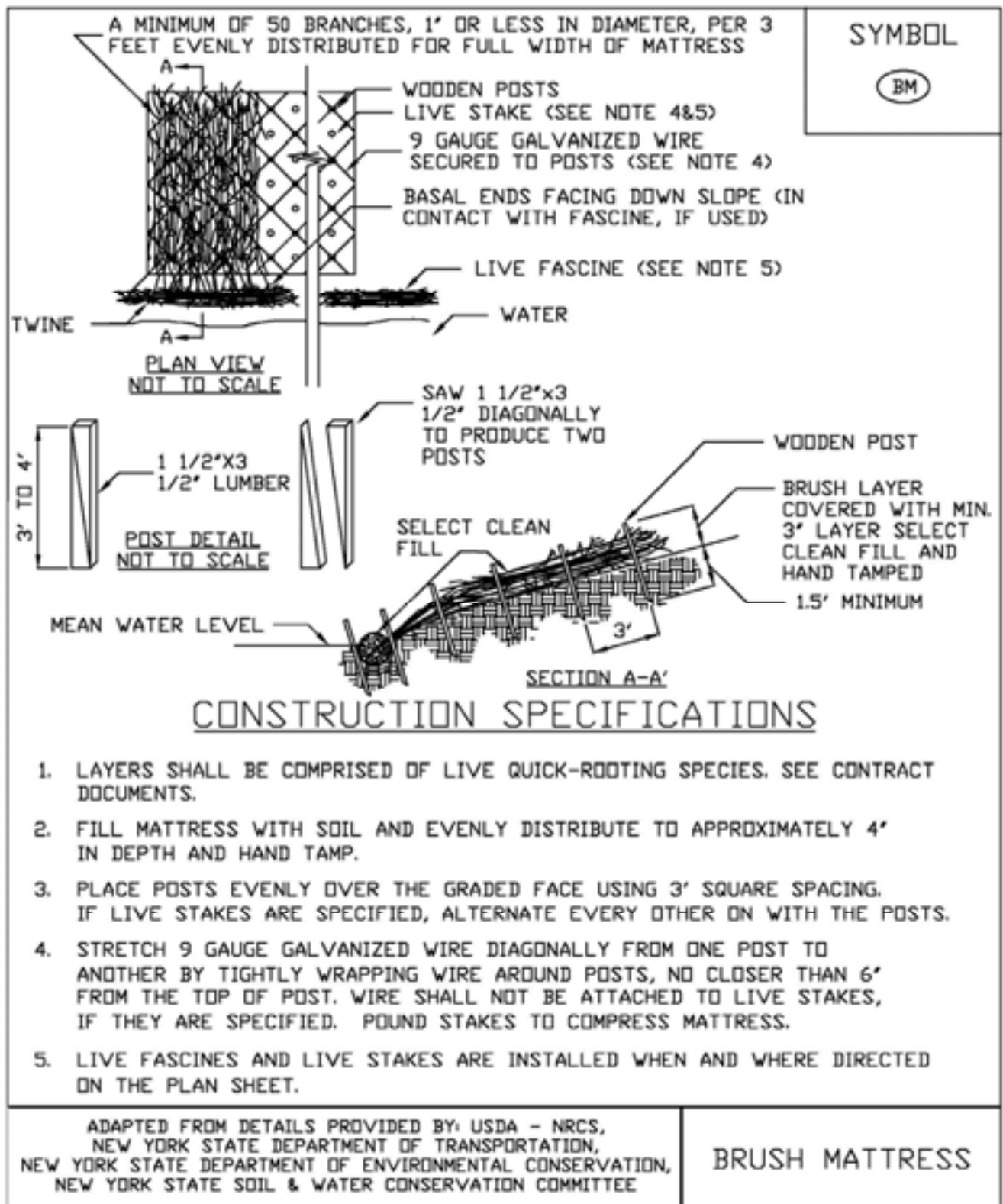
Construction Specifications

1. Prepare slope surface by grading to a uniform, smooth surface, clear of obstruction. Slopes should be graded before the brush mattress is installed.
2. The fascine toe should be installed first. Then lay brush beginning at the downstream end of the work. The toe below the waterline may be anchored by rock.
3. The butt end of the brush will be placed upstream and plant materials inclined approximately 30 degrees.
4. The upstream edge of the mattress will be keyed into the slope 2 feet. Stakes will be driven throughout the mattress on 3-foot centers each way beginning along the toe of the mattress.
5. No. 9 wire will be attached to the stakes and tightened to secure the mattress.
6. Slope areas above the mattress will be shaped and seeded.

Maintenance

Scheduled inspections the first year are necessary to make sure the anchoring system is sound. Broken wire or missing stakes shall be replaced immediately. Any missing toe material shall be replaced. The brush mattress may need to be watered periodically during the first year if installation is done during the summer months.

Figure 4.7
Brush Mattress



STANDARD AND SPECIFICATIONS FOR FERTILIZER APPLICATION



Definition & Scope

The **permanent** incorporation of fertilizer into the planting zone of the soil profile to provide nutrient amendments to the soil for vigorous support to plant and vegetation growth.

Conditions Where Practice Applies

This standard applies to all areas where permanent seeding, sodding, and plant establishment is required. All application of fertilizer shall be in accordance with Nutrient Runoff Law - ECL Article 17, Title 21. Phosphorus runoff poses a threat to water quality. Therefore, under New York Law, fertilizer containing phosphorus may only be applied to lawn or non-agricultural turf when:

1. A soil test indicates that additional phosphorus is needed for growth of that lawn or non-agricultural turf, or
2. The fertilizer is used for newly established lawn or non-agricultural turf during the first growing season.

For projects located within watersheds where enhanced phosphorus removal standards are required as part of its post-construction stormwater management plan, use of any fertilizer containing more than 0.67 percent phosphate (P_2O_5) content will be done only with a valid soil test demonstrating the need for that formulation.

Design Criteria

Fertilizer is sold with an analysis printed on the tag or bag shown as three numbers separated by a dash, such as 5-10-5. The first number is the percent of the total weight of the bag that is nitrogen (N), the second is the percent of

phosphate (phosphorus, P), and the third is the percent of potash (potassium, K). Other elements are sometimes included and are listed with these three basic components.

For example a 40 lb bag of 5-10-5 fertilizer contains 5% of 40 lbs of Nitrogen which equals 2 lbs. There is 10% of 40 lbs of phosphate (phosphorus) which equals 4 lbs, and there is 5% of potash (potassium), another 2 lbs., for a total of 8 lbs of active fertilizer in the 40 lb bag. The rest is filler to aid in spreading the material over the area to be treated.

Specify the design fertilizer mix and application rates based on the results of the soil tests.

Specifications

1. In no case shall fertilizer be applied between December 1 and April 1 annually.
2. Fertilizer shall not be spread within 20 feet of a surface water.
3. Any fertilizer falling or spilled into impervious surface areas such as parking lots, roadways, and sidewalks should be immediately contained and legally applied or placed in an appropriate container.
4. Incorporate the fertilizer, and lime if specified, into the top 2-4 inches of the topsoil or soil profile.
5. When applying fertilizer by hydro seeding care should be taken to apply mix only to seed bed areas at an appropriate flow rate to prevent erosion and spraying onto impervious areas.



STANDARD AND SPECIFICATIONS FOR FIBER ROLL



Definition & Scope

A fiber roll is a coir (coconut fiber), straw, or excelsior roll encased in netting of jute, nylon, or burlap to dissipate energy along streambanks, channels, and bodies of water and to reduce sheet flow on slopes.

Conditions Where Practice Applies

Fiber rolls are used where the water surface levels are relatively constant. Artificially controlled streams for hydropower are not good candidates for this technique. The rolls provide a good medium for the introduction of herbaceous vegetation. Planting in the fiber roll is appropriate where the roll will remain continuously wet.

Design Criteria

1. The roll is placed in a shallow trench dug below baseflow or in a 4 inch trench on the slope contour and anchored by 2" x 2", 3-foot long posts driven on each side of the roll (see Figure 4.8).
2. The roll is contained by a 9-gauge non-galvanized wire placed over the roll from post to post. Braided nylon rope (1/8" thick) may be used.
3. The anchor posts shall be spaced laterally 4 feet on center on both sides of the roll and driven down to the top of the roll.
4. Soil is placed behind the roll and planted with suitable herbaceous or woody vegetation. If the roll will be continuously saturated, wetland plants may be planted into voids created in the upper surface of the roll.
5. Where water levels may fall below the bottom edge of the roll, a brush layer of willow should be installed so

as to lay across the top edge of the roll.

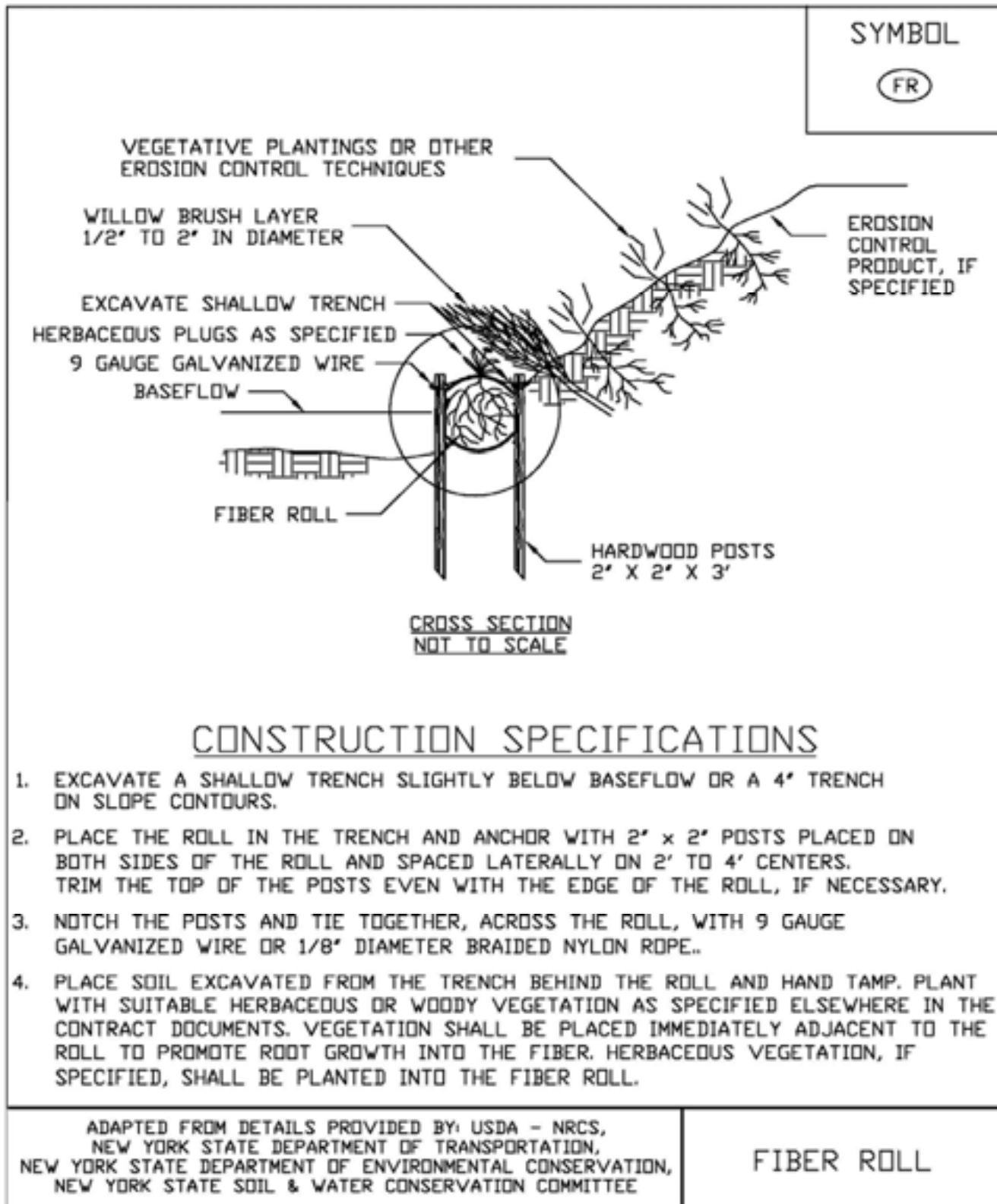
6. Where fiber rolls are used to reduce sheet flow on slopes they should be at least 12" in diameter and spaced according to the straw bale dike standard for sediment control.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability.



Figure 4.8
Fiber Roll



STANDARD AND SPECIFICATIONS FOR LANDGRADING



Definition & Scope

Permanent reshaping of the existing land surface by grading in accordance with an engineering topographic plan and specification to provide for erosion control and vegetative establishment on disturbed, reshaped areas.

Design Criteria

The grading plan should be based upon the incorporation of building designs and street layouts that fit and utilize existing topography and desirable natural surrounding to avoid extreme grade modifications. Information submitted must provide sufficient topographic surveys and soil investigations to determine limitations that must be imposed on the grading operation related to slope stability, effect on adjacent properties and drainage patterns, measures for drainage and water removal, and vegetative treatment, etc.

Many municipalities and counties have regulations and design procedures already established for land grading and cut and fill slopes. Where these requirements exist, they shall be followed.

The plan must show existing and proposed contours of the area(s) to be graded. The plan shall also include practices for erosion control, slope stabilization, safe disposal of runoff water and drainage, such as waterways, lined ditches, reverse slope benches (include grade and cross section), grade stabilization structures, retaining walls, and surface and subsurface drains. The plan shall also include phasing of these practices. The following shall be incorporated into the plan:

1. Provisions shall be made to safely convey surface runoff to storm drains, protected outlets, or to stable water courses to ensure that surface runoff will not

damage slopes or other graded areas; see standards and specifications for Grassed Waterway, Diversion, or Grade Stabilization Structure.

2. Cut and fill slopes that are to be stabilized with grasses shall not be steeper than 2:1. When slopes exceed 2:1, special design and stabilization consideration are required and shall be adequately shown on the plans. (Note: Where the slope is to be mowed, the slope should be no steeper than 3:1, although 4:1 is preferred because of safety factors related to mowing steep slopes.)
3. Reverse slope benches or diversion shall be provided whenever the vertical interval (height) of any 2:1 slope exceeds 20 feet; for 3:1 slope it shall be increased to 30 feet and for 4:1 to 40 feet. Benches shall be located to divide the slope face as equally as possible and shall convey the water to a stable outlet. Soils, seeps, rock outcrops, etc., shall also be taken into consideration when designing benches.
 - A. Benches shall be a minimum of six feet wide to provide for ease of maintenance.
 - B. Benches shall be designed with a reverse slope of 6:1 or flatter to the toe of the upper slope and with a minimum of one foot in depth. Bench gradient to the outlet shall be between 2 percent and 3 percent, unless accompanied by appropriate design and computations.
 - C. The flow length within a bench shall not exceed 800 feet unless accompanied by appropriate design and computations; see Standard and Specifications for Diversion on page 3.9
4. Surface water shall be diverted from the face of all cut and/or fill slopes by the use of diversions, ditches and swales or conveyed downslope by the use of a designed structure, except where:
 - A. The face of the slope is or shall be stabilized and the face of all graded slopes shall be protected from surface runoff until they are stabilized.
 - B. The face of the slope shall not be subject to any concentrated flows of surface water such as from natural drainage ways, graded ditches, downspouts, etc.
 - C. The face of the slope will be protected by anchored stabilization matting, sod, gravel, riprap, or other stabilization method.

5. Cut slopes occurring in ripable rock shall be serrated as shown in Figure 4.9 on page 4.26. The serrations shall be made with conventional equipment as the excavation is made. Each step or serration shall be constructed on the contour and will have steps cut at nominal two-foot intervals with nominal three-foot horizontal shelves. These steps will vary depending on the slope ratio or the cut slope. The nominal slope line is 1 ½: 1. These steps will weather and act to hold moisture, lime, fertilizer, and seed thus producing a much quicker and longer-lived vegetative cover and better slope stabilization. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.
6. Subsurface drainage shall be provided where necessary to intercept seepage that would otherwise adversely affect slope stability or create excessively wet site conditions.
7. Slopes shall not be created so close to property lines as to endanger adjoining properties without adequately protecting such properties against sedimentation, erosion, slippage, settlement, subsidence, or other related damages.
8. Fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris, and other objectionable material. It should be free of stones over two (2) inches in diameter where compacted by hand or mechanical tampers or over eight (8) inches in diameter where compacted by rollers or other equipment. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.
9. Stockpiles, borrow areas, and spoil shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.
10. All disturbed areas shall be stabilized structurally or vegetatively in compliance with the Permanent Construction Area Planting Standard on page 4.42.
4. Areas to be filled shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material.
5. Areas that are to be topsoiled shall be scarified to a minimum depth of four inches prior to placement of topsoil.
6. All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence, or other related problems. Fill intended to support buildings, structures, and conduits, etc., shall be compacted in accordance with local requirements or codes.
7. All fill shall be placed and compacted in layers not to exceed 9 inches in thickness.
8. Except for approved landfills or nonstructural fills, fill material shall be free of frozen particles, brush, roots, sod, or other foreign objectionable materials that would interfere with, or prevent, construction of satisfactory fills.
9. Frozen material or soft, mucky or highly compressible materials shall not be incorporated into fill slopes or structural fills.
10. Fill shall not be placed on saturated or frozen surfaces.
11. All benches shall be kept free of sediment during all phases of development.
12. Seeps or springs encountered during construction shall be handled in accordance with the Standard and Specification for Subsurface Drain on page 3.48 or other approved methods.
13. All graded areas shall be permanently stabilized immediately following finished grading.
14. Stockpiles, borrow areas, and spoil areas shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.

Construction Specifications

See Figures 4.9 and 4.10 for details.

1. All graded or disturbed areas, including slopes, shall be protected during clearing and construction in accordance with the erosion and sediment control plan until they are adequately stabilized.
2. All erosion and sediment control practices and measures shall be constructed, applied and maintained in accordance with the erosion and sediment control plan and these standards.
3. Topsoil required for the establishment of vegetation shall be stockpiled in amount necessary to complete finished grading of all exposed areas.



Figure 4.9
Typical Section of Serrated Cut Slope

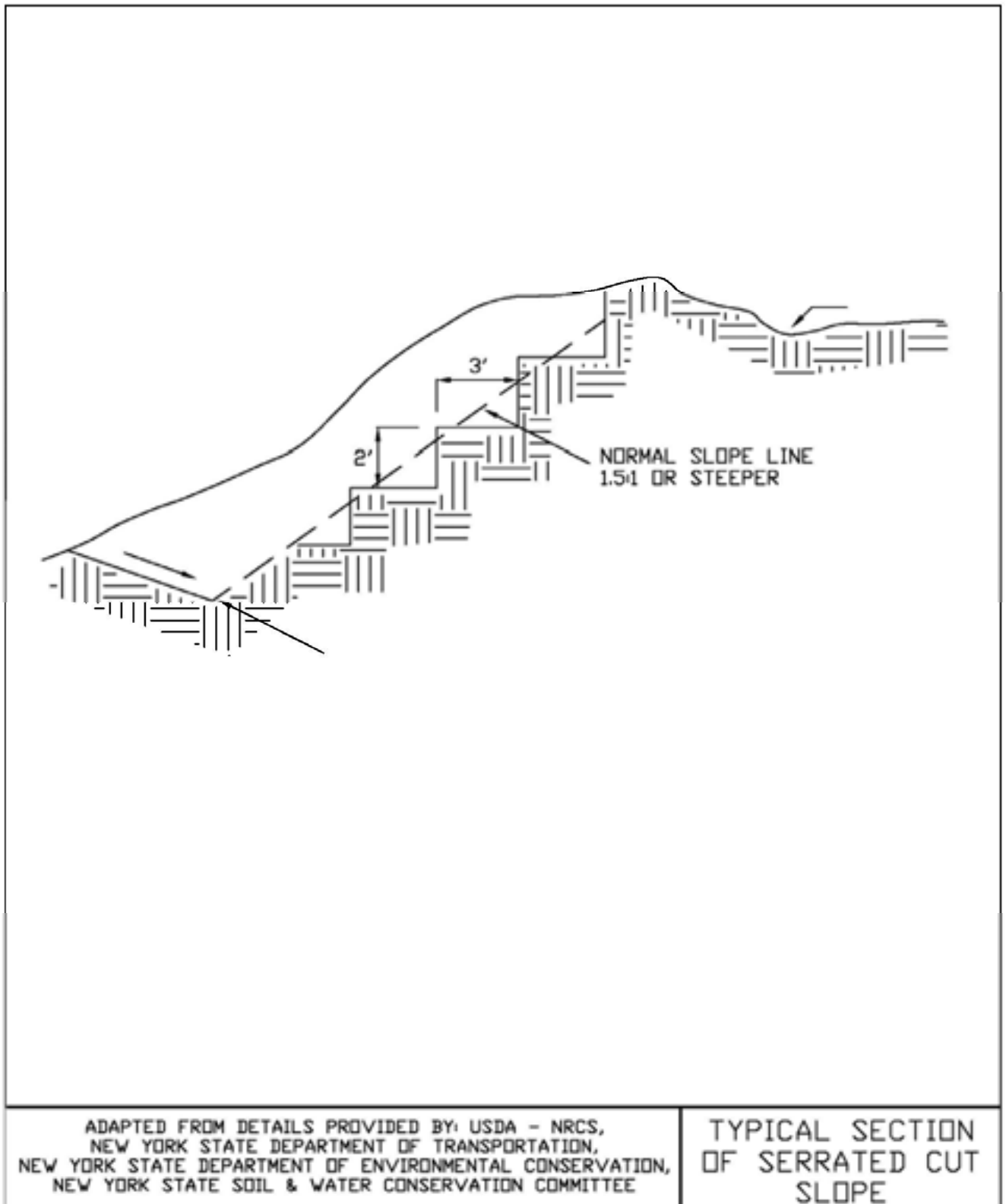


Figure 4.10
Landgrading

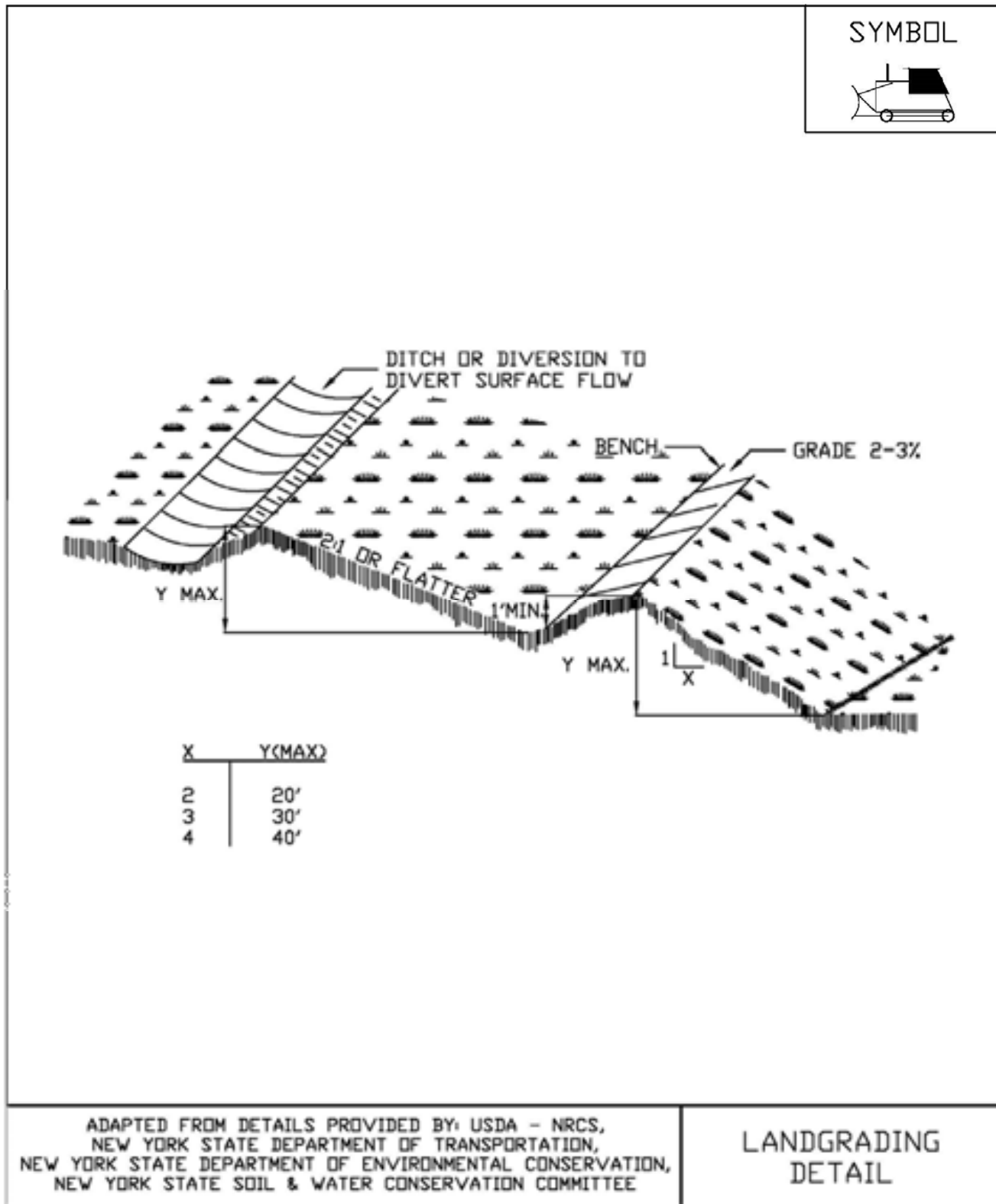


Figure 4.11
Landgrading - Construction Specifications

<u>CONSTRUCTION SPECIFICATIONS</u>	
<ol style="list-style-type: none"> 1. ALL GRADED OR DISTURBED AREAS INCLUDING SLOPES SHALL BE PROTECTED DURING CLEARING AND CONSTRUCTION IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN UNTIL THEY ARE PERMANENTLY STABILIZED. 2. ALL SEDIMENT CONTROL PRACTICES AND MEASURES SHALL BE CONSTRUCTED, APPLIED AND MAINTAINED IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN. 3. TOPSOIL REQUIRED FOR THE ESTABLISHMENT OF VEGETATION SHALL BE STOCKPILED IN AMOUNT NECESSARY TO COMPLETE FINISHED GRADING OF ALL EXPOSED AREAS. 4. AREAS TO BE FILLED SHALL BE CLEARED, GRUBBED, AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS OR OTHER OBJECTIONABLE MATERIAL. 5. AREAS WHICH ARE TO BE TOPSOILED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF FOUR INCHES PRIOR TO PLACEMENT OF TOPSOIL. 6. ALL FILLS SHALL BE COMPACTED AS REQUIRED TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE OR OTHER RELATED PROBLEMS. FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES AND CONDUITS, ETC. SHALL BE COMPACTED IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES. 7. ALL FILL SHALL BE PLACED AND COMPACTED IN LAYERS NOT TO EXCEED 9 INCHES IN THICKNESS. 8. EXCEPT FOR APPROVED LANDFILLS, FILL MATERIAL SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OTHER OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH OR PREVENT CONSTRUCTION OF SATISFACTORY FILLS. 9. FROZEN MATERIALS OR SOFT, MUCKY OR HIGHLY COMPRESSIBLE MATERIALS SHALL NOT BE INCORPORATED IN FILLS. 10. FILL SHALL NOT BE PLACED ON SATURATED OR FROZEN SURFACES. 11. ALL BENCHES SHALL BE KEPT FREE OF SEDIMENT DURING ALL PHASES OF DEVELOPMENT. 12. SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD. 13. ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY FOLLOWING FINISHED GRADING. 14. STOCKPILES, BORROW AREAS AND SPOIL AREAS SHALL BE SHOWN ON THE PLANS AND SHALL BE SUBJECT TO THE PROVISIONS OF THIS STANDARD AND SPECIFICATION. 	
ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	LANDGRADING SPECIFICATIONS

STANDARD AND SPECIFICATIONS FOR LIME APPLICATION



The amount of limestone needed can be estimated by using the following table. A soil test is the only way to determine the soil pH. This table is very general, but it is useful for planning.

Definition & Scope

Permanent incorporation of agricultural ground limestone within the top 2 to 6 inches of the soil profile to increase the soil pH from an acidic level to a neutral level to provide an active growth medium for vegetation.

Conditions Where Practice Applies

At all locations where a vigorous growth of vegetation is desired and the soil pH is less than 7.0 or neutral.

Design Criteria

Liming material sold in New York varies considerably in several ways. The mineral content (calcium and magnesium) of the limestone may be high or low and, the fineness or particle sizes vary between suppliers. Two types of limestone are sold. The most common is limestone high in calcium. Dolomitic limestone contains magnesium (Mg) and calcium (Ca). Limestone sold in NY varies from 0 to 20% Mg while the calcium content of lime varies from 14.7% to 51.5%. Particle size determines how rapidly the calcium and magnesium will react with the acid in the soil. The finer the particle sizes, the quicker the reaction.

When obtaining agricultural limestone, one should state on the specification that the amount should be adjusted to 100% effective neutralizing value (ENV). This is the way to compare materials as it adjusts for the reactive Ca and Mg and the particle size. The ENV is stated as the ratio needed to convert a limestone recommendation to 100% ENV. Thus, if the recommendation is 4 tons/acre of 100% ENV lime and the lime being used had an 80% ENV (1/ENV = 1.25), 4 times 1.25 or 5 tons/acre would be required.

General lime guidelines (at 100% ENV)

Initial Soil pH	Sands	Sandy Loams	Loam and Silt Loams	Silty Clay Loams
4.5	2.5	6.0	9.5	13.0
4.6-4.7	2.5	6.0	9.0	12.5
4.8-4.9	2.5	5.5	8.5	12.0
5.0-5.1	2.0	5.0	7.5	10.5
5.2-5.3	1.5	4.0	6.5	8.5
5.4-5.5	1.0	3.0	4.0	6.0
5.6-5.7	1.0	2.0	3.0	4.5
5.8-5.9	0.7	1.5	2.5	3.5
6.0-6.1	0.6	1.5	2.0	3.0
6.2-6.3	0.4	1.0	1.5	2.0
6.4-6.5	0.3	0.7	1.0	1.5
6.6-6.7	0.2	0.5	0.7	1.0
Lime guidelines are in tons per acre and are based on a plow depth of 8.0 inches. Correct rate if plowing to a different depth.				
Conversion for small areas: 1 ton/acre = 2,000#/43,560 ft ² , 46#/1,000 ft ²				

Note: Lime should not be applied within 50 feet of streams and wetlands.

STANDARD AND SPECIFICATIONS FOR LIVE CRIB WALL



Definition & Scope

A hollow box-like structure made with an interlocking arrangement of untreated logs or timber members spiked together and anchored into the slope. The structure is filled with suitable earthfill materials and layers of live branch cuttings which root inside the structure and extend into the slope. This protects exposed or eroded streambanks from the erosive forces of flowing water and stabilize the toe of slope to reduce slope steepness.

Conditions Where Practice Applies

Generally applicable where flows are less than 6 feet per second and no degradation of the streambed occurs. Can reduce steepness and provide stability where space is limited and a vertical structure is needed. It is not intended to be used where the integrity of a road or structure is dependent on the cribwall since it is not designed to resist large lateral earth pressures.

Design Criteria

1. The vegetated cribwall structure shall be designed to a height for its intended purpose.
2. Live branch cuttings should be 1/2 to 2 inches in diameter and long enough to reach from the front of the structure to the undisturbed soil.
3. The structure will be built with a batter of 1 to 12. Large spikes or rebar are required to secure the logs or timbers together (10 inches minimum).
4. Only untreated logs or timber shall be used in the cribwall.
5. Installation begins with excavating to a stable

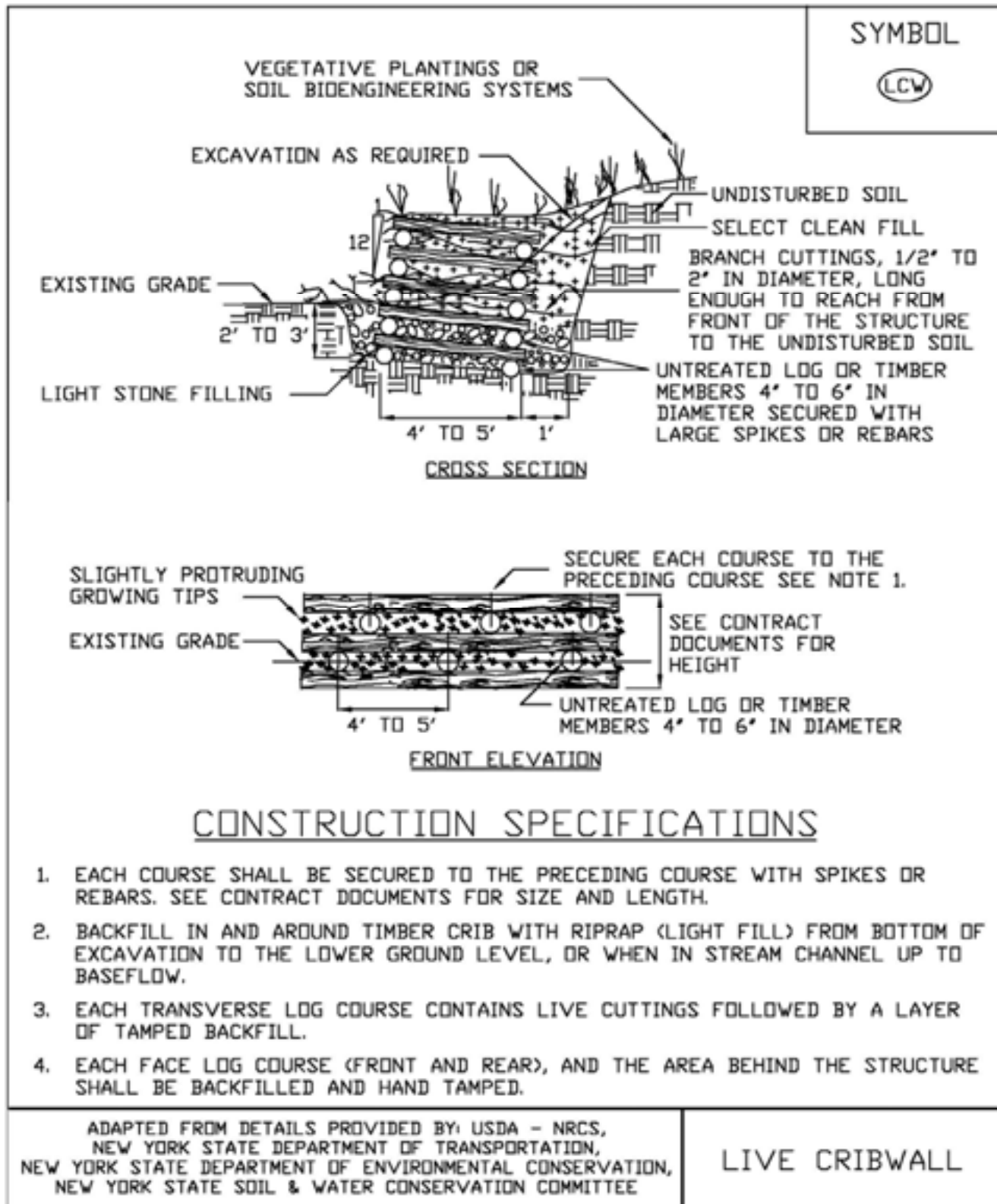
foundation 2' - 3' below the ground elevation at the toe of slope with the back of the excavation (to the slope) slightly deeper than the front.

6. The first course of logs is placed along the front and back of the excavated foundation approximately 4-5 feet apart and parallel to the slope contour.
7. The next course is placed at right angles on top of the previous course to overhang the front and back of the previous logs by 3-6 inches.
8. Each course is placed in the same manner and fastened to the preceding course to the desired grade.
9. Stone fill is placed in the bottom of the structure up to the ground level and up to the base flow in a stream channel.
10. Once the cribwall structure reaches the existing ground elevation, live branch cuttings are placed on the stone fill parallel with the slope contour.
11. The cuttings are then covered with select clean fill with a maximum size of 3 inches and not more than 20 percent passing a 200 sieve size.
12. The live branch cuttings shall be placed at each course followed by the select fill to the top of the structure with the growing tips slightly protruding from the cribwall face.
13. The plant materials shall be kept in a healthy growing condition by watering. Also see maintenance below.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability. Plant materials may need to be watered periodically during the first growing season if installed during summer months.

Figure 4.12
Live Cribwall



STANDARD AND SPECIFICATIONS FOR LIVE FASCINES



Definition & Scope

The placement of groups or bundles of twigs, whips, or branches in shallow trenches, on the contour, on either cut or fill slopes. To stabilize slopes by slowing water movement down the slope, increasing infiltration, trapping slope sediments, and increasing soil stability with root systems.

Conditions Where Practice Applies

On sloping areas such as road cuts, slumped areas, road fills, gullies, and streambanks subject to erosion, seepage, or weathering, which have a low to medium hazard potential should slope failure occur. Slopes must be 1:1 or flatter.

Design Criteria

Materials—Shall be a native or nursery grown cultivar that is capable of performing the intended function.

Fascines—Shall be made by forming the bundles 8-15 feet long, 4 inches minimum in diameter, from stems no more than 1 inch in diameter.

Overlap—Fascines should be overlapped at the tapered ends a minimum of 1-foot.

Vertical Spacing—The spacing of the contours for the fascines is dependent on the degree of erosion or potential erosion at the site. Factors include slope steepness, soil type, drainage, and existing ground cover. The following is a general guide to selecting contour interval:

Slope	Contour Interval
1:1	3'
1.5:1	3'
2:1	4'
2.5:1	4'
3:1	5'
3.5:1	5'
4:1	6'
6:1	8'

See Figure 4.13 for details.

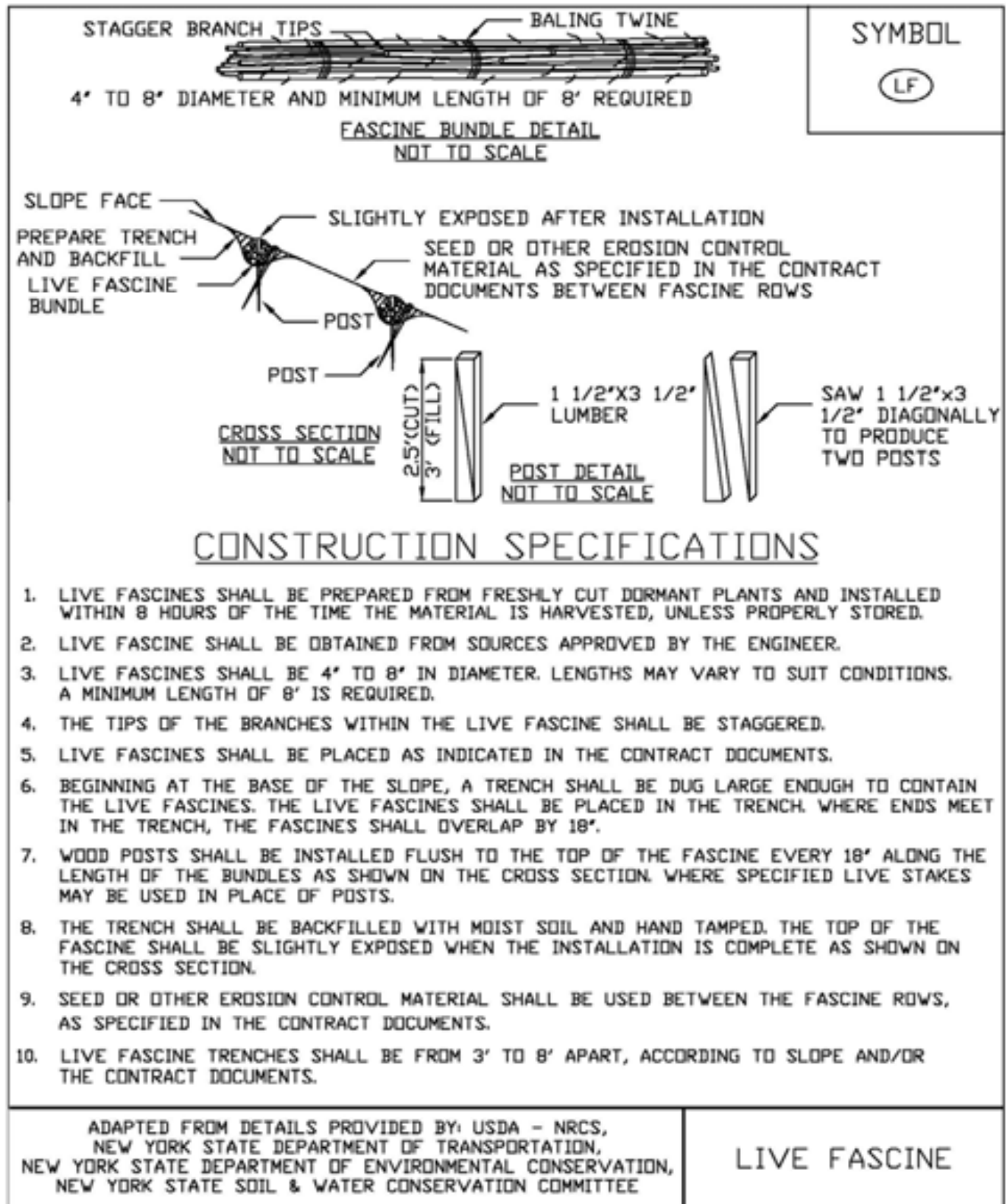
Construction Specifications

1. Fascines shall be 4 inches minimum in diameter.
2. Prior to placing the fascines, the slope shall be smoothed and graded with obstructions removed. Any structural measures for revetment, drainage, or surface water management will be installed first.
3. Working from the bottom of the slope to the top, excavate the fascine trench. Place fascines in trench and anchor with stakes spaced at 24 inches. Cover fascines with soil leaving about 10% exposed to view. Fascines shall be overlapped 12 inches minimum in the trench.
4. Soil shall be worked into the fascine and compacted by walking on the fascine being covered.
5. All disturbed areas should be seeded upon completion of fascine placement.

Maintenance

Regular inspection and maintenance of fascine installations should be conducted especially during the first year of establishment. Loose stakes should be reset and settled fill areas should be brought back to grade. Prompt corrections to gullies, sloughs or other evident problems shall be made.

Figure 4.13
Live Fascine



STANDARD AND SPECIFICATIONS FOR LIVE STAKES



Definition & Scope

A stake or pole fashioned from live woody material to create a living root mat that stabilizes the soil by reinforcing and binding soil particles together and by contributing to the reduction of excess soil moisture.

Conditions Where Practice Applies

Live stakes are an appropriate technique for repair of small earth slips and slumps that are frequently wet and for stabilizing raw streambanks. This technique is for relatively uncomplicated site conditions when construction time is limited and an inexpensive vegetative method for stabilization is derived. It is not intended where structural integrity is required nor to resist large, lateral earth pressures.

Design Criteria

1. Live stakes shall be 1 - 2 inches in diameter and 2-6 feet long, depending on site application.
2. No leaf buds shall have initiated growth beyond 1/4" and the cambium layer shall be moist, green and healthy.
3. All material shall be maintained in a continuously cool, covered, and moist state prior to use and be in good condition when installed.
4. Materials harvested on site shall be installed the same day they are prepared. Nursery grown material shall be maintained in a moist condition until installed.
5. Installation Details
 - A. The lengths of live cuttings/live stakes depends upon the application. If through riprap, the length

shall extend through the surface of the stone fill. At least half the length shall be inserted into the soil, below the stone fill. Spacing along the waterline is usually 1 foot.

- B. Minimum 2 to 4 inches and two live buds of the live stake shall be exposed above the stone filling.
- C. Live stakes shall be cut to a point on the basal end for insertion in the ground.
- D. Use a dead blow hammer to drive stakes into the ground. The hammer head should be filled with shot or sand. A dibble, iron bar, or similar tool shall be used to make a pilot hole to prevent damaging the material during installation.
- E. Live cuttings shall be inserted by hand into pilot holes.
- F. When possible, tamp soil around live stakes.
- G. Care shall be taken not to damage the live stakes during installation. Those damaged at the top during installation shall be trimmed back to undamaged condition.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability. Plant materials may need to be watered periodically during the first growing season if installed during summer months.

Figure 4.14
Live Stake

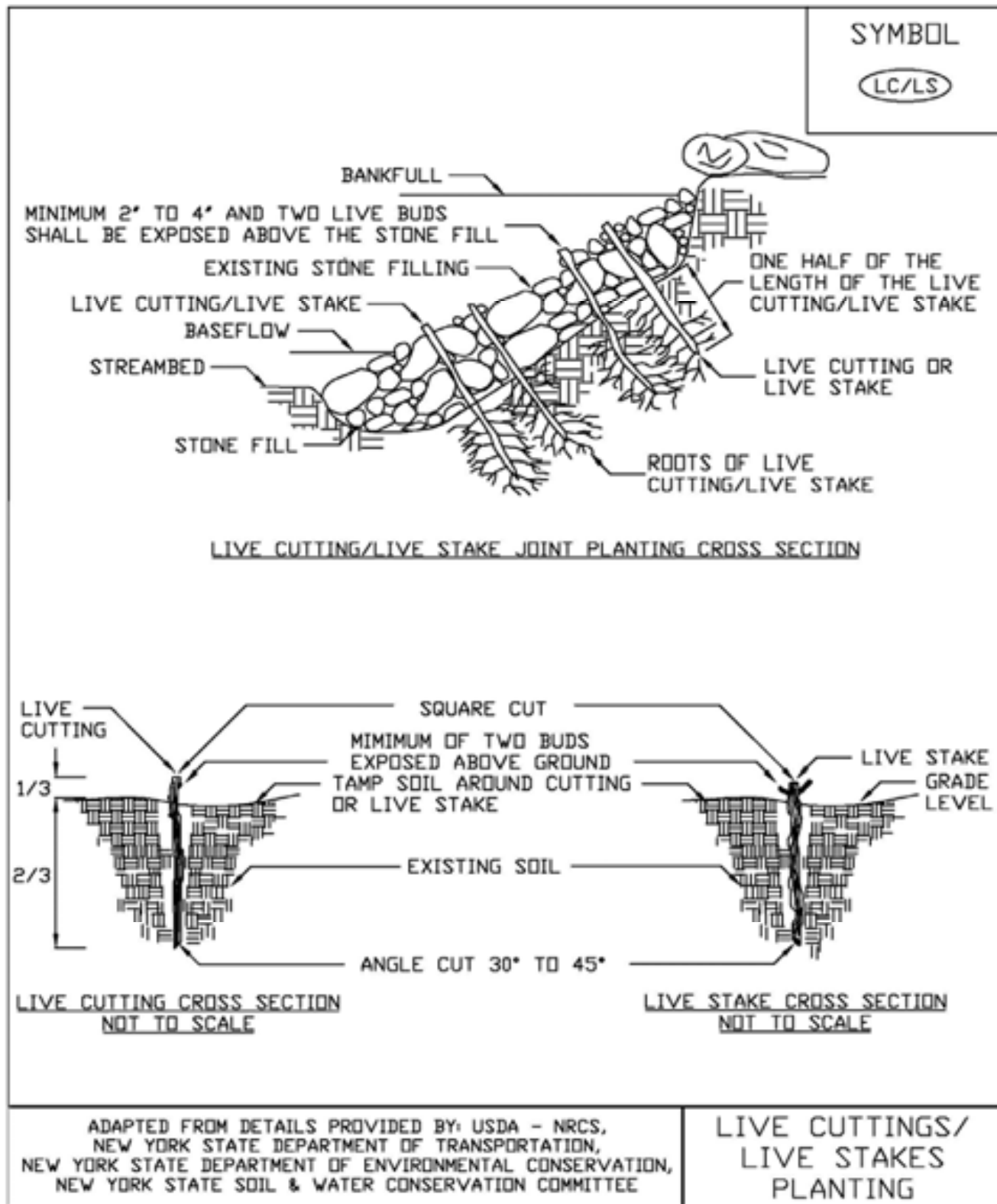


Figure 4.15
Live Stake Construction Specifications

	<p style="text-align: center;">SYMBOL</p> <p style="text-align: center;">(LC/LS)</p>
<p style="text-align: center;"><u>CONSTRUCTION SPECIFICATIONS</u></p> <ol style="list-style-type: none"> 1. CARE SHALL BE TAKEN NOT TO DAMAGE THE LIVE CUTTINGS/LIVE STAKES DURING INSTALLATION. THOSE DAMAGED SHALL BE LEFT IN PLACE AND SUPPLEMENTED WITH AN INTACT LIVE CUTTING/LIVE STAKE. 2. THE LENGTHS OF LIVE CUTTINGS/LIVE STAKES DEPENDS UPON THE APPLICATION. THE LENGTH SHALL EXTEND THROUGH THE SURFACE OF THE STONE FILL. AT LEAST HALF THE LENGTH SHALL BE INSERTED IN TO THE SOIL, BELOW THE STONE FILL. 3. A PILOT HOLE IS REQUIRED TO ENSURE THAT THE LIVE CUTTING/LIVE STAKE IS NOT DAMAGED WHEN DRIVEN THROUGH THE STONE FILLING. ACCESS SHALL BE MADE THROUGH THE USE OF A DIBBLE BAR, OR SIMILAR TOOL TO WORK AN OPENING THROUGH THE ROCK LAYER. 4. MINIMUM 2' TO 4' AND TWO LIVE BUDS OF THE LIVE CUTTING/LIVE STAKE SHALL BE EXPOSED ABOVE THE STONE FILLING. 5. LIVE CUTTINGS SHALL RANGE FROM 1/2' TO 1' IN DIAMETER AND BE FROM 1' TO 4' IN LENGTH. 6. LIVE STAKES SHALL RANGE FROM 1' TO 4' IN DIAMETER AND BE FROM 5' TO 6' IN LENGTH. 7. SEE CONTRACT DOCUMENTS FOR SPECIES, SIZE, SPACING, LOCATION, AND FINAL DETERMINATION ON USE OF CUTTINGS OR STAKES. 8. LIVE CUTTINGS/LIVE STAKES SHALL BE CUT TO A POINT ON THE BASAL END FOR INSERTION IN THE GROUND. 9. USE A DEAD BLOW HAMMER TO DRIVE STAKES INTO THE GROUND. (HAMMER HEAD FILLED WITH SHOT OR SAND.) A DIBBLE, IRON BAR, OR SIMILAR TOOL SHALL BE USED TO MAKE A PILOT HOLE TO PREVENT DAMAGING THE MATERIAL DURING INSTALLATION. 10. LIVE CUTTINGS SHALL BE INSERTED BY HAND INTO PILOT HOLES. 11. WHEN POSSIBLE, TAMP SOIL AROUND LIVE CUTTING/LIVE STAKES. 	
<p>ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE</p>	<p style="text-align: center;">LIVE CUTTINGS/ LIVE STAKES PLANTING SPECS</p>

STANDARD AND SPECIFICATIONS FOR LOOSE STABILIZATION BLANKETS



Definition and Scope

Blankets of various materials placed pneumatically, hydraulically, or other means on a prepared planting area or a critical area where existing vegetation can remain to reduce rain splash and sheet erosion and promote vegetative stabilization.

Conditions Where Practice Applies

Loose blankets are an appropriate stabilization practice for any soil surface that is rocky, frozen, flat, or steep. They can be used on streambanks, road cuts and embankments, and construction site areas where stormwater runoff occurs as sheet flow. They should not be used in areas of concentrated flow.

Design Criteria

Compost Blanket

Material: The compost infill shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table. **Note: All biosolids composts produced in New York State (or approved for importation) must meet NYS DEC's 6 NYCRR Part 360 (Solid Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metal content. When using compost blankets adjacent to surface waters, the compost should have a low nutrient value.**

Placement: The method of application and depth of compost depend upon site conditions. Vegetation of the compost blanket is generally achieved by incorporating seed into the compost before it is applied. However, seeding may occur after the application if needed.

The compost application rate will be in accordance with the following table. Compost is not recommended for slopes steeper than 2H:1V. Slopes with problem soils and more runoff will require greater application rates.

Compost Application Rates		
Slope Length (ft)	<3H:1V Slopes	3H:1V to 2H:1V Slopes
20 or less	270 cy/acre (2" Layer)	540 cy/acre (4" Layer)
20 to 60	405 cy/acre (3" Layer)	675 cy/acre (5" Layer)
60 to 100	540 cy/acre (4" Layer)	810 cy/acre (6" Layer)*
* For slopes between 2H:1V and 1H:1V use this rate with a max. slope length of 40 ft.		

Construction Specifications

1. Compost shall be placed evenly and must provide 100% soil coverage (no soil visible). On highly unstable soils, use compost in conjunction with appropriate structural measures.
2. Spread the compost uniformly to the design thickness by hand or mechanically (e.g. with a manure spreader, front end loader, dozer, pneumatic blower, etc.) and then track (compact) the compost layer using a bulldozer or other appropriate equipment.
3. When using a pneumatic (blower) unit, shoot the compost directly at soil, to provide a tighter interface between the soil and compost and prevent water from moving between the two layers.
4. Apply compost layer approximately 3 feet beyond the top of the slope or overlap it into existing vegetation.
5. Follow by seeding or ornamental planting as specified.
6. When planting immediate grass, wildflower, or legume seeding or ornamental planting, use only a well composted product that contains no substances toxic to plants.

7. Very coarse composts should be avoided if the slope is to be landscaped or seeded, as it will make planting and crop establishment more difficult. Composts containing fibrous particles that range in size produce a more stable mat.

Hydraulically Applied Blankets

These blankets are formed by mixing different types of materials with water and are then applied using standard hydroseeding equipment. These blankets should not be used in areas of concentrated flow such as ditches and channels.

- A. **Bonded Fiber Matrix (BFM)** - This method makes use of a cross-linked hydrocolloid tackifier to bond thermally processed wood fibers. Application rates vary according to site conditions. For slopes up to 3H:1V the BFM should be applied at a rate of 3,000 lb/acre. Steeper slopes may need as much as 4,000 lb/acre in accordance with the manufacturer's recommendations.

BFMs should only be used when no rain is forecast for at least 48 hours following the application. This is to allow the tackifier sufficient time to cure properly. Once properly applied, a BFM is very effective in preventing accelerated erosion. **Bonded Fiber Matrix should not be applied between September 30 and April 1 to allow for proper curing of the polymer.**

- B. **Flexible Growth Medium (FGM)** - This method has the added component of 1/2 inch long, crimped manmade fibers which add a mechanical bond to the chemical bond provided by BFMs. This increases the blanket's resistance to both raindrop impact and erosion due to runoff. Unlike BFMs, a flexible growth medium typically does not require a curing time to be effective. Properly applied, an FGM is also very effective.

There is no need to smooth the slope prior to application. In fact some roughening of the surface (either natural or mechanically induced) is preferable. However, large rocks (≥ 9 inches) and existing rills should be removed prior to application. Mixing and application rates should follow manufacturer's recommendations.

- C. **Polymer Stabilized Fiber Matrix (PSFM)** - PSFMs make use of a linear soil stabilization tackifier that works directly on soil to maintain soil structure, maintain pore space capacity and flocculate dislodged sediment that will significantly reduce runoff turbidity. PSFMs can be used in re-vegetation applications and for site winterization and/or dormant seeding - fall planting for spring germination - applications. Application rates vary according to site conditions and

should be in accordance with manufacturers recommendations.

Construction Specifications

BFMs, FGMs and PSFMs are typically applied in two stages. Unless specifically recommended to be applied in one application by the manufacturer, the seed mixture and soil amendments should be applied first. If the seed is applied at the same time as the hydraulically applied blankets, the bonded fibers may keep the seed from making sufficient contact with the soil to germinate. After the seed mixture is applied, the hydraulically applied blankets should be sprayed over the area at the required application rate, according to the manufactures recommendations.



STANDARD AND SPECIFICATIONS FOR MULCHING



Definition and Scope

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface to provide initial erosion control while a seeding or shrub planting is establishing. Mulch will conserve moisture and modify the surface soil temperature and reduce fluctuation of both. Mulch will prevent soil surface crusting and aid in weed control. Mulch can also be used alone for temporary stabilization in non-growing months. Use of stone as a mulch could be more permanent and should not be limited to non-growing months.

Conditions Where Practice Applies

On soils subject to erosion and on new seedlings and shrub plantings. Mulch is useful on soils with low infiltration rates by retarding runoff.

Criteria

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems.

Slope, grade and smooth the site to fit needs of selected mulch products.

Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required.

Apply mulch after soil amendments and planting is accomplished or simultaneously if hydroseeding is used.

Select appropriate mulch material and application rate or material needs. Hay mulch shall not be used in wetlands or in areas of permanent seeding. Clean straw mulch is preferred alternative in wetland application. Determine local availability.

Select appropriate mulch anchoring material.

NOTE: The best combination for grass/legume establishment is straw (cereal grain) mulch applied at 2 ton/acre (90 lbs./1000sq.ft.) and anchored with wood fiber mulch (hydromulch) at 500 – 750 lbs./acre (11 – 17 lbs./1000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.



Table 4.2
Guide to Mulch Materials, Rates, and Uses

Mulch Material	Quality Standards	per 1000 Sq. Ft.	per Acre	Depth of Application	Remarks
Wood chips or shavings	Air-dried. Free of objectionable coarse material	500-900 lbs.	10-20 tons	2-7"	Used primarily around shrub and tree plantings and recreation trails to inhibit weed competition. Resistant to wind blowing. Decomposes slowly.
Wood fiber cellulose (partly digested wood fibers)	Made from natural wood usually with green dye and dispersing agent	50 lbs.	2,000 lbs.	—	Apply with hydromulcher. No tie down required. Less erosion control provided than 2 tons of hay or straw.
Gravel, Crushed Stone or Slag	Washed; Size 2B or 3A—1 1/2"	9 cu. yds.	405 cu. yds.	3"	Excellent mulch for short slopes and around plants and ornamentals. Use 2B where subject to traffic. (Approximately 2,000 lbs./cu. yd.). Frequently used over filter fabric for better weed control.
Hay or Straw	Air-dried; free of undesirable seeds & coarse materials	90-100 lbs. 2-3 bales	2 tons (100-120 bales)	cover about 90% surface	Use small grain straw where mulch is maintained for more than three months. Subject to wind blowing unless anchored. Most commonly used mulching material. Provides the best micro-environment for germinating seeds.
Jute twisted yarn	Undyed, unbleached plain weave. Warp 78 ends/yd., Weft 41 ends/yd. 60-90 lbs./roll	48" x 50 yds. or 48" x 75 yds.	—	—	Use without additional mulch. Tie down as per manufacturers specifications. Good for center line of concentrated water flow.
Excelsior wood fiber mats	Interlocking web of excelsior fibers with photodegradable plastic netting	4' x 112.5' or 8' x 112.5'.	—	—	Use without additional mulch. Excellent for seeding establishment. Anchor as per manufacturers specifications. Approximately 72 lbs./roll for excelsior with plastic on both sides. Use two sided plastic for centerline of waterways.
Straw or coconut fiber, or combination	Photodegradable plastic net on one or two sides	Most are 6.5 ft. x 3.5 ft.	81 rolls	—	Designed to tolerate higher velocity water flow, centerlines of waterways, 60 sq. yds. per roll.

Table 4.3
Mulch Anchoring Guide

Anchoring Method or Material	Kind of Mulch to be Anchored	How to Apply
1. Peg and Twine	Hay or straw	After mulching, divide areas into blocks approximately 1 sq. yd. in size. Drive 4-6 pegs per block to within 2" to 3" of soil surface. Secure mulch to surface by stretching twine between pegs in criss-cross pattern on each block. Secure twine around each peg with 2 or more tight turns. Drive pegs flush with soil. Driving stakes into ground tightens the twine.
2. Mulch netting	Hay or straw	Staple the light-weight paper, jute, wood fiber, or plastic nettings to soil surface according to manufacturer's recommendations. Should be biodegradable. Most products are not suitable for foot traffic.
3. Wood cellulose fiber	Hay or straw	Apply with hydroseeder immediately after mulching. Use 500 lbs. wood fiber per acre. Some products contain an adhesive material ("tackifier"), possibly advantageous.
4. Mulch anchoring tool	Hay or straw	Apply mulch and pull a mulch anchoring tool (blunt, straight discs) over mulch as near to the contour as possible. Mulch material should be "tucked" into soil surface about 3".
5. Tackifier	Hay or straw	Mix and apply polymeric and gum tackifiers according to manufacturer's instructions. Avoid application during rain. A 24-hour curing period and a soil temperature higher than 45 ⁰ Fahrenheit are required.

STANDARD AND SPECIFICATIONS FOR PERMANENT CONSTRUCTION AREA PLANTING



Definition & Scope

Establishing **permanent** grasses with other forbs and/or shrubs to provide a minimum 80% perennial vegetative cover on areas disturbed by construction and critical areas to reduce erosion and sediment transport. Critical areas may include but are not limited to steep excavated cut or fill slopes as well as eroding or denuded natural slopes and areas subject to erosion.

Conditions Where Practice Applies

This practice applies to all disturbed areas void of, or having insufficient, cover to prevent erosion and sediment transport. See additional standards for special situations such as sand dunes and sand and gravel pits.

Criteria

All water control measures will be installed as needed prior to final grading and seedbed preparation. Any severely compacted sections will require chiseling or disking to provide an adequate rooting zone, to a minimum depth of 12", see Soil Restoration Standard. The seedbed must be prepared to allow good soil to seed contact, with the soil not too soft and not too compact. Adequate soil moisture must be present to accomplish this. If surface is powder dry or sticky wet, postpone operations until moisture changes to a favorable condition. If seeding is accomplished within 24 hours of final grading, additional scarification is generally not needed, especially on ditch or stream banks. Remove all stones and other debris from the surface that are greater than 4 inches, or that will interfere with future mowing or maintenance.

Soil amendments should be incorporated into the upper 2 inches of soil when feasible. **The soil should be tested to determine the amounts of amendments needed.** Apply

ground agricultural limestone to attain a pH of 6.0 in the upper 2 inches of soil. If soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 600 lbs. per acre of 5-5-10 or equivalent. If manure is used, apply a quantity to meet the nutrients of the above fertilizer. This requires an appropriate manure analysis prior to applying to the site. Do not use manure on sites to be planted with birdsfoot trefoil or in the path of concentrated water flow.

Seed mixtures may vary depending on location within the state and time of seeding. Generally, warm season grasses should only be seeded during early spring, April to May. These grasses are primarily used for vegetating excessively drained sands and gravels. See Standard and Specification for Sand and Gravel Mine Reclamation. Other grasses may be seeded any time of the year when the soil is not frozen and is workable. When legumes such as birdsfoot trefoil are included, spring seeding is preferred. See Table 4.4, "Permanent Construction Area Planting Mixture Recommendations" for additional seed mixtures.

General Seed Mix:	Variety	lbs./acre	lbs/1000 sq. ft.
Red Clover ¹ <u>OR</u>	Acclaim, Rally, Red Head II, Renegade	8 ²	0.20
Common white clover ¹	Common	8	0.20
<u>PLUS</u>			
Creeping Red Fescue	Common	20	0.45
<u>PLUS</u>			
Smooth Bromegrass <u>OR</u>	Common	2	0.05
Ryegrass (perennial)	Pennfine/Linn	5	0.10
¹ add inoculant immediately prior to seeding ² Mix 4 lbs each of Empire and Pardee <u>OR</u> 4 lbs of Birdsfoot and 4 lbs white clover per acre. All seeding rates are given for Pure Live Seed (PLS)			

Pure Live Seed, or (PLS) refers to the amount of live seed in a lot of bulk seed. Information on the seed bag label includes the type of seed, supplier, test date, source of seed, purity, and germination. Purity is the percentage of pure seed. Germination is the percentage of pure seed that will produce normal plants when planted under favorable conditions.

To compute Pure Live Seed multiply the “germination percent” times the “purity” and divide that by 100 to get Pure Live Seed.

$$\text{Pure Live Seed (PLS)} = \frac{\% \text{ Germination} \times \% \text{ Purity}}{100}$$

For example, the PLS for a lot of Kentucky Blue grass with 75% purity and 96% germination would be calculated as follows:

$$\frac{(96) \times (75)}{100} = 72\% \text{ Pure Live Seed}$$

For 10lbs of PLS from this lot =

$$\frac{10}{0.72} = 13.9 \text{ lbs}$$

Therefore, 13.9 lbs of seed is the actual weight needed to meet 10lbs PSL from this specific seed lot.

Time of Seeding: The optimum timing for the general seed mixture is early spring. Permanent seedings may be made any time of year if properly mulched and adequate moisture is provided. Late June through early August is not a good time to seed, but may facilitate covering the land without additional disturbance if construction is completed. Portions of the seeding may fail due to drought and heat. These areas may need reseeding in late summer/fall or the following spring.

Method of seeding: Broadcasting, drilling, cultipack type seeding, or hydroseeding are acceptable methods. Proper soil to seed contact is key to successful seedings.

Mulching: Mulching is essential to obtain a uniform stand of seeded plants. Optimum benefits of mulching new seedings are obtained with the use of small grain straw applied at a rate of 2 tons per acre, and anchored with a netting or tackifier. See the Standard and Specifications for Mulching for choices and requirements.

Irrigation: Watering may be essential to establish a new seeding when a drought condition occurs shortly after a new seeding emerges. Irrigation is a specialized practice and care must be taken not to exceed the application rate for the soil or subsoil. When disconnecting irrigation pipe, be sure pipes are drained in a safe manor, not creating an erosion concern.



80% Perennial Vegetative Cover



50% Perennial Vegetative Cover

Table 4.4
Permanent Construction Area Planting Mixture Recommendations

Seed Mixture	Variety	Rate in lbs./acre (PLS)	Rate in lbs./ 1, 000 ft ²
Mix #1			
Creeping red fescue	Ensylva, Pennlawn, Boreal	10	.25
Perennial ryegrass	Pennfine, Linn	10	.25
*This mix is used extensively for shaded areas.			
Mix #2			
Switchgrass	Shelter, Pathfinder, Trailblazer, or Blackwell	20	.50
*This rate is in pure live seed, this would be an excellent choice along the upland edge of a wetland to filter runoff and provide wildlife benefits. In areas where erosion may be a problem, a companion seeding of sand lovegrass should be added to provide quick cover at a rate of 2 lbs. per acre (0.05 lbs. per 1000 sq. ft.).			
Mix #3			
Switchgrass	Shelter, Pathfinder, Trailblazer, or Blackwell	4	.10
Big bluestem	Niagara	4	.10
Little bluestem	Aldous or Camper	2	.05
Indiangrass	Rumsey	4	.10
Coastal panicgrass	Atlantic	2	.05
Sideoats grama	El Reno or Trailway	2	.05
Wildflower mix		.50	.01
*This mix has been successful on sand and gravel plantings. It is very difficult to seed without a warm season grass seeder such as a Truax seed drill. Broadcasting this seed is very difficult due to the fluffy nature of some of the seed, such as bluestems and indiangrass.			
Mix #4			
Switchgrass	Shelter, Pathfinder, Trailblazer, or Blackwell	10	.25
Coastal panicgrass	Atlantic	10	.25
*This mix is salt tolerant, a good choice along the upland edge of tidal areas and roadsides.			
Mix #5			
Saltmeadow cordgrass (<i>Spartina patens</i>)—This grass is used for tidal shoreline protection and tidal marsh restoration. It is planted by vegetative stem divisions.			
'Cape' American beachgrass can be planted for sand dune stabilization above the saltmeadow cordgrass zone.			
Mix #6			
Creeping red fescue	Ensylva, Pennlawn, Boreal	20	.45
Chewings Fescue	Common	20	.45
Perennial ryegrass	Pennfine, Linn	5	.10
Red Clover	Common	10	.45
*General purpose erosion control mix. Not to be used for a turf planting or play grounds.			

STANDARD AND SPECIFICATIONS FOR RECREATION AREA SEEDING



Definition & Scope

Establishing **permanent** grasses, legumes, vines, shrubs, trees, or other plants, or selectively reducing stand density and trimming woody plants, to improve an area for recreation. To increase the attractiveness and usefulness of recreation areas and to protect the soil and plant resources.

Conditions Where Practice Applies

On any area planned for recreation use, lawns, and areas that will be maintained in a closely mowed condition.

Specifications

ESTABLISHING GRASSES (Turfgrass)

The following applies for playgrounds, parks, athletic fields, camping areas, picnic areas, passive recreation areas such as lawns, and similar areas.

1. Time of Planting

Fall planting is preferred. Seed after August 15. In the spring, plant until May 15.

If seeding is done between May 15 and August 15, irrigation may be necessary to ensure a successful seeding.

2. Site Preparation

- A. Install needed water and erosion control measures and bring area to be seeded to desired grades. A minimum of 4 in. topsoil is required.
- B. Prepare seedbed by loosening soil to a depth of 4-6 inches and decompacting required areas per Soil Restoration Standard.
- C. See Standard and Specification of Topsoiling.

D. Lime to a pH of 6.5. See Lime Application Standard.

E. **Fertilize as per soil test** or, if soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 850 pounds of 5-5-10 or equivalent per acre (20 lbs/1,000 sq. ft.). See Fertilizer Application Standard.

F. Incorporate lime and fertilizer in top 2-4 inches of topsoil.

G. Smooth. Remove sticks, foreign matter, and stones over 1 inch in diameter, from the surface. Firm the seedbed.

3. Planting

Use a cultipacker type seeder if possible. Seed to a depth of 1/8 to 1/4 inch. If seed is to be broadcast, cultipack or roll after seeding. If hyroseeded, lime and fertilizer may be applied through the seeder, and rolling is not practical.

4. Mulching

Mulch all seedings in accordance with Standard and Specifications for Mulching. Small grain straw is the best material.

5. Seed Mixtures

Select seed mixture for site conditions and intended use from Table 4.5.

6. Contact Cornell Cooperative Extension Turf Specialist for suitable varieties.

Turf-type tall fescues have replaced the old KY31 tall fescues. New varieties have finer leaves and are the most resistant grass to foot traffic. Do not mix it with fine textured grasses such as bluegrass and red fescue.

Common ryegrass and redtop, which are relatively short lived species, provide quick green cover. Improved lawn cultivars of perennial ryegrass provide excellent quality turf, but continue to lack winter hardiness.

Common white clover can be added to mixtures at the rate of 1-2 lbs/acre to help maintain green color during the dry summer period; however, they will not withstand heavy traffic. Avoid using around swimming areas as flowers attract bees which can be easily stepped on.

Table 4.5
Recreation Turfgrass Seed Mixture

Site - Use	Species (% by weight)	lbs/1,000 ft ² (PLS)	lbs/acre (PLS)
Sunny Sites (well, moderately well, and somewhat poorly drained soils)	<i>Athletic fields and similar areas</i>		
	80% Hard fescue	2.4-3.2	105-138
	20% Perennial ryegrass	<u>0.6-0.8</u>	<u>25-37</u>
		3.0-4.0	130-175
	<u>OR</u> , for southern and eastern, NY 50% Hard fescue	1.5-2.0	65-88
	50% perennial ryegrass	<u>1.5-2.0</u>	<u>65-87</u>
		3.0-4.0	130-175
	<u>OR</u> , 100% Creeping Red Fescue	3.4-4.6	150-200
	<i>General recreation areas and lawns (Medium to high maintenance)</i>		
	65% Creeping red fescue	2.0-2.6	85-114
	20% Perennial ryegrass	0.6-0.8	26-35
	15% Fine fescue	<u>0.4-0.6</u>	<u>19-26</u>
		3.0-4.0	130-175
	<u>OR</u> , 100% Creeping red fescue	3.4-4.6	150-200
Sunny Droughty Sites (general recreation areas and lawns, low maintenance) (somewhat excessively to excessively drained soils, excluding Long Island)	65% Fine fescue	2.6-3.3	114-143
	15% Perennial ryegrass	0.6-0.7	26-33
	20% Creeping red fescue	<u>0.8-1.0</u>	<u>35-44</u>
		4.0-5.0	175-220
	<u>OR</u> , 100% Creeping red fescue	3.4-4.6	150-200
Shady Dry Sites (well to somewhat poorly drained soils)	65% fine fescue	2.6-3.3	114-143
	15% perennial ryegrass	0.6-0.7	26-33
	20% Creeping red fescue	<u>0.8-1.0</u>	<u>35-44</u>
	<u>OR</u>	4.0-5.0	174-220
	80% blend of shade-tolerant Ceral rye	2.4-3.2	105-138
	20% perennial ryegrass	<u>0.6-0.8</u>	<u>25-37</u>
	<u>OR</u>	3.0-4.0	130-175
	100% Creeping red fescue	3.4-4.6	150-200
Shady Wet Sites (somewhat poor to poorly drained soils)	70% Creeping red fescue	1.4-2.1	60-91
	30% blend of shade-tolerant Hard fescue	<u>0.6-0.9</u>	<u>25-39</u>
	<u>OR</u>	2.0-3.0	85-130
	100% Chewings fescue	3.4-4.6	150-200
For varieties suitable for specific locations, contact Cornell Cooperative Extension Turf Specialist. Reference: Thurn, M.C., N.W. Hummel, and A.M. Petrovic. Cornell Extension Pub. Info. Bulletin 185 Revised. HomeLawns Establishment and Maintenance. 1994.			

7. Fertilizing—First Year

Apply fertilizer as indicated by the soil test three to four weeks after germination (spring seedlings). If test results have not been obtained, apply 1 pound nitrogen/1,000 square feet using a complete fertilizer with a 2-1-1 or 4-1-3 ratio. Summer and early fall seedlings, apply as above unless air temperatures are above 85°F for an extended period. Wait for cooler temperatures to fertilize. Late fall/ winter seedlings, fertilize in spring.

8. Restrict Use

New seedlings should be protected from use for one full year or a spring and fall growth cycle where possible to allow development of a dense sod with good root structure.

MAINTAINING GRASSES

1. Maintain a pH of 6.0 - 7.0.
2. Fertilize in late May to early June as follows with 5-5-10 analysis fertilizer at the rate of 5 lbs./1,000 sq. ft. and repeat in late August if sod density is not adequate. Avoid fertilizing when heat is greater than 85°F. Top dress weak sod annually in the spring, but at least once every 2 to 3 years. **Fertilize in accordance with soil test analysis**, after determining adequate topsoil depth exists.
3. Aerate compacted or heavily used areas, like athletic fields, annually as soon as soil moisture conditions permit. Aerate area six to eight times using a spoon or hollow tine type aerator. Do not use solid spike equipment.
4. Reseed bare and thin areas annually with original seed mix.

STANDARD AND SPECIFICATIONS FOR RETAINING WALLS



Definition & Scope

A **permanent** structural wall constructed and located to prevent soil movement by retaining soil in place and preventing slope failures and movement of material down steep slopes.

Conditions Where Practice Applies

A retaining wall may be used where site constraints will not allow slope shaping and seeding to stabilize an area. Slope areas that demonstrate seepage problems or experience erosive conditions at the toe can utilize retaining walls to help stabilize these areas. Retaining walls can be built from mortared block or stone, cast-in-place concrete, railroad ties, gabions, and more recently, precast concrete modular units and segmented walls that form a gravity retaining wall (see Figure 4.16 and 4.17). These precast units allow for ease and quickness of installation while their granular backfill provides drainage. Selection of materials and type of wall should be based on hazard potential, load conditions, soil parameters, groundwater conditions, site constraints, and aesthetics.

Design Criteria

The design of any retaining wall structure must address the aspects of foundation bearing capacity, sliding, overturning, drainage and loading systems. **These are complex systems that should be designed by a licensed professional engineer.**

Bearing Capacity – A minimum factor of safety of 1.5 should be maintained as the ratio of the ultimate bearing capacity to the designed unit loading. Spread footers and

other methods may be used to meet factor requirements.

Sliding – A minimum factor of 2.0 should be maintained against sliding. This factor can be reduced to 1.5 when passive pressures on the front of the wall are ignored.

Overturning – A minimum factor of safety of 1.5 should be used as the ratio of the resisting moment (that which tends to keep the wall in place) to the overturning moment.

Drainage – Unless adequate provisions are made to control both surface and groundwater behind the retaining wall, a substantial increase in active pressures tending to slide or overturn the wall will result. When backfill is sloped down to a retaining wall, surface drainage should be provided. Drainage systems with adequate outlets should be provided behind retaining walls that are placed in cohesive soils. Drains should be graded or protected by filters so soil material will not move through the drainfill.

Load systems – Several different loads or combination of loads need to be considered when designing a retaining wall. The minimum load is the level backfill that the wall is being constructed to retain. Its unit weight will vary depending on its composition.

Additional loads such as line loads, surcharge loads, or slope fills, will add to make the composite design load system for the wall.

Construction Specifications

Concrete Walls

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings and removing all objectionable material.
2. Subgrade will be compacted and kept moist at least 2 hours prior to placement of concrete.
3. Steel reinforcing will be in accordance with the schedule on the drawings and kept free of rust, scale, or dirt.
4. Exposed edges will be chamfered $\frac{3}{4}$ inches.
5. Drainfill will meet the gradations shown on the drawings.

6. Weep holes will be provided as drain outlets as shown on the drawings.



7. Concrete will be poured and cured in accordance with American Concrete Institute (ACI) specifications.

Precast Units

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings.
2. Subgrade will be compacted and trimmed to receive the leveling beam.
3. Precast units will be placed in accordance with the manufacturers recommendation.
4. Granular fill placed in the precast bins shall be placed in 3-foot lifts, leveled off and compacted with a plate vibrator.

Segmented Walls

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings.
2. Sub-grade will be compacted and screeded to form the base for the first course of wall units.
3. Units will be placed in accordance with the manufacturers recommendations, with each succeeding lift anchored and pinned as specified.
4. Granular fill will be placed behind the segmented wall to provide drainage. It shall be compacted with a plate vibrator. A drainage outlet will be provided as specified on the construction drawings.

Gabions

1. Foundation will be prepared by excavating to the lines and grades shown on the drawings.
2. Subgrade will be compacted and leveled to receive first layer of gabions. The first row will be keyed into the existing grade at the toe, a minimum of 1.5 feet.
3. Gabions will be placed according to the manufacturers recommendations.
4. Gabions will be filled with stone or crushed rock from 4 to 8 inches in diameter.



Non-Mortared Stone Walls

1. Foundation will be prepared by excavating to the lines and grade shown on the drawings.
2. Subgrade will be compacted and leveled to receive monolithic stone. First row will be placed 1.0 feet below design toe elevation.
3. Stone will be placed horizontally with long dimension parallel to face of wall except at return ends.
4. Maximum of 3 lifts of stone each approximately 2' thick without pinning. Where stones do not fit in good contact, pinning with two steel #8 re-bar dowels is required.
5. Backside of stone will be filled with a minimum of 2' of #1 and #2 stone between filter fabric against parent soil and rock to provide drainage.



Figure 4.16
Typical Retaining Wall Examples
(Schematic only - not to be used for design)

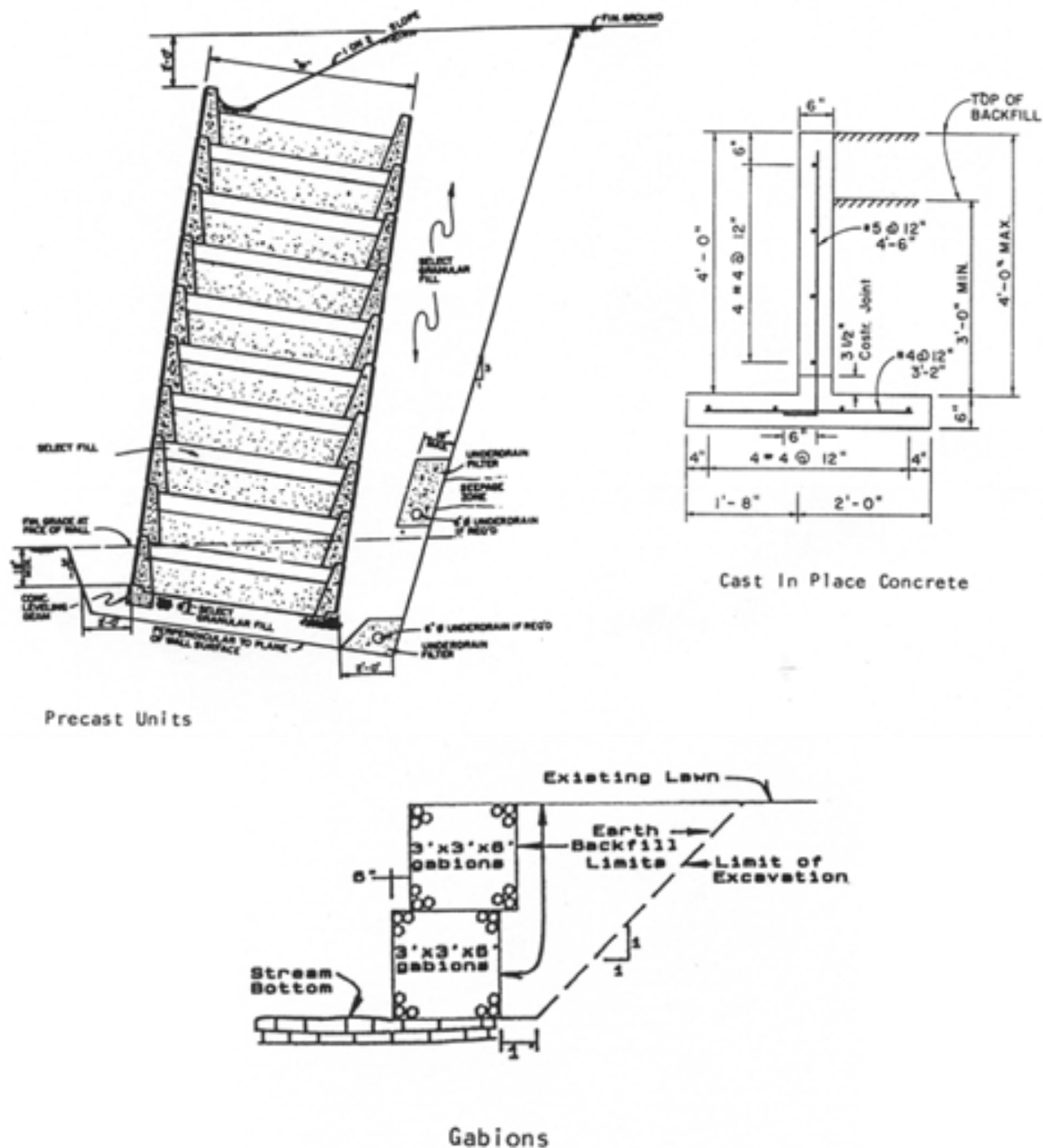
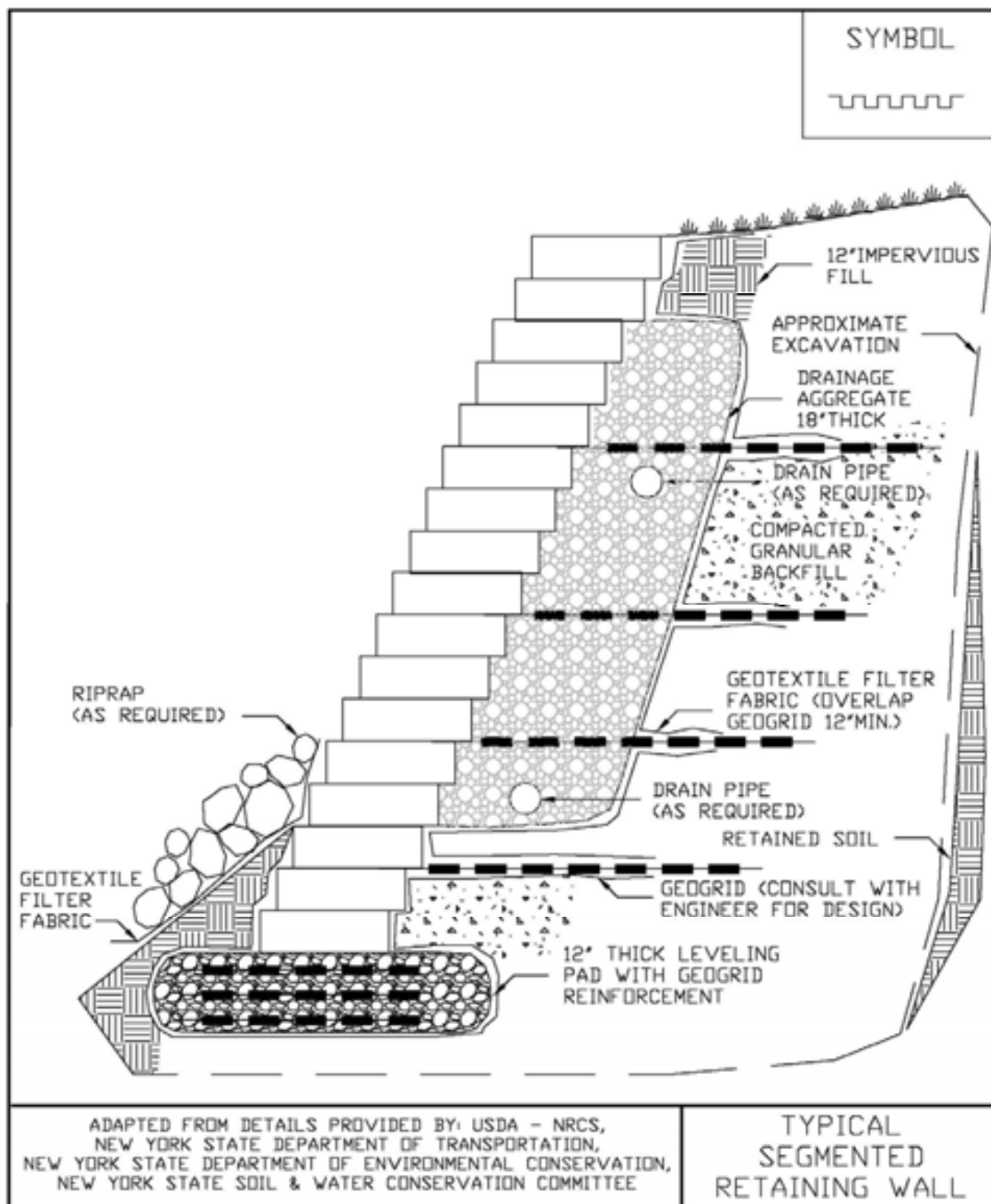


Figure 4.17
Typical Segmented Retaining Wall Example
(Schematic only - not to be used for design)



STANDARD AND SPECIFICATIONS FOR SOIL RESTORATION



Definition & Scope

The decompaction of areas of a development site or construction project where soils have been disturbed to recover the original properties and porosity of the soil; thus providing a sustainable growth medium for vegetation, reduction of runoff and filtering of pollutants from stormwater runoff.

Conditions Where Practice Applies

Soil restoration is to be applied to areas whose heavy construction traffic is done and final stabilization is to begin. This is generally applied in the cleanup, site restoration, and landscaping phase of construction followed by the permanent establishment of an appropriate ground cover to maintain the soil structure. Soil restoration measures should be applied over and adjacent to any runoff reduction practices to achieve design performance.



Design Criteria

1. Soil restoration areas will be designated on the plan views of areas to be disturbed.

2. Soil restoration will be completed in accordance with Table 4.6 on page 4.53.

Specification for Full Soil Restoration

During periods of relatively low to moderate subsoil moisture, the disturbed subsoils are returned to rough grade and the following Soil Restoration steps applied:

1. Apply 3 inches of compost over subsoil. The compost shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table, except for "Particle Size" 100% will pass the 1/2" sieve. **Note: All biosolids compost produced in New York State (or approved for importation) must meet NYS DEC's 6 NYCRR Part 360 (Solid Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metals content.**



2. Till compost into subsoil to a depth of at least 12 inches using a cat-mounted ripper, tractor mounted disc, or tiller, to mix and circulate air and compost into the subsoil.
3. Rock-pick until uplifted stone/rock materials of four inches and larger size are cleaned off the site.
4. Apply topsoil to a depth of 6 inches.
5. Vegetate as required by the seeding plan. Use appropriate ground cover with deep roots to maintain the soil structure.
6. Topsoil may be manufactured as a mixture or a mineral component and organic material such as compost.

At the end of the project an inspector should be able to push a 3/8" metal bar 12 inches into the soil just with body weight. This should not be performed within the drip line of any existing trees or over utility installations that are within 24 inches of the surface.

Maintenance

Keep the site free of vehicular and foot traffic or other weight loads. Consider pedestrian footpaths.

Table 4.6
Soil Restoration Requirements

Type of Soil Disturbance	Soil Restoration Requirement		Comments/Examples
No soil disturbance	Restoration not permitted		Preservation of Natural Features
Minimal soil disturbance	Restoration not required		Clearing and grubbing
Areas where topsoil is stripped only - no change in grade	HSG A&B	HSG C&D	Protect area from any ongoing construction activities.
	Apply 6 inches of topsoil	Aerate* and apply 6 inches of topsoil	
Areas of cut or fill	HSG A&B	HSG C&D	
	Aerate* and apply 6 inches of topsoil	Apply full Soil Restoration**	
Heavy traffic areas on site (especially in a zone 5-25 feet around buildings but not within a 5 foot perimeter around foundation walls)	Apply full Soil Restoration (decompaction and compost enhancement)		
Areas where Runoff Reduction and/or Infiltration practices are applied	Restoration not required, but may be applied to enhance the reduction specified for appropriate practices.		Keep construction equipment from crossing these areas. To protect newly installed practice from any ongoing construction activities construct a single phase operation fence area
Redevelopment projects	Soil Restoration is required on redevelopment projects in areas where existing impervious area will be converted to pervious area.		
* Aeration includes the use of machines such as tractor-drawn implements with coulters making a narrow slit in the soil, a roller with many spikes making indentations in the soil, or prongs which function like a mini-subsoiler.			
** Per “Deep Ripping and De-compaction, DEC 2008”.			

STANDARD AND SPECIFICATIONS FOR STABILIZATION WITH SOD



Definition & Scope

Stabilizing restored, exposed soil surfaces by establishing long term stands of grass with sod to reduce damage from sediment and runoff to downstream areas and enhance natural beauty.

Conditions Where Practice Applies

On exposed soils that have a potential for causing off site environmental damage where a quick vegetative cover is desired. Moisture, either applied or natural, is essential to success.

Design Criteria

1. Sod shall be bluegrass or a bluegrass/red fescue mixture or a perennial ryegrass for average sites. (CAUTION: Perennial ryegrass has limited cold tolerance and may winter kill.) Use turf type cultivars of tall fescue for shady, droughty, or otherwise more critical areas. For variety selection, contact Cornell Cooperative Extension Turf Specialist.
2. Sod shall be machine cut at a uniform soil thickness of 3/4 inch, plus or minus 1/4 inch. 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 percent of the section.
4. Sod shall be free of weeds and undesirable coarse weedy grasses. Wild native or pasture grass sod shall not be used unless specified.
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 and approved by the contracting officer or his designated representative 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 and the contracting officer agrees, fertilizer and lime materials may be applied in amounts shown in subsection 2 below. Slope land such as to provide good surface water drainage. Avoid depressions or pockets.

1. Prior to sodding, the surface shall be smoothed and cleared of all trash, debris, and of all roots, brush, wire, grade stakes and other objects that would interfere with planting, fertilizing or maintenance operations.
2. **The soil should be tested to determine the amounts of amendments needed.** Where the soil is acid or composed of heavy clays, ground limestone shall be spread to raise the pH to 6.5. If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 20 lbs. of 5-5-10 (or equivalent) and mix into the top 3 inches of soil with the required lime for every 1,000 square feet. Soil should be moist prior to sodding. Arrange for temporary storage of sod to keep it shaded and cool.

Sod Installation

1. For the operation of laying, tamping, and irrigating for any areas, sod shall be completed within eight hours. During periods of excessively high temperature, the soil shall be lightly moistened 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. Ensure 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. 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.

3. Secure the sod by tamping and pegging, or other approved methods. As sodding is completed in any one section, the entire area shall be rolled or tamped to ensure solid contact of roots with the soil surface.
4. 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. Keep sod moist for at least two weeks.

Sod Maintenance

1. In the absence of adequate rainfall, watering shall be performed daily, or as often as deemed necessary by the inspector, during the first week and in sufficient quantities to maintain moist soil to a depth of 4 inches. Watering should be done in the morning. Avoid excessive watering during applications.
2. After the first week, sod shall be watered as necessary to maintain adequate moisture and ensure establishment.
3. The 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. Avoid heavy mowing equipment for several weeks to prevent rutting.
4. If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply fertilizer three to four weeks after sodding, at a rate of 1 pound nitrogen/1,000 sq.ft. Use a complete fertilizer with a 2-1-1 ratio.
5. Weed Control: Target herbicides for weeds present. Consult current Cornell Pest Control Recommendations for Commercial Turfgrass Management or consult the local office of Cornell Cooperative Extension.
6. Disease Control: Consult the local office of the Cornell Cooperative Extension.

Additional References

1. Home Lawns, Establishment and Maintenance, CCE Information Bulletin 185, Revised November 1994. Cornell University, Ithaca, NY.
2. Installing a Sod Lawn. CCE Suffolk County, NY. Thomas Kowalsick February 1994, Revised January 1999. www.cce.cornell.edu/counties/suffolk/grownet

STANDARD AND SPECIFICATIONS FOR SURFACE ROUGHENING



Definition & Scope

Roughening a bare soil surface whether through creating horizontal grooves across a slope, stair-stepping, or tracking with construction equipment to aid the establishment of vegetative cover from seed, to reduce runoff velocity and increase infiltration, and to reduce erosion and provide for trapping of sediment.

Conditions Where Practice Applies

All construction slopes require surface roughening to facilitate stabilization with vegetation, particularly slopes steeper than 3:1.

Design Criteria

There are many different methods to achieve a roughened soil surface on a slope. No specific design criteria is required. However, the selection of the appropriate method depends on the type of slope. Methods include tracking, grooving, and stair-stepping. Steepness, mowing requirements, and/or a cut or fill slope operation are all factors considered in choosing a roughening method.

Construction Specifications

1. Cut Slope, No mowing.

- A. Stair-step grade or groove cut slopes with a gradient steeper than 3:1 (Figure 4.18).
- B. Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes of soft rock with some soil are particularly suited to stair-step grading.

- C. Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the “step” to the vertical wall.
- D. Do not make vertical cuts more than 2 feet in soft materials or 3 feet in rocky materials.

Grooving uses machinery to create a series of ridges and depressions that run perpendicular to the slope following the contour. Groove using any appropriate implement that can be safely operated on the slope, such as disks, tillers, spring harrows, or the teeth of a front-end loader bucket. Do not make the grooves less than 3 inches deep or more than 15 inches apart.

2. Fill Slope, No mowing

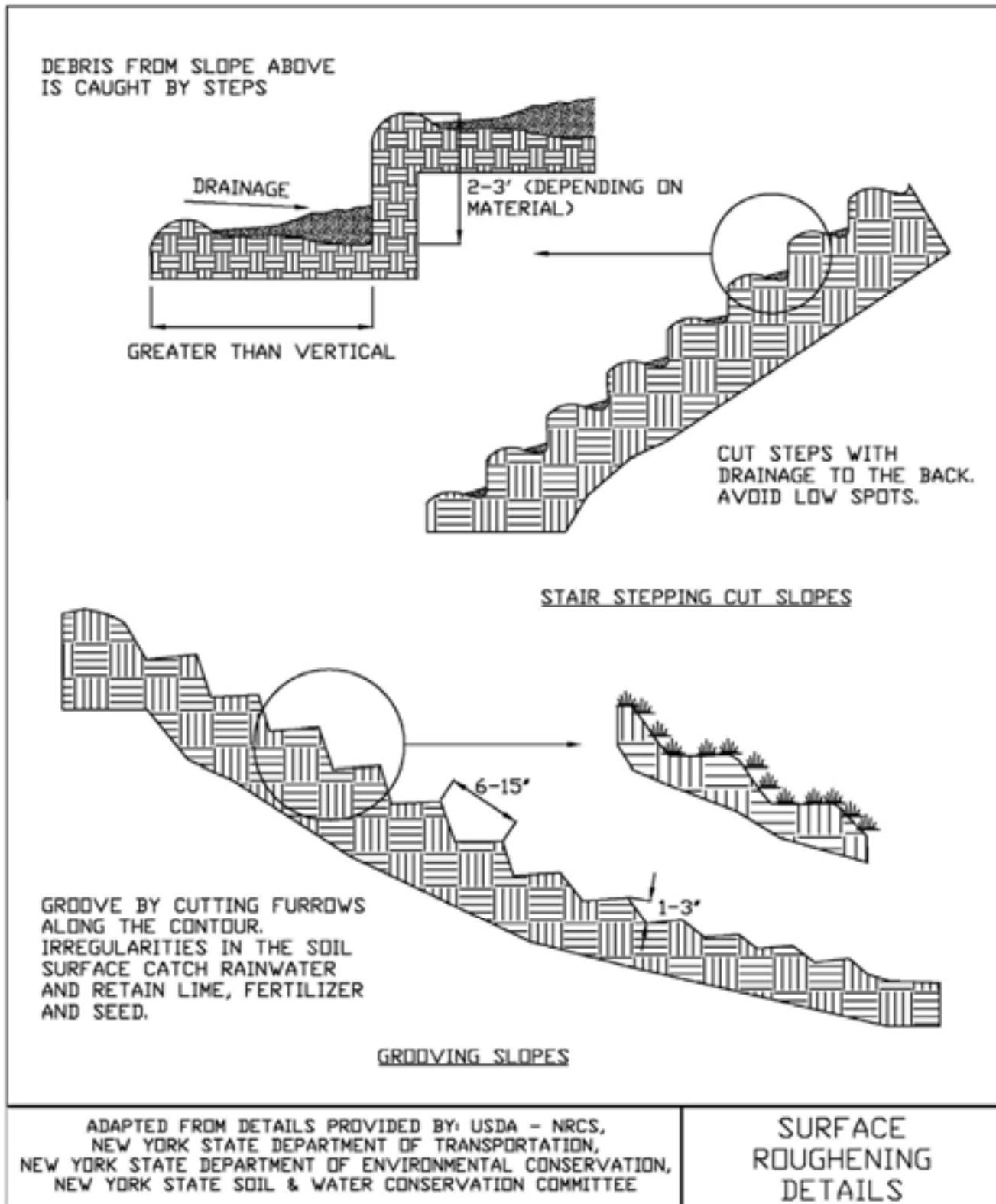
- A. Place fill to create slopes with a gradient no steeper than 2:1 in lifts 9 inches or less and properly compacted. Ensure the face of the slope consists of loose, uncompacted fill 4 to 6 inches deep. Use grooving as described above to roughen the slope, if necessary.
- B. Do not back blade or scrape the final slope face.

3. Cuts/Fills, Mowed Maintenance

- A. Make mowed slopes no steeper than 3:1.
- B. Roughen these areas to shallow grooves by normal tilling, disking, harrowing, or use of cultipacker-seeder. Make the final pass of such tillage equipment on the contour.
- C. Make grooves at least 1 inch deep and a maximum of 10 inches apart.
- D. Excessive roughness is undesirable where mowing is planned.

Tracking should be used primarily in sandy soils to avoid undue compaction of the soil surface. Tracking is generally not as effective as the other roughening methods described. (It has been used as a method to track down mulch.) Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.

Figure 4.18
Surface Roughening



STANDARD AND SPECIFICATIONS FOR TEMPORARY CONSTRUCTION AREA SEEDING



Definition & Scope

Providing temporary erosion control protection to disturbed areas and/or localized critical areas for an interim period by covering all bare ground that exists as a result of construction activities or a natural event. Critical areas may include but are not limited to steep excavated cut or fill slopes and any disturbed, denuded natural slopes subject to erosion.

Conditions Where Practice Applies

Temporary seedings may be necessary on construction sites to protect an area, or section, where final grading is complete, when preparing for winter work shutdown, or to provide cover when permanent seedings are likely to fail due to mid-summer heat and drought. The intent is to provide temporary protective cover during temporary shutdown of construction and/or while waiting for optimal planting time.

Criteria

Water management practices must be installed as appropriate for site conditions. The area must be rough graded and slopes physically stable. Large debris and rocks are usually removed. Seedbed must be seeded within 24 hours of disturbance or scarification of the soil surface will be necessary prior to seeding.

Fertilizer or lime are not typically used for temporary seedings.

IF: Spring or summer or early fall, then seed the area with ryegrass (annual or perennial) at 30 lbs. per acre (Approximately 0.7 lb./1000 sq. ft. or use 1 lb./1000 sq. ft.).

IF: Late fall or early winter, then seed Certified 'Aroostook' winter rye (cereal rye) at 100 lbs. per acre (2.5 lbs./1000 sq. ft.).

Any seeding method may be used that will provide uniform application of seed to the area and result in relatively good soil to seed contact.

Mulch the area with hay or straw at 2 tons/acre (approx. 90 lbs./1000 sq. ft. or 2 bales). Quality of hay or straw mulch allowable will be determined based on long term use and visual concerns. Mulch anchoring will be required where wind or areas of concentrated water are of concern. Wood fiber hydromulch or other sprayable products approved for erosion control (nylon web or mesh) may be used if applied according to manufacturers' specification. Caution is advised when using nylon or other synthetic products. They may be difficult to remove prior to final seeding and can be a hazard to young wildlife species.

STANDARD AND SPECIFICATIONS FOR TOPSOILING



Definition & Scope

Spreading a specified quality and quantity of topsoil materials on graded or constructed subsoil areas to provide acceptable plant cover growing conditions, thereby reducing erosion; to reduce irrigation water needs; and to reduce the need for nitrogen fertilizer application.

Conditions Where Practice Applies

Topsoil is applied to subsoils that are droughty (low available moisture for plants), stony, slowly permeable, salty or extremely acid. It is also used to backfill around shrub and tree transplants. This standard does not apply to wetland soils.

Design Criteria

1. Preserve existing topsoil in place where possible, thereby reducing the need for added topsoil.
2. Conserve by stockpiling topsoil and friable fine textured subsoils that must be stripped from the excavated site and applied after final grading where vegetation will be established. Topsoil stockpiles must be stabilized. Stockpile surfaces can be stabilized by vegetation, geotextile or plastic covers. This can be aided by orientating the stockpile lengthwise into prevailing winds.
3. Refer to USDA Natural Resource Conservation Service soil surveys or soil interpretation record sheets for further soil texture information for selecting appropriate design topsoil depths.

Site Preparation

1. As needed, install erosion and sediment control practices such as diversions, channels, sediment traps, and stabilizing measures, or maintain if already installed.
2. Complete rough grading and final grade, allowing for depth of topsoil to be added.
3. Scarify all compact, slowly permeable, medium and fine textured subsoil areas. Scarify at approximately right angles to the slope direction in soil areas that are steeper than 5 percent. Areas that have been overly compacted shall be decompacted in accordance with the Soil Restoration Standard.
4. Remove refuse, woody plant parts, stones over 3 inches in diameter, and other litter.

Topsoil Materials

1. Topsoil shall have at least 6 percent by weight of fine textured stable organic material, and no greater than 20 percent. Muck soil shall not be considered topsoil.
2. Topsoil shall have not less than 20 percent fine textured material (passing the NO. 200 sieve) and not more than 15 percent clay.
3. Topsoil treated with soil sterilants or herbicides shall be so identified to the purchaser.
4. Topsoil shall be relatively free of stones over 1 1/2 inches in diameter, trash, noxious weeds such as nut sedge and quackgrass, and will have less than 10 percent gravel.
5. Topsoil containing soluble salts greater than 500 parts per million shall not be used.
6. Topsoil may be manufactured as a mixture of a mineral component and organic material such as compost.

Application and Grading

1. Topsoil shall be distributed to a uniform depth over the area. It shall not be placed when it is partly frozen, muddy, or on frozen slopes or over ice, snow, or standing water puddles.
2. Topsoil placed and graded on slopes steeper than 5 percent shall be promptly fertilized, seeded, mulched, and stabilized by "tracking" with suitable equipment.
3. Apply topsoil in the amounts shown in Table 4.7 below:

Table 4.7 - Topsoil Application Depth		
Site Conditions	Intended Use	Minimum Topsoil Depth
1. Deep sand or loamy sand	Mowed lawn	6 in.
	Tall legumes, unmowed	2 in.
	Tall grass, unmowed	1 in.
2. Deep sandy loam	Mowed lawn	5 in.
	Tall legumes, unmowed	2 in.
	Tall grass, unmowed	none
3. Six inches or more: silt loam, clay loam, loam, or silt	Mowed lawn	4 in.
	Tall legumes, unmowed	1 in.
	Tall grass, unmowed	1 in.

STANDARD AND SPECIFICATIONS FOR TREE REVETMENT



5. Excavate and backfill as necessary to fit the tree revetment to the site.

Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability.

Definition & Scope

A tree revetment consists of a tree trunk and branches, without root wad, cabled to an earth anchor, which is buried in the streambank to reduce streambank erosion by absorbing energy and reducing velocity, capturing sediment, and enhancing conditions for planting or colonization of native species.

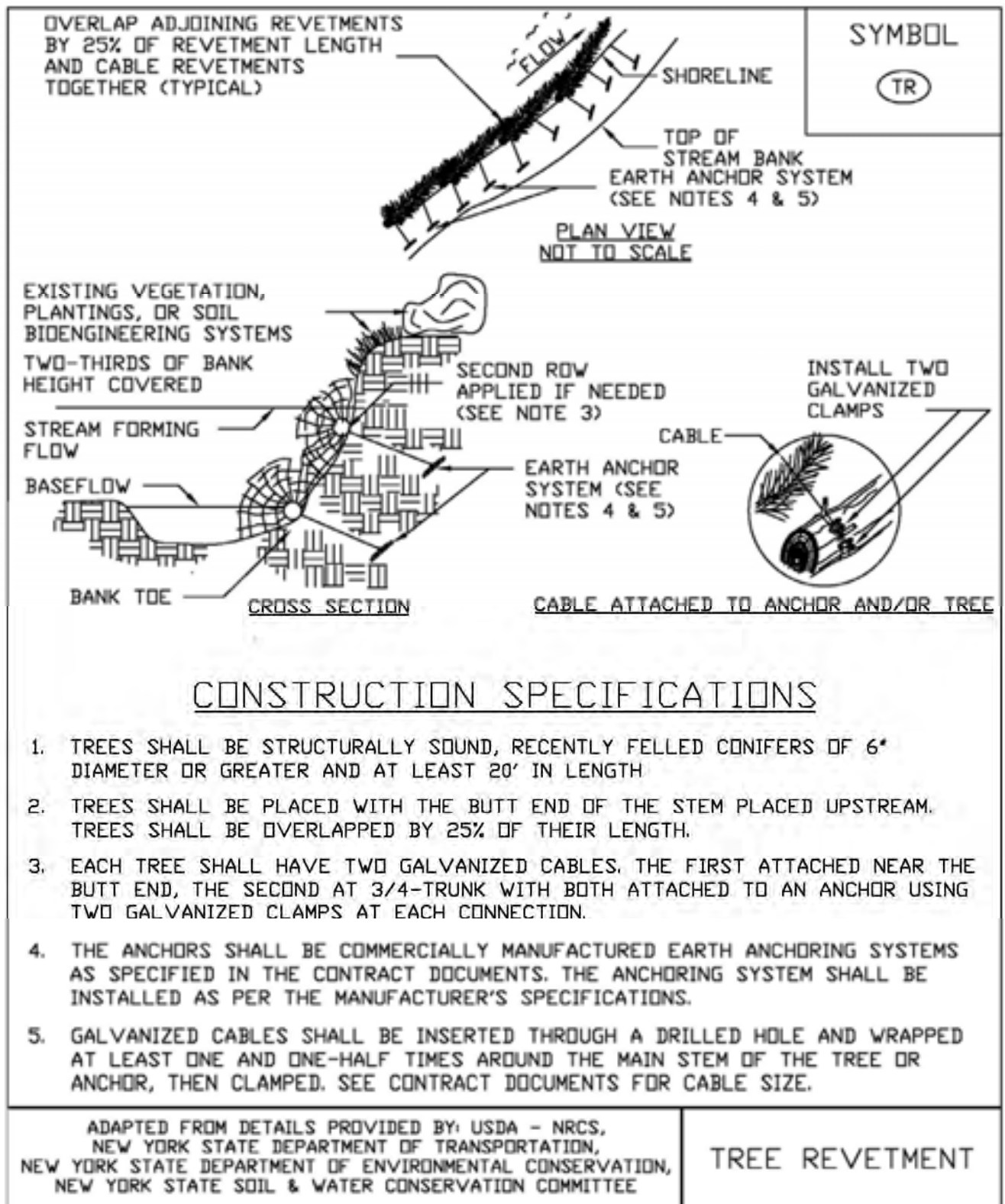
Conditions Where Practice Applies

This practice is appropriate for streambanks that are eroded or undercut. It should not be used near bridges or other structures where there is a potential for downstream damage if a revetment dislodges. Their use should be limited to non-flashy streams where the needs for future maintenance are less critical.

Design Criteria

1. Trees shall be sound, recently felled spruce or fir of 6" or greater diameter and at least 20 feet in length.
2. Trees are placed initially at the base flow elevation with the butt end upstream. Multiple tree revetments shall be overlapped by 25% of their length, working from downstream to upstream.
3. Each tree shall have their branches trimmed off on the bank side and have two anchors, one near the butt end and the other at 3/4 distance up the trunk.
4. The tree shall be fastened with galvanized cable to the anchors, which will be commercially manufactured earth anchoring systems. The butt end cable shall also be attached to the stem of the next tree at 3/4 the distance from the base, as it is placed to the outside of the previous tree.

**Figure 4.19
Tree Revetment**



STANDARD AND SPECIFICATIONS FOR TREES, SHRUBS, AND VINES



Definition & Scope

Establishing trees, shrubs, and vines or selectively reducing stand density and trimming woody plants to protect the soil and plant resources, improve an area for recreation and increase the attractiveness and usefulness of areas.

Conditions Where Practice Applies

On any area planned for recreation or landscape use such as yard areas, leisure areas, picnic areas, and park lands providing outdoor recreational opportunities.

Criteria and Specifications

1. Planting nursery stock

A. Select species to serve the intended purpose. See Appendix G, Table G.1, "Trees Suitable for Landscape and Conservation Plantings in New York." Where planting of trees is to be done in recreation areas, use those species resistant to compaction listed in Table G.2, "Susceptibility of Tree Species to Compaction" whenever possible.

B. Plant Materials

1) Plants shall conform to the species, variety, size, number, and conditions as stated in a conservation plan or on a plant list shown on landscape drawings. "American Standard for Nursery Stock," by American Association of Nurserymen, shall be used to develop the plant list for landscape drawings and to check quality of plant materials.

2) Durable, legible labels with the scientific and common name and cultivar shall be securely

attached to plants, bundles of seedlings, containers, and/or flats.

C. Plant Protection

Prior to delivery, the trunk, branches, and foliage of the plants shall be sprayed with non-toxic antidesiccant, applied according to the manufacturer's recommendations. This does not apply to state nursery seedlings.

D. Planting Time

Deciduous trees and shrubs: April 1 to June 1 and October 15 to December 15. Evergreen trees and shrubs: April 1 to June 1 and September 1 to November 15.

E. Spacing

Plant all trees and shrubs well back from buildings to allow for mature crown size. The following are guides for planning:

Large Trees	50-60 feet apart
Small Trees	20-30 feet apart
Columnar Species	6-8 feet apart
Hedges	1-4 feet apart
Shrubs	For clumps, plan spacing so mature shrubs will be touching or overlapping by only 1 or 2 feet

F. Site Preparation

1) Individual sites for planting seedlings can be prepared by scalping the sod away from a four foot square area where the seedling is to be planted.

2) All planting beds shall be cultivated to a depth of 8 inches, or chemically treated for weed control. Remove objectionable objects that will interfere with maintenance of site.

G. Planting

1) Plants shall be located as shown on plans and/or drawings and, where necessary, located on the site by stakes, flags or other means.

2) Prior to planting, remove galvanized wire basket securing root ball, untie and roll down burlap covering from around the stem.

3) The plants shall be set upright in holes as illustrated in Figure G.1 in Appendix G.

4) All plants shall be thoroughly watered on the same day of planting. Plants that have settled shall be reset to grade.

H. Wrapping

Immediately after planting, wrap deciduous tree trunks from the bottom to the first limb with a 4 inch wide bituminous impregnated, insect resistant tape or paper manufactured for that purpose. Tie with jute (bag strings) at top and bottom. The wrap should be removed per nursery recommendations.

I. Mulching

Mulch the disturbed area around individual trees and shrubs with a 2-3" layer of wood chips. Pull wood chips 1 inch away from the base of shrubs to avoid fungus development.

J. Pruning

After planting, prune to remove injured twigs and branches. The natural shape of the plant should not be changed.

K. Cleanup and Maintenance

1) After all work is complete, all excess soil, peat moss, debris, etc., shall be removed from the site.

2) Water plants two weeks after planting. For two years, water plants every two weeks during dry periods, which exceed three weeks without a good soaking rain, or water as needed in accordance with local conditions. Shrubs may require 5 to 10 gallons and trees, 20 to 30 gallons for each watering.

3) Remove trunk wrap per nursery recommendation.

2. Transplanting "Wild" Stock

Successful transplanting of wild stock will require heavy equipment and considerable labor as a large weight of soil must be moved with the roots.

- A. Select trees and shrubs with good form and full crowns.
- B. Transplant only when plants are dormant and soil is moist. Wrap soil ball with burlap to prevent soil from separating from roots.
- C. Table 4.8 shows minimum diameter and

approximate weight of soil ball that must be moved with each size plant.

- D. Plant and maintain as described above for nursery stock.

PRUNING AND THINNING

Use	Cleared Width Each Side of Trail Tread (ft.)	Cleared Height (ft.)
<u>TRAILS</u>		
Hiking	1	8
Bicycle	2	10
Motorbike	2	10
Horse	2	12
X-Country Ski	Total: 3-12	12 ¹
Snowmobile	Total: 6-12	12 ¹
<u>PICNIC & CAMPING AREAS</u>		
Campfire/Grill	10 ft. diam.	15
¹ Includes allowance for snow depth and snow load on branches		

1. Pruning

- A. Remove trees, limbs, and limb stubs to the above widths and heights specified for the intended use.
- B. Remove dead, diseased, or dying limbs that may fall.
- C. Do not remove more than one-third of the live crown of a tree in a year.
- D. Cut limbs flush to the branch bark ridge.
- E. Use the 3 or 4 cut pruning method on all branches over 2 inches in diameter: First cut about one-third the way through the underside of the limb (about 6-12 inches from the tree trunk). Then (approximately an inch further out) make a second cut through the limb from the upper side. When the branch is removed, there is no splintering of the main tree trunk. Remove the stub. If the branch is larger than 5-6 inches in diameter, use the four cut system. Cuts 1 and 2 remain the same and cut 3 should be from the underside of the limb, on the outside of the branch collar. Cut 4 should be from the top and in alignment with the 3rd cut. Cut 3 should be 1/4 to 1/3 the way through the limb. This will prevent the bark from peeling down the trunk. Do not paint the cut surface.

2. Thinning

- A. Remove dead, diseased, dying, poorly anchored, or ice damaged trees that pose a hazard to recreationists or that interfere with intended use.
- B. To maintain grass cover in a wooded area, thin according to formula $D \times 3$ (average diameter of the trunk of overstory trees, in inches, times three—the answer is the spacing between trees to be left, in feet). For example, for trees with average diameter of 6 inches, spacing after thinning should leave trees 18 feet apart on average. Crown cover after thinning should be about 50 percent.
- C. Selectively thin as needed to favor those trees that are most “resistant” to compaction around their roots. See Table G.2, “Susceptibility of Tree Species to Compaction” in Appendix G. If the soil on the site is naturally well drained, those species in the “intermediate” group may also be favored.

Table 4.8
Size and Weight of Earth Ball Required to Transplant Wild Stock

Caliper ¹ (Inches)	Shade Trees (Maple, Ash, Oak, Birch, etc.)		Small Trees & Shrubs (Crabapple, Thornapple, Viburnum, Dogwood, etc.)		
	Minimum Diameter Ball (Inches)	Weight of Ball (lbs.)	Up to 6 ft. Height — 6 ft. and Caliper ¹	Minimum Diameter Ball (Inches)	Weight of Ball (lbs.)
1/2	14	88	2	12	55
3/4	16	130	3	14	88
1	18	186	4	16	130
1-1/4	20	227	5	18	186
1-1/2	22	302	3/4	18	186
1-3/4	24	390	1	20	227
2	28	621	1-1/2	22	302
3	32	836	1-3/4	24	390
3-1/2	38	1,400	2	28	621
4	42	1,887	2-1/2	32	836
			3	38	1,400

¹Caliper is a diameter measurement of trees at a height of 6 inches above the ground.

STANDARD AND SPECIFICATIONS FOR VEGETATED ROCK GABIONS



Definition & Scope

A combination of vegetation with rock filled gabions used for slope stabilization by providing a retaining wall with plant canopy to reduce runoff, temperature, and provide a vegetated cover to hardened surfaces.

Conditions Where Practice Applies

On steep sloping areas such as road cuts, slumped areas, gully cuts, low fill areas, or areas that are subject to erosion, seepage and weathering and have a low to medium hazard potential should slope failure occur.

Design Criteria

Materials - shall be a native or nursery grown cultivars capable of performing intended function. The live branch cutting shall be 1/2" to 1" in diameter and long enough for each gabion row to extend the tops a minimum of 1 foot beyond the next upper gabion row and be in contact with the undisturbed soil behind the gabion wall.

Spacing - The plant cuttings shall be placed tightly side by side with stem contact with each other on top of each gabion row on a 1" layer of raked backfill.

Note: These can be complex systems that should be designed by a licensed professional engineer.

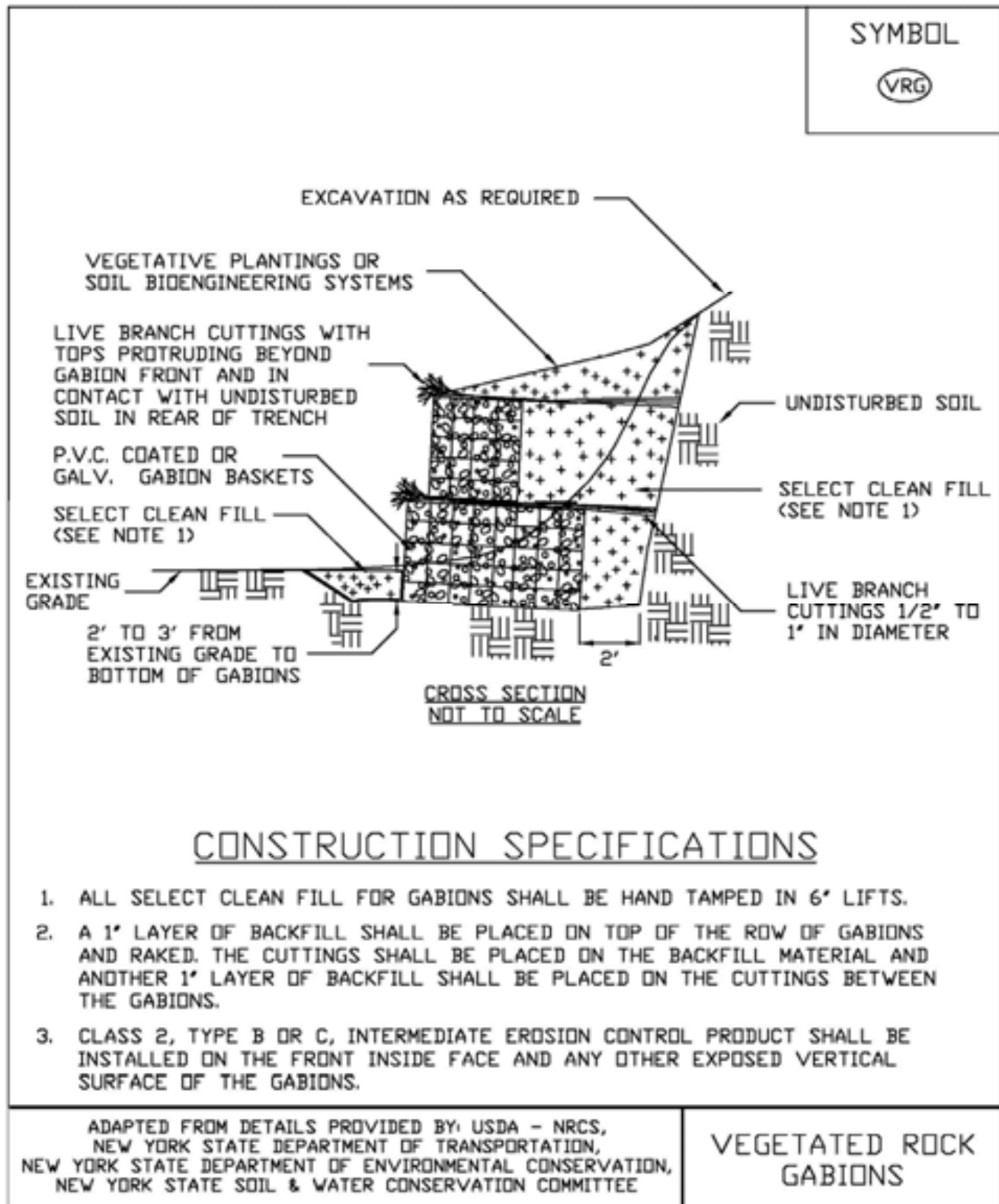
Construction Specifications

1. Prepare the foundation for the gabions by excavating to the lines and grades shown on the drawings.
2. Subgrade will be compacted and leveled to receive the first layer of gabions. The first row will be keyed into the existing grade at the toe, a minimum of 1.5 feet.
3. Gabions will be placed according to the design and filled with stone or crushed rock from 4-8 inches in diameter. A geotextile should be draped over the basket prior to placement of backfill or plant bedding.
4. Backfill behind with select clean fill and compact by hand tamping, or light mechanical tampers, in 6" lifts.
5. On top of each row of gabions place 1" of select backfill as a plant bedding prior to placement of plant cuttings.
6. Place plant cuttings in a tight configuration with stem to stem contact so plants extend beyond the next gabion facing by 1 foot and beyond the back of the wall in contact with native soil.
7. Grade above the final row of plant cuttings with select clean fill to a slope no steeper than 2 horizontal to 1 vertical.

Maintenance

Regular inspection and maintenance of this system should be conducted especially during the first year of establishment. Repairs should be made to gabions as necessary and all settled areas should be brought back to grade.

Figure 4.20
Vegetated Rock Gabions



STANDARD AND SPECIFICATIONS FOR VEGETATING SAND AND GRAVEL BORROW AREAS



Definition & Scope

Permanently vegetating inactive borrow areas with sustainable herbaceous perennial plants in order to stabilize the soil, thus preventing wind and water erosion; creating a more aesthetically pleasing view; and enhancing the wildlife habitat for greater diversity.

Condition Where Practice Applies

Sand and gravel borrow areas which have had EITHER the top portion of the soil profile replaced as 'topsoil' or overburden with greater than 15 percent fines included, OR the sand and gravel mined condition remains without 'topsoil' being replaced resulting in sand and gravel with less than 15 percent fines.

Design Criteria

- Depending upon the type of unconsolidated material being mined, side slopes shall be graded in accordance with the New York State Mined Land Reclamation Law. Minimum requirements are: for fine sand, silt, clay the slope shall not exceed 2 horizontal to 1 vertical (26°); for coarse sand and gravel the slope shall not exceed 1.5 horizontal to 1 vertical (33°)
- Rocks and other debris shall be removed from the site or buried during grading if allowed.
- Surface soil layer shall be sampled from 0-6" in depth. Combine about 15 core samples to represent the site soil conditions. Analyze to determine pH, P and K.
- Obtain a larger (5-10 lbs.) soil sample to represent the surface soil texture. Analyze for percent fines (particles less than .074 mm or 200 mesh sieve).
- Apply soil amendments as indicated by soil chemical test. The surface to be seeded shall be limed to a pH of

6.0 using agricultural ground limestone. Fertilize to achieve a moderate level of available phosphorus (P_2O_5) and potassium (K_2O). If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply 50 pounds per acre of nitrogen. Incorporation will be accomplished following the seeding.

- Select the appropriate seed mix based on percent fines and time of planting.
 - IF 15 percent fines or less:** use the warm season grass mix. If fall planting is necessary, use a temporary cover to allow planting of the warm season grasses in early spring. Two (2) bushels of oats per acre is suggested as this will winter kill and not be competitive when the permanent seeding is made. Another option is small grain straw at two (2) tons per acre. Do not use old hay.
 - Warm Season Grass Table:
 - IF greater than 15 percent fines:** use a grass/legume mixture, or the warm season grass mix.

Species	Variety	Certified Seed PLS*/Acre (lbs.)
Switchgrass	Blackwell, Shelter Pathfinder, or Trailblazer	2
Coastal panicgrass	Atlantic	2
Big bluestem	Niagara	4
Little bluestem	Aldous or Camper	4
Sand bluestem	Goldstrike	2
Sand lovegrass	Nebraska 27 or Bend	2
Total mix (PLS/acre)		16 lbs.
*Pure Live Seed (PLS) = (% germination x %purity)/100 Pounds to be seeded = (100 x lbs. of 100% PLS required)/% PLS of commercial seed being used.		

D. Grass/Legume Table:

Species	Variety	Pure Live Seed Per Acre (lbs.)
Creeping red fescue	Common	10
Smooth Bromegrass	Common	2
Perennial ryegrass	Pennfine/Linn	5
Red clover*	Empire plus Pardee	8**
* legume in seed mixture needs to be inoculated. ** 4 lbs. of each is best. 8 lbs. of either one is good.		

OR

Species	Variety	Pure Live Seed per Acre (lbs.)
Flatpea*	Lathco	10.0
Perennial pea*	Lancer	2.0
American vetch*	Common	10.0
Hard fescue	Common	10.0
Total Mix (lbs./acre)		32.0
* legume in seed mixture needs to be inoculated.		

difficult due to the lightweight and fluffy seed characteristics of some species.

E. Incorporate the soil amendments and seed.

- i. "Tracking" an area is using a bulldozer having cleats at least 1 inch in depth. Operation of the dozer shall be perpendicular to the contour and such that the entire area is covered by the tracks.

OR

- ii. Pulling a cultipacker over the entire site with the tines up or no deeper than 1 inch. This option only works if soil moisture is near field capacity.

8. Mulching is essential for immediate erosion control and uniform establishment of cool season grasses and legumes on sands and gravels. Use a heavier rate for the grass/legume seedings of 4000 lbs./ac. Use only small grain straw. Mulching of warm season grasses may not be necessary when runoff and sediment delivery is not an issue. If erosion control is necessary for warm season grass sites, mulch with 3000 lbs./ac. of small grain straw (not grass hay). On sites where mulch can be avoided, warm season grasses will respond favorably.
9. Anchor the mulch by using the bulldozer tracking technique. This may be done simultaneously with seed incorporation. Optional anchoring techniques and materials are available in the Mulching Standard.
10. Site protection is necessary to avoid wheel and tire damage.

7. Planting instructions:

- A. Planting dates are very critical for warm season grasses. Very early spring (March/April) is best. The success rate decreases notably by the end of May. Fall seedings are not recommended. Grass/legume mixes may be reliably planted from early spring through June 15. Avoid June 16 through August 15. After August 15, seed anytime until ground freezes.
- B. A temporary cover of 2 bushels of oats may be seeded between August 15 and September 15 (oats will winter kill). This works well preparing for early spring seedings.
- C. Inoculate legume seed immediately prior to actual seeding. Use 4 times the standard agricultural rates.
- D. The seed mix must be uniformly broadcast. A hydroseeder works well or spread by hand if necessary. The use of spinner type seeders is

STANDARD AND SPECIFICATIONS FOR VEGETATING SAND DUNES AND TIDAL BANKS



Definition & Scope

Establishing and maintaining **permanent** vegetative cover in order to provide coastal shoreline protection to stabilize sand dunes, provide for sand entrapment for dune building, and provide for protection of dune vegetation from foot traffic and vehicles. Also to stabilize tidal banks and provide for long term protection.

Condition Where Practice Applies

On any coastal shoreline, including shorelines of the Great Lakes, Lake Champlain, Long Island Sound and the Atlantic Ocean where vegetation can be expected to effectively stabilize a site.

Specifications

1. Sand dunes

A. Where stabilization of existing sand dunes and/or re-establishment of beachgrass is needed.

1) Long Island and NYC area, use Certified 'Cape' American Beachgrass. Planting of frontal dunes should be accomplished by April 30. Refer to American Beachgrass Information Sheet for specific instructions.

2) Lake Champlain and Great Lakes, use the Lake Champlain strain or species if adequate planting material is available. Use American beachgrass guidelines for planting. 'Cape' will do well but is very aggressive compared with the Lake Champlain strain. Some people consider 'Cape' an invasive plant in these locations.

3) 'Atlantic' coastal panicgrass is excellent for

back dune areas. Seed at 10 pounds pure live seed per acre. Refer to Standard and Specifications for Vegetative Stabilization of Sand and Gravel Pits for determining the proper amount of pure live seed.

4) Immediately after planting, a wooden sand fence (snow fence) will be built to protect the beachgrass from vehicle and foot traffic. The fence shall surround the planted area at a distance of 15 feet from the planted area. Passageways should be provided to allow pedestrians to cross the planted area at appropriate intervals. Elevated boardwalks, or dune cross-overs, are desirable and required by DEC on many stretches of coastline. .

B. Where sand dunes are strengthened or reconstructed through sand entrapment, and shore conditions allow for sand deposition, appropriate permits for altering shorelines must be obtained prior to beginning work.

2. Building, Planting, and Maintaining Coastal Sand Dunes

Dune stabilization work should start as far landward as possible. Whenever feasible, leave room for two or more dune lines for a double layer of protection. Dunes grow toward the sand supply, which is the ocean or the lake.

A. Building the dune:

1) Vegetatively.

Where blowing sand is available, a simple, relatively inexpensive and successful method exists for building dunes. It consists of planting American beachgrass strips parallel to the coastline. As the windblown sand moves off the beach landward, it drops its load of sand, beginning the natural cycle of dune growth. The plantings will trap most of the windblown sand, particularly during the growing season when the grass will continue to grow up through the newly trapped sand.

2) Sand Fences (Snow Fence Material).

The use of sand fence is effective and the material is readily available. It may be more expensive than building dunes vegetatively, but is less expensive than doing it with machinery. Normally it is also much faster than with

vegetation alone.

To form a barrier dune, erect the sand fences in parallel lines 30 or 40 feet apart. The fences should be roughly parallel to the water line and yet be as nearly as possible at a right angle to the prevailing winds. See Figure 4.21 on page 4.72. Where this is not possible, erect a single line of fence parallel with the water at least 140 feet from the MHT line and space 30 foot long perpendicular spurs 40 feet apart along the seaward side to trap lateral drift.

As the fences fill with sand, additional sets of fence can be placed over those filled until the barrier dune has reached a protective height.

To widen an old dune, the fencing should be set seaward at a distance of 15 feet from the old dune base.

Materials -

Use standard 4-foot sand (snow) fence. The fence should be sound and free of decay, broken wire, and missing or broken slats.

Wood posts for fence support should be black locust, red cedar, white cedar, or other wood of equal life and strength. They do not need to be treated. They should be a minimum of 6 ft. 6 in. long and a minimum diameter of 3 inches. Standard fence post length is usually 7 ft.- 8 ft. and should be used where possible.

Four (4) wire ties should be used to fasten the fence to the wood posts. Weave fence between posts so that every other post will have fence on ocean side of posts. Tie wires should be no smaller than 12 gauge galvanized wire.

The bottom of the fence should be set about 3 inches into the sand, or a mechanical grader could be used to push some sand against the bottom of fence.

3) Sand fence plus vegetation -

The combination of these two approaches is more effective than either one alone. The sand fence should be placed as discussed above. Bands of vegetation should then be planted parallel to the fence on the landward and seaward side. Each bank of vegetation should be about 20 feet wide and placed 10 to 15 feet from the sand fence. As the sand fills between the two fences, additional fence can be erected

or the area between the fences can be planted. Such a combination can trap most of the wind blown sand crossing the dune area and produce a much broader based dune than either approach alone. See Figure 4.22.

3. Tidal Streams and Estuaries

The procedures to determine the effectiveness potential of stabilization of tidal streams and estuaries are found in Table 4.9 on page 4.73.

Plants to be used are as follows:

- A. Certified 'Cape' American beachgrass
- B. Certified 'Bayshore' smooth cordgrass
- C. Certified 'Avalon' saltmeadow cordgrass
- D. Certified 'Atlantic' coastal panicgrass

- 4. Coastal panicgrass is primarily used in freshwater tidal areas above high tide line. Frequently, it is seeded over top of saltmeadow cordgrass plantings.

5. Additional Reference

"Best of Beach Vegetation" by W. Curtis Sharp. Reprints from Parks and Recreation Resources. Volume 1, Nos. 1, 2, 4 & 5, 7 & 8. Published in January, February, May/June, July/August 1982.

Figure 4.21
Combination of Sand Fence and Vegetation for Dune Building

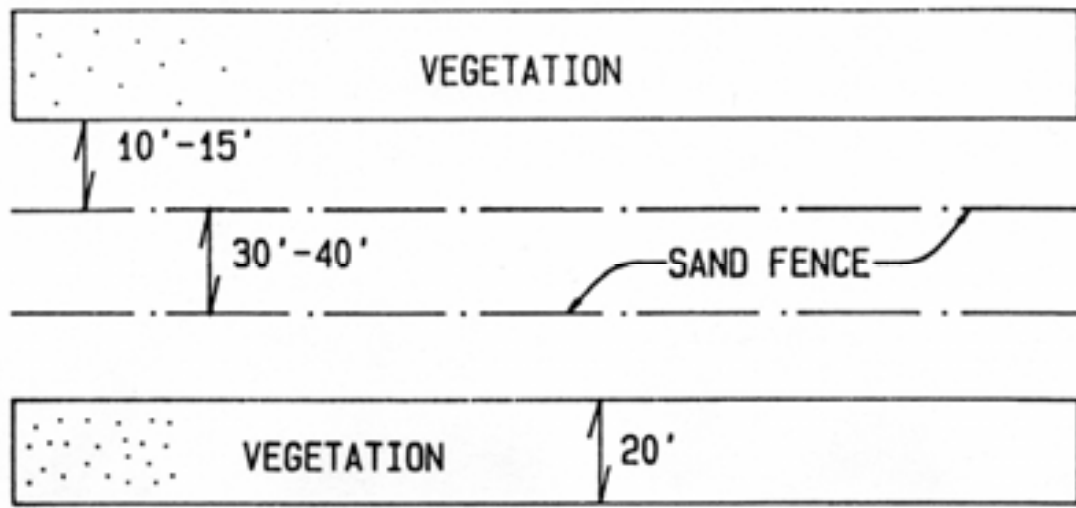


Figure 4.22
Typical Cross-Section Created by a Combination
of Sand Fence and Vegetation

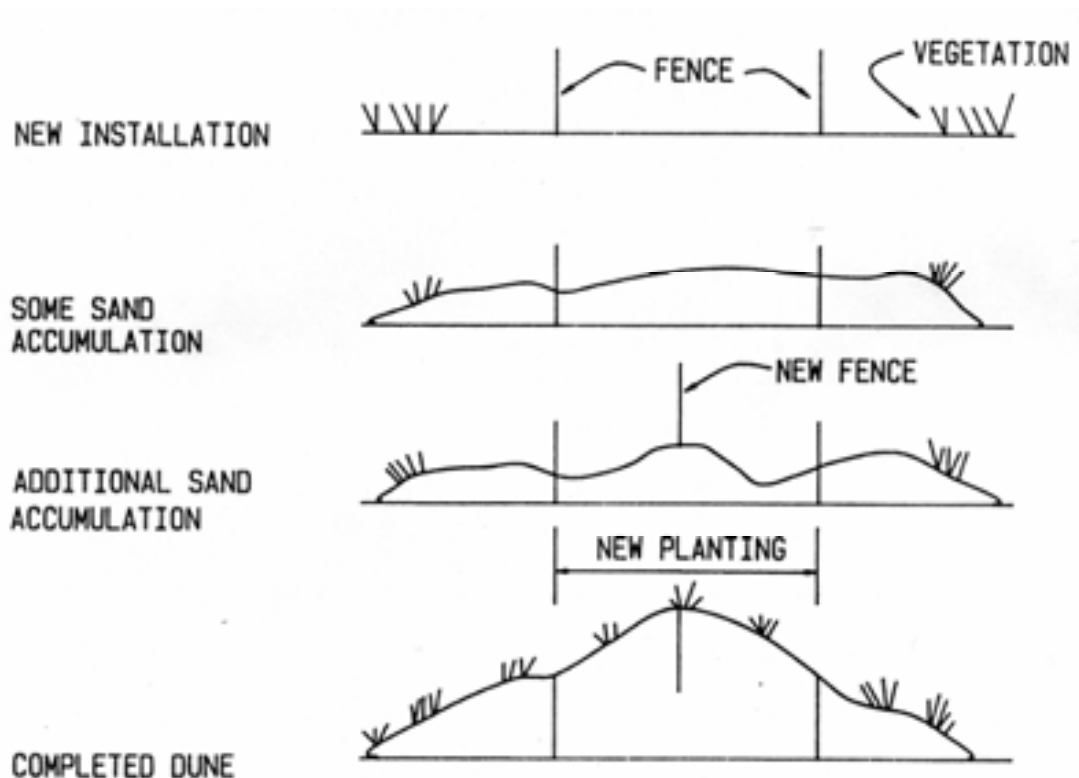


Table 4.9
Vegetative Treatment Potential for Eroding Tidal Shorelines

DIRECTIONS FOR USE

1. Evaluate each of the first four shoreline variables and match the site characteristics of the variable to the appropriate descriptive category.
2. Place the Vegetative Treatment Potential (VTP) assigned for each of the four variables in the right hand column.
3. Obtain the Cumulative Vegetative Treatment Potential for variables 1, 2, 3 & 4 by adding the VTP for each.
4. If it is 23 or more, the potential for the site to be stabilized with vegetative is very good and the rest of the table need not be used. If it is below 23, go to step 5.
5. Determine the VTP for shoreline variable 5 through 9 and obtain the cumulative VTP for variables 1-9.
6. Compare the cumulative VTP score with the Vegetative Treatment Potential Scale at the bottom of this page.

SHORELINE VARIABLES

DIRECTION FOR USE

VTP

The Vegetative Treatment Potential (VTP) is located in bold type.

1. Fetch: Average distance in miles of open water measured perpendicular to the shore and 45 degrees either side of perpendicular to shore.	Less than 0.5 miles 8	0.5 thru 1.4 miles 7	1.5 thru 3.4 miles 4	3.5 thru 4.9 miles 2	over 5 miles ¹ 0	
2. General shape of shoreline for distance of 200 yards on each side of planting site.	Coves 8	Irregular shoreline 3		Headland or straight shoreline 0		
3. Shoreline orientation: General geographic direction the shoreline faces.	Any less than 1/2 mile fetch 5	West to North 3	South to West 2	South to East 1	North to East 0	
4. Boat traffic: Proximity of site to recreational & commercial boat traffic.	None 5	1-10 per week within 1/2 mi. of shore. 3	More than 10 per week within 1/2 mi. of shore. 2	1-10 per week within 100 yds. of shore. 1	More than 10 per week within 100 yds. of shore. 0	

Cumulative Vegetative Treatment Potential for Variables 1, 2, 3 & 4 _____

If this score is 23 or above, the potential for the site is very good and the rest of the table need not be used. If it is below 23, go to step 5 below.

5. Width of beach above mean high tide in feet	Greater than 10 ft. 3	10 ft. thru 7 ft. 2	6 ft. thru. 3 ft. 1	Less than 3 ft. 0	
6. Potential width ² of Planting area in feet	More than 20 ft. 3	20 ft. thru 15 ft. 2	14 ft. thru 10 ft. 1	Less than 10 ft. Do not plant	
7. On shore gradient slope from MLW to toe of bank.	below 8% 6	8% thru 14% 3	15% thru 20% 1	Over 20% 0	
8. Beach Vegetation	Vegetation below toe of slope 3		No vegetation below toe of slope 0		
9. Depth of sand ³ at mean high tide in inches.	more than 10 in. 3	10 in. thru 3 in. 2	less than 3 in. 0		

Cumulative Vegetative Treatment Potential for Variables 1-9 _____

1. Do not plant.
2. If tidal fluctuation is 2.5 feet or less, measure from MLW to toe of bank. If tidal fluctuation is over 2.5 feet, measure from MW to toe of bank.
3. Refers to depth of sand deposited by littoral drift over the substrata.

Vegetative Treatment Potential Scale

If the VTP is,		Potential of site to be Stabilized with Vegetation
Between	And	
40	33	Good
32	24	Fair
23	16	Poor

Figure 4.23

American Beachgrass Information Sheet

(*Ammophila breviligulata* Fern)

Adapted from USDA—NRCS Plant Guide²

Use: Major use is to stabilize moving sand along the Atlantic Sea coast and Great Lakes region. It is the best species for the initial stabilization of frontal dunes.

Useful as an erosion control plant on non-dune areas where soils are very sandy and the site conditions make establishment of seeded species very difficult. Also used on soils high in salinity such as industrial waste needing vegetative cover.

Description: American beachgrass is a leafy, spreading grass with many stems per clump. It may reach a height of two to three feet. The seed head is a spike-like panicle, about ten inches long, and appears in late July or August. Leaves are long and narrow, and may become rolled or folded as it matures.

One outstanding growth characteristic is the strong underground stems (rhizomes) that spread beneath the sand and give rise to many new plants. Its vigorous growth enables the plant to withstand heavy deposits of sand and the ability to grow up through deposits.

Adaptation: American beachgrass is native to the mid-Atlantic coastal region from Maine to North Carolina, and the Great Lakes region. It will grow on island sites, high in sand and/or saline content, provided adequate amounts of nitrogen and other nutrients are present.

Varieties: ‘Cape’ is the most recent variety and was developed by the Soil Conservation Service at the Cape May Plant Materials Center, Cape May Court House, N.J. ‘Hatteras’ developed by the Agricultural Experiment Station in North Carolina is a variety better adapted to southern climates.

Source: Both are commercially available vegetatively. Seed not available.

Establishment: The best time to plant beachgrass is from October 1 to April 30. If properly planted, good survival can be expected at any time during this period, except when soil is frozen. Summer plantings are not satisfactory. American beachgrass can be planted either by hand or by mechanical equipment designed for this work. The stems of plants called ‘culms’ are used for planting stock. Two or three culms are planted per hole. Space plants 18” by 18”, unless wind erosion is severe, then reduce spacing to 12” by 12”. Stagger the plantings in alternate rows to provide

maximum erosion control. On very stable areas where wind is not a factor, a spacing of 24” x 24” is suitable. An 18” x 18” spacing requires 58,500 culms (3 culms/planting unit) per acre, or 1,350 culms per 1,000 square feet.

Beachgrass culms must be planted at least 8” deep. This prevents plants from drying out, as well as being blown out by the wind. A tiling or ditching spade is an excellent tool for opening the planting hole. A two person crew works best in planting on frontal dunes and loose sandy areas. The culms and roots must be kept cool and moist before and during planting. Success of planting will increase if the stock is dormant or has made very little growth.

Fertilizer properly applied is the key to good vigorous growth, as coastal sands are rather infertile. Fertilize in March or April with 30 to 40 pounds of inorganic nitrogen per acre until desired density is obtained.

Management: Once the stand is well established, the rate of fertilizer applied can be reduced by half, or applied only when the stand appears to be weakening.

Exclude vehicular traffic if possible and provide elevated boardwalks for pedestrians. Pedestrian and vehicular traffic that bends or breaks the culms will seriously damage the plants and may kill them. Move boardwalks, or dune cross-overs, when beachgrass underneath begins to weaken and become open, exposing the sand for potential blowing. On frontal dunes, any area devoid of protective cover is subject to blowing and eventual ruin. Replanting of beachgrass stands that become open should be an annual operating procedure.



AMERICAN BEACHGRASS

Figure 4.24

Cordgrass Information Sheet

Smooth Cordgrass (*Spartina alterniflora*) and Saltmeadow Cordgrass (*Spartina patens*)

Adapted from USDA—NRCS Plant Fact Sheets²

Description: Smooth cordgrass, a long life perennial, is the dominant, most productive marsh plant in the regularly flooded inter-tidal zone along the Atlantic and Gulf coast from Newfoundland to Florida and Texas. Smooth cordgrass grows three to seven feet tall with stems up to 1/2 inch in diameter. The leaves are twelve to twenty inches long, tapering to a point. The seed heads, produced in

September and October, are ten to twelve inches long and hold twelve to fifteen spikelets, each two to three inches long. Its primary method of spreading is by vigorous, hollow rhizomes.

Saltmeadow cordgrass grows in salt marshes and sandy meadows along the Atlantic and Gulf coasts from Quebec to Florida and Texas. It occupies the area immediately above the inter-tidal zone. Mature plants are grayish green, usually one to three feet tall. The leaf sheath is round; the leaf blade is long and narrow, usually rolled inward giving a wiry appearance; the upper side of the leaf is rough. The seed heads produced in October have spikelets that grow almost at right angles to the rachis or main stem. Saltmeadow cordgrass reproduces rapidly by long, scaly, slender rhizomes.

Both smooth and saltmeadow cordgrasses are used by waterfowl as a source of food. Saltmeadow cordgrass is also used by muskrats for housing materials.

Uses: Because of their adaptation to brackish water, smooth and saltmeadow cordgrasses occur naturally or can be planted to stabilize eroding shorelines. Planted along the shoreline, the cordgrasses absorb the wave energy and collect the sediment brought in by water. As the sediment is dropped, the band of vegetation expands, pushing the mean high tide away from the tow of the bank, thus reducing the potential for continuous erosion.

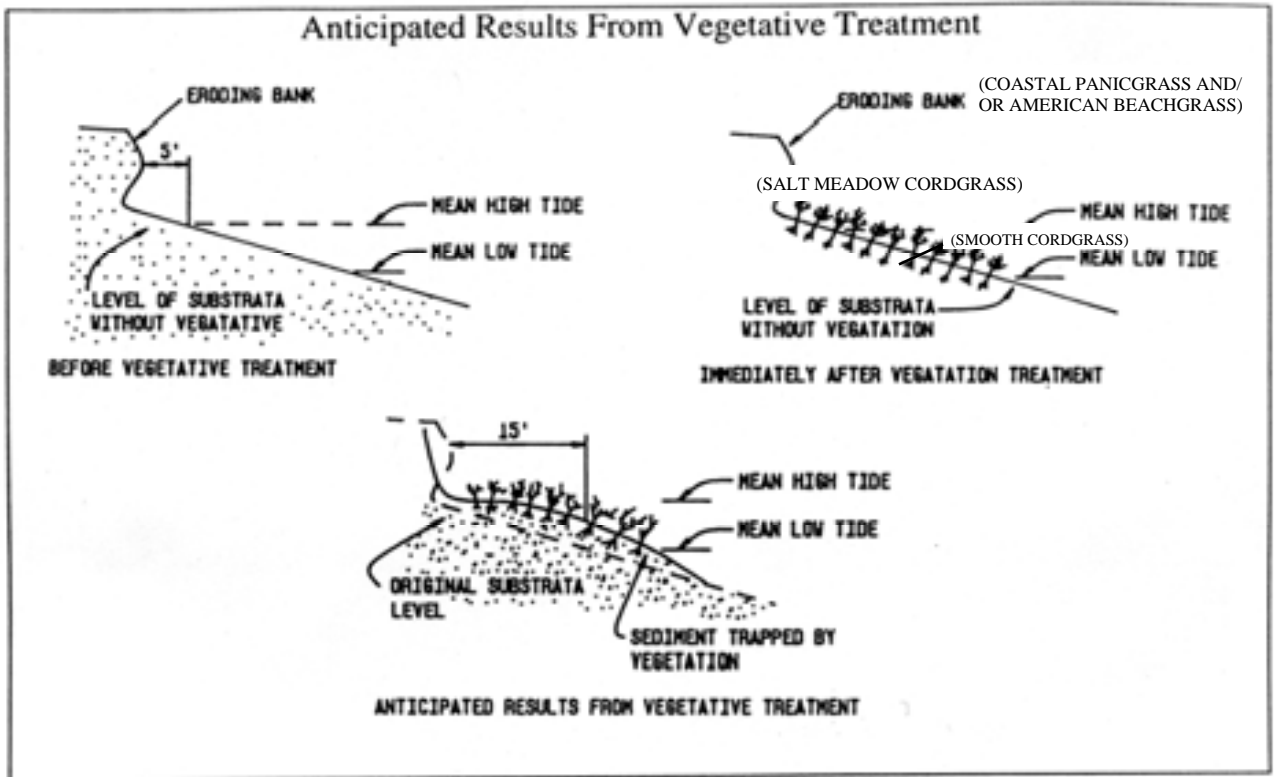
Establishment of Shoreline Plantings: Smooth cordgrass is planted between the mean low water level and the mean high water level. Saltmeadow cordgrass is planted above



Spartina alterniflora



Spartina patens



the smooth cordgrass from mean high water to the toe of the slope. If the distance from the mean high water to the toe of the slope exceeds 10 feet, American beachgrass should also be planted in the upper part of the slope.

Establishment of Plants: There are three types of plant materials that can be used for planting along the shoreline. One type is seedlings grown in peat pots. Such plants should be about 12 inches tall with 3-5 stems per container before they are large enough for transplanting. The container is planted with the root mass.

A second method is to grow the plants in containers which allow the plants with the root mass to slip out at the time of planting. Their size, etc., are the same as above. The advantage of this method is that it eliminates the barrier occasionally created by the peat pots that may produce a slight turbulence around the plant and wash it out.

A third type is to harvest culms from natural or cultivated stands which are then planted directly to the shoreline. If the plants are to be taken from natural stands, they should be growing in sandy substrata. The stands should be open and developing rather than dense and mature. The culms will be ready for digging and transplanting when the top growth is six to ten inches tall. Each culm should have a well developed root.

Methods one, two and three are equally recommended for smooth cordgrass. Methods one and two are recommended for saltmeadow cordgrass. Although method three can be

used, performance expectations will be less than with the other two methods. Coastal panicgrass can be planted using method one or be seeded.

Typical plantings consist of one row parallel to the shoreline. Transplants should be midway between the high and low tide elevations. Plant spacing within the row will vary according to the size of the transplant materials being used and the rate at which full coverage is desired. One gallon container stock are generally planted at 5' to 8' centers and plugs generally on 2'-3' centers. Smooth cordgrass typically produces 8'-10' rhizomes for lateral spread in one growing season. If two rows are planted, allow 5' between rows. The spacing to be used is influenced by the severity of the site. On sites that have a potential of being washed away, the spacing should be closer. In protected areas where there is little danger of the planting being initially destroyed, the spacing can be wider. The hole made in the substrata should fully accommodate the plant roots. Be sure to seal the hole by pressing the soil around the roots with your heel.

Planting Method/Fertilization:

Planting Methods: When planting trade-gallons, transplants should be planted in a hole. Post-hole diggers, gas drills with modified bits, or any other methods of digging are satisfactory. The planting hole should be the same size or only slightly larger than the root-ball and deep enough so that the top of the root-ball is flush or slightly below ground. The top of the root-ball should not protrude above

nor be more than 2” below normal ground. The planting hole should be tightly closed around the plant to prevent the plant from wobbling and plants should remain erect after planting.

Planting sites where high wave energy is a problem may require the addition of a plant anchor. A plant anchor consists of ¼” steel re-bar bent into a hook (candy-cane shape) and pushed down into the soil so that the hook lays across the root-ball, pinning it to the ground. Anchors are generally about 30” in overall length and will add to the cost of the planting. However, anchors are generally necessary at unusually problematic sites to prevent plants from washing out.

When planting bare-root plugs, holes need only be approximately 3” in diameter and deep enough to cover the roots. Any style of tool that will punch a hole this size such as a dibble bar will work. Cupping the roots of the plug in hand and pushing down into the mud carefully will also work in more fluid soils. There are no plant anchors for plugs, and in practice, plugs should not be used at any site where wave energy is a factor.

Fertilization: There is no clear consensus on the effectiveness of fertilizer when used in saturated and/or anaerobic soils. However, the additional cost of fertilizer is a small investment given the overall cost involved in vegetative restoration.

Slow-release fertilizer tablets are commercially available in a range of weights and analyses. Recommended tablet weight should be between 15 and 25 grams and have a nitrogen content of not less than 15% and not more than 30%. When using tablets with trade-gallon plants, push the tablet into the top 3” of the root-ball immediately prior to or immediately after planting the transplant. The resulting

hole should be pinched closed. When using tablets with bare-root plugs, drop the tablet in the planting hole prior to inserting the plug.

Planting should be made between mid Spring and July 1. The early Spring plantings are more hazardous because of storms and less favorable soil temperatures. Actual dates are influenced by location. Late Spring plantings are preferred.

Site Suitability: A high percentage of plantings made on tidal shorelines fail due to shoreline conditions, storms, etc. Most shoreline conditions can be identified and their likelihood of contributing to success or failure estimated. They are shown in Table 3.9.

While the procedure outline in Table 3.9 has been tested against actual plantings, there is no guarantee the outcome of the planting will be as the guideline suggests. For instance, unexpected storms could completely eliminate the value of these guidelines and destroy the planting.

Management of Established Plantings: Plantings should be monitored frequently each year. Plants destroyed or washed out should be replanted as quickly as possible. All debris washed onto the plantings should be immediately removed to prevent smothering the plants.

Sources: Smooth and saltmeadow cordgrasses are available commercially. Because commercial sources are subject to change, contact your local USDA Natural Resources Conservation Service office for sources closest to you. ‘Bayshore’ smooth cordgrass, ‘Avalon’ saltmeadow cordgrass, and ‘Atlantic’ coastal panicgrass are recommended varieties for Long Island.

STANDARD AND SPECIFICATIONS FOR VEGETATING WATERWAYS



Definition & Scope

Waterways are a **permanently** constructed conveyance channel, shaped or graded. They are vegetated for the safe transport of excess surface water from construction sites and urban areas without damage from erosion.

Conditions Where Practice Applies

This standard applies to vegetating waterways and similar water carrying structures.

Supplemental measures may be required with this practice. These may include: subsurface drainage to permit the growth of suitable vegetation and to eliminate wet spots; a section stabilized with asphalt, stone, or other suitable means; or additional storm drains to handle snowmelt or storm runoff.

Retardance factors for determining waterway dimensions are shown in Table 3.1 on page 3.10 and "Maximum Permissible Velocities for Selected Grass and Legume Mixtures" (See Table 4.10 on page 4.79).

Design Criteria

Waterways or outlets shall be protected against erosion by vegetative means as soon after construction as practical. Vegetation must be well established before diversions or other channels are outletted into them. Consideration should be given to the use of turf reinforcement mats, excelsior matting, other rolled erosion control products, or sodding of channels to provide erosion protection as soon after construction as possible. It is strongly recommended that the center line of the waterway be protected with one of the above materials to avoid center gullies and to protect seedlings from erosion before establishment.

1. Liming, fertilizing, and seedbed preparation.

- A. Lime to pH 6.5.
 - B. **The soil should be tested to determine the amounts of amendments needed.** If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 1.0 lbs/1,000 sq. ft. of N, P₂O₅, and K₂O.
 - C. Lime and fertilizer shall be mixed thoroughly into the seedbed during preparation.
 - D. Channels, except for paved section, shall have at least 4 inches of topsoil.
 - E. Remove stones and other obstructions that will hinder maintenance.
2. Timing of Seeding.
 - A. Early spring and late August are best.
 - B. Temporary cover to protect from erosion is recommended during periods when seedings may fail.

3. Seed Mixtures:

Mixtures	Rate per Acre (lbs)	Rate per 1,000 sq. ft. (lbs)
A. White clover or ladino clover ¹	8	0.20
Smooth brome grass	20	0.45
Creeping red fescue ²	2	0.05
Total	30	0.70

OR

B. Smooth brome grass ³	25	0.60
Creeping red fescue	20	0.50
Perennial ryegrass	10	0.20
Total	55	1.30

¹ Inoculate with appropriate inoculum immediately prior to seeding. Ladino or birdsfoot trefoil may be substituted for common white clover and seeded at the same rate.

² Perennial ryegrass may be substituted for the creeping red fescue but increase seeding rate to 5 lbs/acre (0.1 lb/1,000 sq. ft).

³ Use this mixture in areas which are mowed frequently. Common white clover may be added if desired and seeded at 8 lbs/acre (0.2 lb/1,000 sq. ft.)

4. Seeding

Select the appropriate seed mixture and apply uniformly over the area. Rolling or cultipacking across the waterway is desirable.

Waterway centers or crucial areas may be sodded. Refer to the standard and specification for Stabilization with Sod. Be sure sod is securely anchored using staples or stakes.

5. Mulching

All seeded areas will be mulched. Channels more than 300 feet long, and/or where the slope is 5 percent or more, must have the mulch securely anchored. Refer to the standard and specifications for Mulching for details.

6. Maintenance

Fertilize, lime, and mow as needed to maintain dense protective vegetative cover.

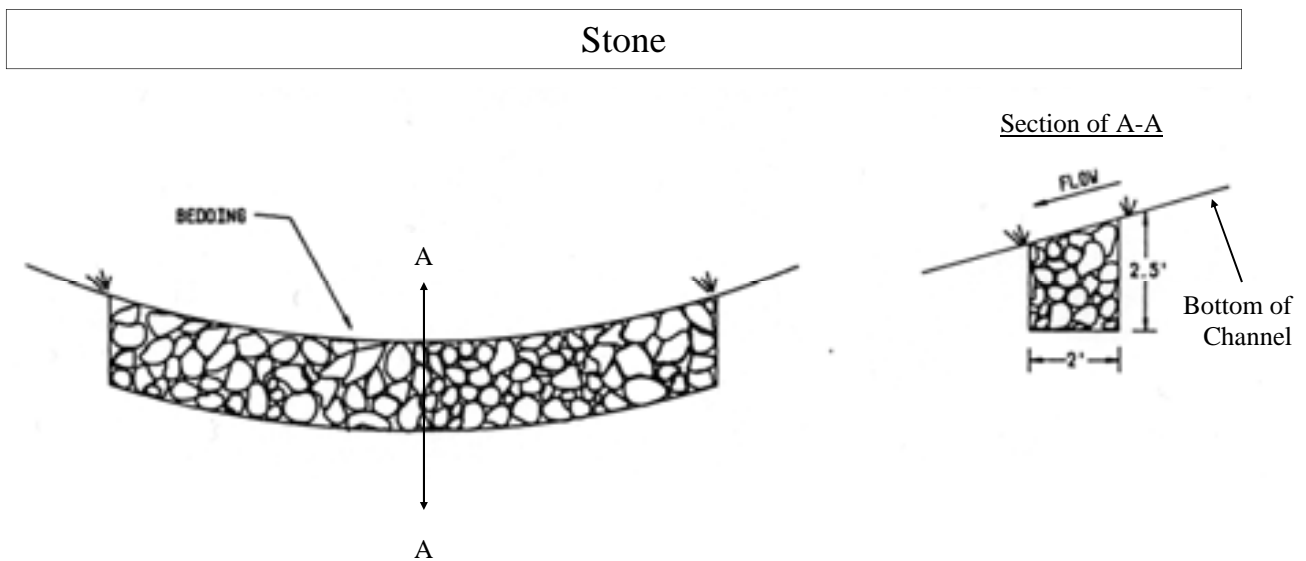
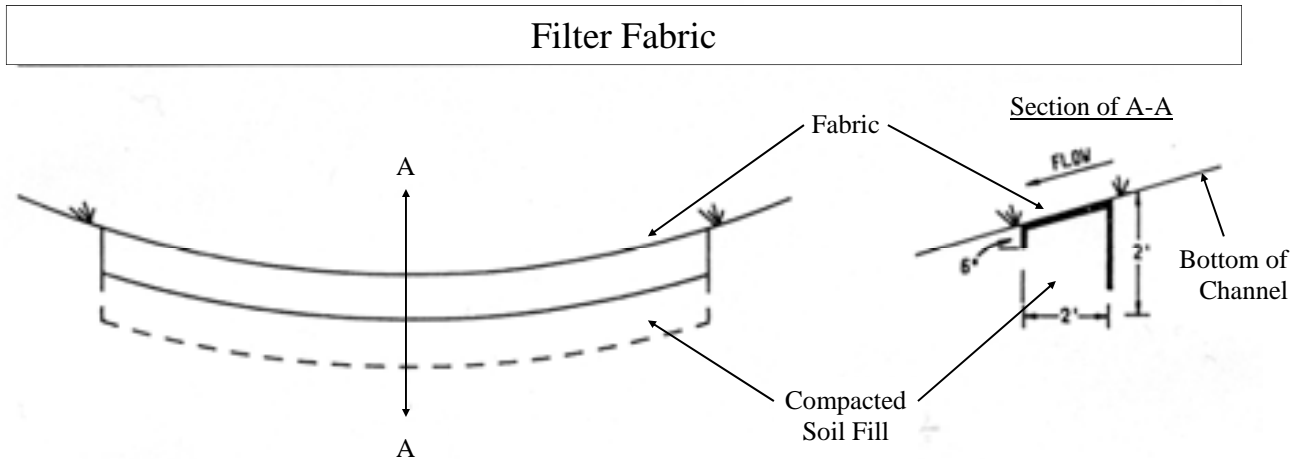
Waterways shall not be used for roadways.

If rills develop in the centerline of a waterway, prompt attention is required to avoid the formation of gullies. Either stone and/or compacted soil fill with excelsior or filter fabric as necessary may be used during the establishment phase. See Figure 4.25, Rill Maintenance Measures. Spacing between rill maintenance barriers shall not exceed 100 feet.

Table 4.10
Maximum Permissible Velocities for Selected Seed Mixtures

Cover	Slope Range ² (%)	Permissible Velocity ¹	
		Erosion-resistant Soils (ft. per sec.) K=0.10 - 0.35 ³	Easily Eroded Soils (ft. per sec.) K=0.36 - 0.80
Smooth Brome Hard Fescue	0-5 5-10 Over 10	7 6 5	5 4 3
Grass Mixtures	² 0-5 5-10	5 4	4 3
White/Red Clover Alfalfa Red Fescue	⁴ 0-5	3.5	2.5
¹ Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained. ² Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section. ³ K is the soil erodibility factor used in the Revised Universal Soil Loss Equation. Visit Appendix A or consult the appropriate USDA-NRCS technical guide for K values for New York State soils. ⁴ Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section. ⁵ Annuals - use on mild slopes or as temporary protection until permanent covers are established. ⁶ Use on slopes steeper than 5 percent is not recommended.			

Figure 4.25
Rill Maintenance Measures



<div>SECTION 5 SEDIMENT CONTROL</div>

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SEDIMENT CONTROL

Scope and Discussion

Sediment control is the second component in the site management plan after erosion control. Primary emphasis should be placed on erosion control first which combines runoff control and soil stabilization to minimize soil erosion. Sediment control practices are then integrated into the plan to further reduce the migration of eroded soil both on and off site.

The majority of sediment control practices utilize settling to capture sediment within a storage volume where it can be contained and managed. These practices include sediment basins, sediment traps and dikes, rock dams, water structures, silt fence, turbidity curtains, straw bale dikes, and portable settling tanks. There is also a group of practices that rely on both filtering and settling to capture sediment. These practices include storm drain inlet protection structures, geotextile filter bags, compost tubes, and buffer filter strips. In addition, the use of chemical polymer substances is a process that may, with NYSDEC approval, be used on sites where disturbed clay soils remain in suspension.

It is important that these sediment control practices be designed, constructed and installed in accordance with the criteria contained in these standards. For these practices to effectively remove sediment from turbid water, the volumes, dimensions, and appropriate attributes of these individual practices must be maintained. This includes the calculated relationships of dimensions to respective drainage areas, length to width ratios, and frequency of inspection and maintenance.

Note: Performing activities within or adjacent to wetlands, streams and waterbodies may require permits from the New York State Department of Environmental Conservation (NYSDEC) pursuant to Article 15 (Protection of Waters), Article 24 (Freshwater Wetlands) and Article 25 (Tidal Wetlands) of the Environmental Conservation Law (ECL). Project owners should contact NYSDEC's Regional Division of Environmental Permits early in the site planning process to discuss the requirements for meeting permit issuance standards. Following the New York State Standards and Specifications for Erosion and Sediment Control may not ensure compliance with the above referenced sections of the ECL.

To assist with the success of these sediment control practices, apply the following concepts for the practice design and location:

1. Keep the clean water clean by diverting runoff from

upslope areas away from disturbed areas.

2. Employ natural vegetative buffers or artificial mats to assist in sediment capture in sheet flow areas.
3. Control concentrated flow to minimize additional erosion that could overwhelm a practice.
4. Stabilize all sediment control systems as soon as they are installed so they do not contribute sediment to site runoff.
5. Remove all practices after use and stabilize the regraded areas immediately.

Sediment accumulated in the sediment control practices must be removed when the sediment has filled the designated storage volume for the practice. The material must be disposed of in a manner that stabilizes it on the construction site. These details, as well as the frequency of inspection, sequences of installation and removal, and an inspection checklist shall be included in the Stormwater Pollution Prevention Plan for the site.

Chemical Treatment

Precipitation of sediment is enhanced with the use of specific chemical flocculants that can be applied to a sediment basin in liquid, powder, or solid form. Flocculants include polyacrylimide, aluminum sulfate (alum), and polyaluminum chloride.



Polymer flocculation shall only be used for dispersive soil-water mixtures that do not respond to normal settling times when allowed to set in sediment traps and basins, i.e. less than 7 days. Controlled application takes place in a sediment basin or trap with anionic polyelectrolytes in the form of liquid, powder, or solid form, such as polyacrylimide, aluminum sulfate, chitosan lactate, or chitosan acetate. Cationic polyelectrolytes have a greater toxicity to fish and other aquatic organisms than anionic

polyelectrolytes because they bind to the gills of fish resulting in respiratory failure (Pitt 2003).

Chemical treatment shall not be substituted for proper planning, phasing, sequencing, and the design of appropriate erosion and sediment control practices.



No polymer application shall take place without written approval from NYSDEC.

Field tests must be conducted on the proposed site at the design basin locations with the tributary soils to establish polymer dosing rates and verify settling performance.

Treated water discharged from sediment basins with polymer treatment will be tested to determine that any residual polymer meets the standards set by NYSDEC. Polymer flocculation systems require daily inspection.

STANDARD AND SPECIFICATIONS FOR BUFFER FILTER STRIP



Land Slope (%)	Minimum Filter Strip Width (ft.)
≤10	50
20	60
30	85
40	105
50	125
60	145
70	165

Definition & Scope

A **temporary/permanent** well vegetated grassed area below a disturbed area that can be used to remove sediment from runoff prior to it reaching surface waters or other designated areas of concern, such as parking lots and road pavement.

Condition Where Practice Applies

This practice is effective when the flow is in the form of sheet flow and the vegetative cover is established prior to disturbance. Surface water must be protected from sediment-laden runoff until buffer filter strip vegetation is established, and then the proposed disturbance can be undertaken. This practice is effective when the flow is in the form of sheet flow (maximum of 150 feet).

Design Criteria

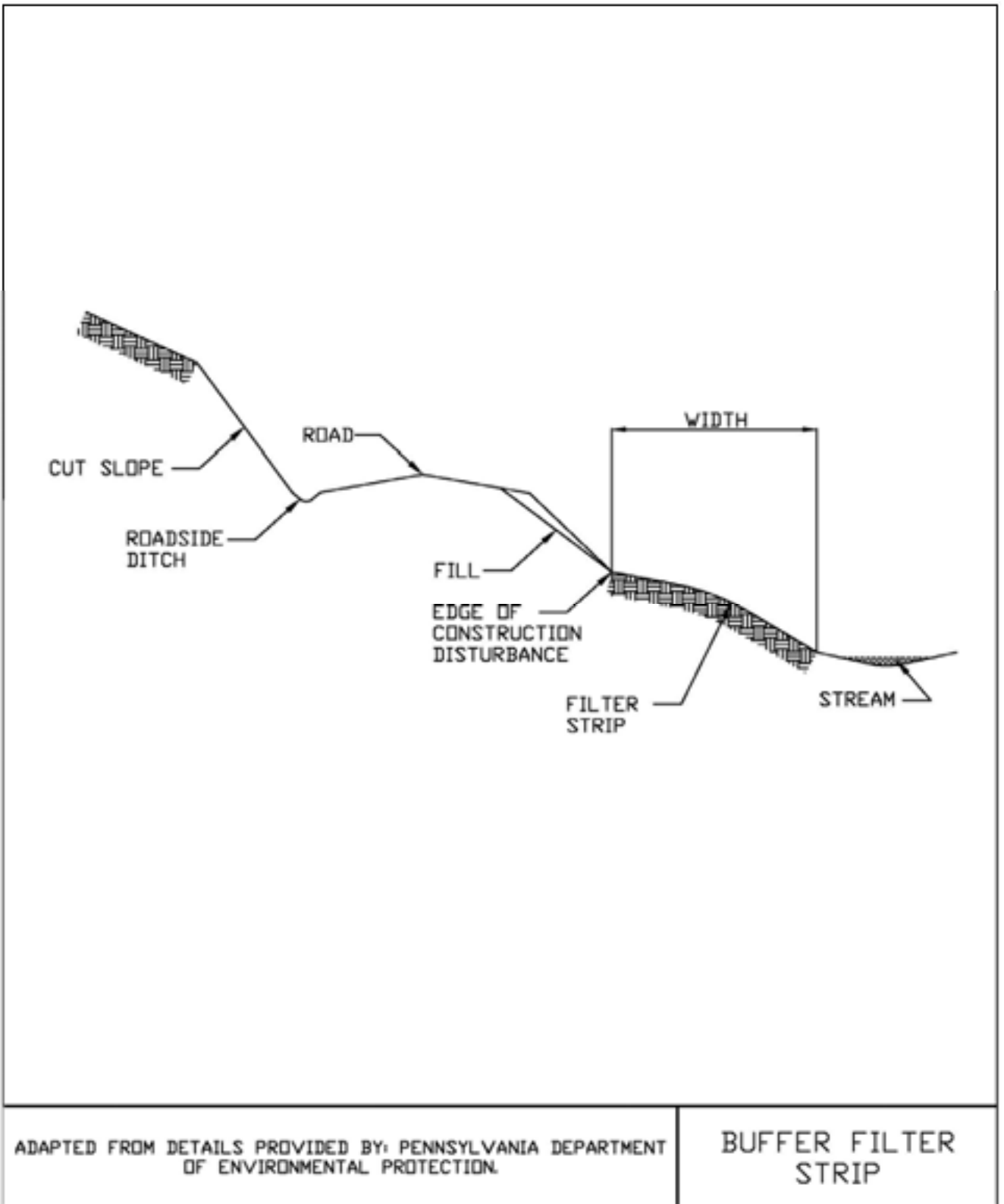
1. The vegetation should be a well established perennial grass. Wooded and brushy areas are not acceptable for purposes of sediment removal.
2. The minimum buffer filter strip width for stream protection shall be in accordance with the following table:

3. The minimum buffer filter strip width to protect paved areas during construction is 20 feet.

Maintenance

If at any time the width of the buffer filter strip has been reduced by sediment deposition to half its original width or concentrated flow has developed, suitable additional practices should be installed. The erosion and sediment control plan shall include these details.

Figure 5.1
Buffer Filter Strip



STANDARD AND SPECIFICATIONS FOR COFFERDAM STRUCTURES



Definition & Scope

A **temporary** barrier placed at a worksite to prevent water from flooding the work area so that construction can take place without discharging sediment into the water resource.

Condition Where Practice Applies

Temporary coffer dams are used to separate streams, rivers, lakes, and other sources of surface water from adjacent locations where soil disturbances are undertaken to complete construction. These barriers can be constructed of manufactured components such as geotextile/plastic tubes filled with water, portable dams formed by metal framing with a geo-membrane, or conventionally constructed earth and stone dike systems.

Design Criteria

The maximum height for this application is 10 feet. No construction activity shall commence in the area of the cofferdam until it is completed and stabilized.

Water Filled Structures

1. These structures shall be sized and installed according to the manufacturers recommendations.
2. Adequate freeboard must be provided to prevent flotation during high water events and periods of below freezing temperatures.
3. The foundation shall be prepared to provide full bottom contact prior to filling.
4. An interior dewatering system shall be designed within

the work area to manage seepage.

5. The ends of the water structures shall be anchored on the stream banks or shorelines at an elevation at least above the top of the structure.

Structural Component Dams

1. These structures shall be sized and installed in accordance with the manufacturers recommendations.
2. The foundation area for the placement of the structural steel framing and the impervious fabric membrane shall be as directed by the manufacturer or by qualified personnel.
3. Dewatering the interior of the coffer dam will be done in a manner that does not disturb the foundation area of the structural frame.
4. A minimum of 2 feet of freeboard shall be provided above the expected high water elevation.

Earthen Cofferdams

1. The earthen coffer dam shall be constructed of fill material that will preclude the transmission of water through the dam, or contain an impermeable core.
2. The minimum top width shall be 8 feet with 2:1 side slopes, and compacted in 9 inch lifts with a minimum of 4 passes of construction equipment.
3. The outside slope shall be covered with a 1 foot layer of rock riprap over a graded stone bedding or geotextile to prevent erosion of soil material into water. An alternative method is to cover the outside slope with an anchored plastic cover with a minimum thickness of 20 mil.
4. Interior work will be conducted in a manner that will not disturb or undermine the earthen coffer dam or its foundation.

Inspection and Maintenance

1. All cofferdams will be inspected daily to assure proper performance and stability as vibration from construction equipment can cause disturbance of the structures.
2. Particular attention should be given to the foundation support system at perimeter of structural component dams. Any undermined or settled areas shall be restored immediately.

3. Any holes, leaks, or torn areas in the geo-membranes or fabric shall be repaired immediately.
4. Any shifting, movement, or settling of the coffer dam shall be addressed immediately to protect workers in the construction area.
5. Inspect the interior dewatering system and ensure that the system is discharging clean water, or is being pumped to appropriate sediment control facility prior to returning to the water resource.
6. Repair or replace any loss of rock riprap or fill that may occur and assure the top of the coffer dam is level without any low spots due to settling.
7. Upon completion of the construction work, remove all excess material, accumulated sediment and debris from the work area, and remove the cofferdam in accordance with the site stabilization plan.

STANDARD AND SPECIFICATIONS FOR COMPOST FILTER SOCK



that 8" diameter socks may be used for residential lots to control areas less than 0.25 acres.

- The flat dimension of the sock shall be at least 1.5 times the nominal diameter.
- The **Maximum Slope Length** (in feet) above a compost filter sock shall not exceed the following limits:

Dia. (in.)	Slope %						
	2	5	10	20	25	33	50
8	225*	200	100	50	20	—	—
12	250	225	125	65	50	40	25
18	275	250	150	70	55	45	30
24	350	275	200	130	100	60	35
32	450	325	275	150	120	75	50

* Length in feet

Definition & Scope

A **temporary** sediment control practice composed of a degradable geotextile mesh tube filled with compost filter media to filter sediment and other pollutants associated with construction activity to prevent their migration offsite.

Condition Where Practice Applies

Compost filter socks can be used in many construction site applications where erosion will occur in the form of sheet erosion and there is no concentration of water flowing to the sock. In areas with steep slopes and/or rocky terrain, soil conditions must be such that good continuous contact between the sock and the soil is maintained throughout its length. For use on impervious surfaces such as road pavement or parking areas, proper anchorage must be provided to prevent shifting of the sock or separation of the contact between the sock and the pavement. Compost filter socks are utilized both at the site perimeter as well as within the construction areas. These socks may be filled after placement by blowing compost into the tube pneumatically, or filled at a staging location and moved into its designed location.

Design Criteria

- Compost filter socks will be placed on the contour with both terminal ends of the sock extended 8 feet upslope at a 45 degree angle to prevent bypass flow.
- Diameters designed for use shall be 12" – 32" except



- The compost infill shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table. **Note: All biosolids compost produced in New York State (or approved for importation) must meet NYS DEC's 6 NYCRR Part 360 (Solid Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metals content. When using compost filter socks adjacent to surface water, the compost should have a low nutrient value.**
- The compost filter sock fabric material shall meet the

7. Compost filter socks shall be anchored in earth with 2" x 2" wooden stakes driven 12" into the soil on 10 foot centers on the centerline of the sock. On uneven terrain, effective ground contact can be enhanced by the placement of a fillet of filter media on the disturbed area side of the compost sock.
8. All specific construction details and material specifications shall appear on the erosion and sediment control constructions drawings when compost filter socks are included in the plan.
3. Socks shall be inspected weekly and after each runoff event. Damaged socks shall be repaired in the manner required by the manufacturer or replaced within 24 hours of inspection notification.
4. Biodegradable filter socks shall be replaced after 6 months; photodegradable filter socks after 1 year. Polypropylene socks shall be replaced according to the manufacturer's recommendations.
5. Upon stabilization of the area contributory to the sock, stakes shall be removed. The sock may be left in place and vegetated or removed in accordance with the stabilization plan. For removal the mesh can be cut and the compost spread as an additional mulch to act as a soil supplement.

Maintenance

1. Traffic shall not be permitted to cross filter socks.
2. Accumulated sediment shall be removed when it reaches half the above ground height of the sock and disposed of in accordance with the plan.

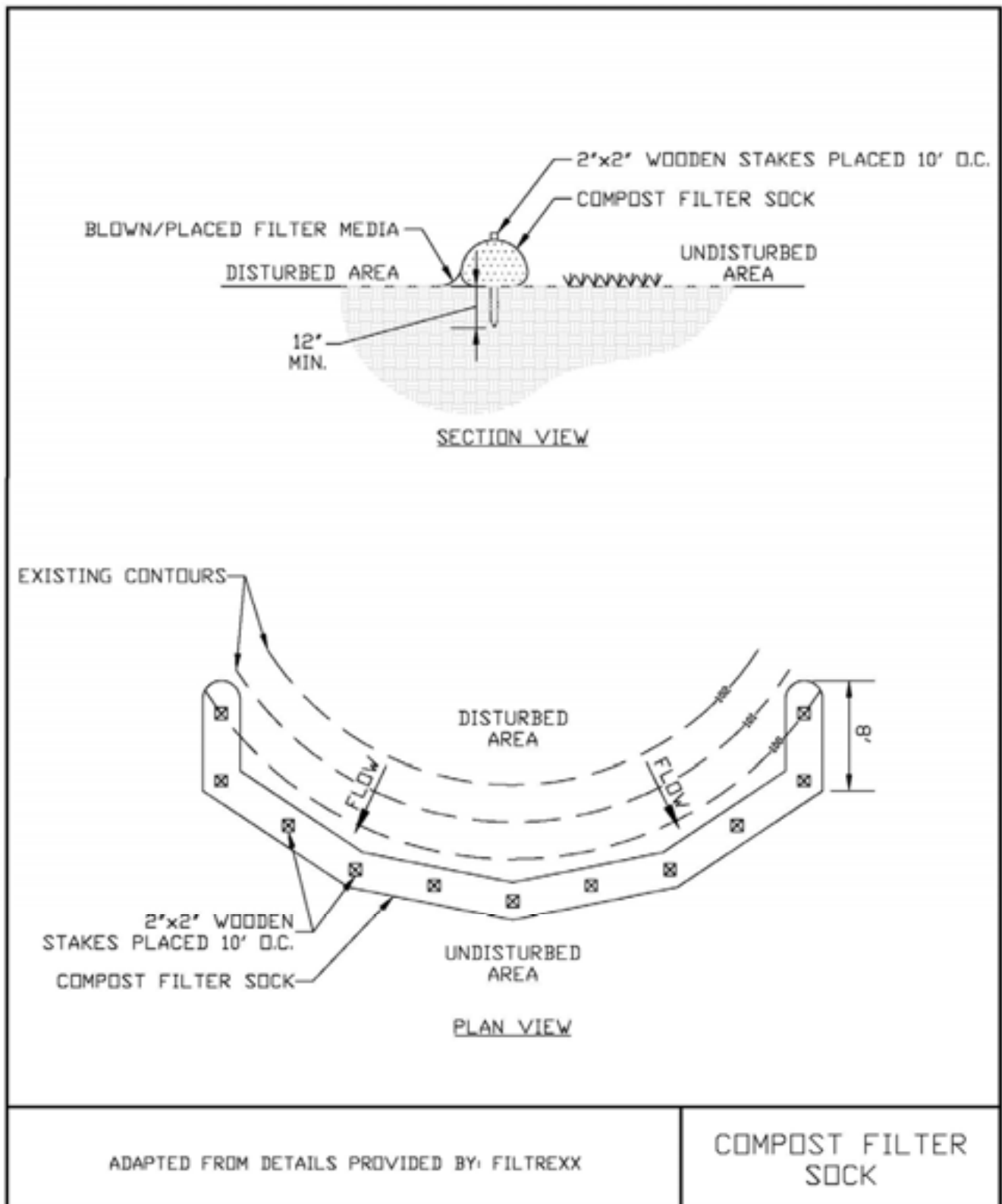
Table 5.1 - Compost Sock Fabric Minimum Specifications Table

Material Type	3 mil HDPE	5 mil HDPE	5 mil HDPE	Multi-Filament Polypropylene (MFPP)	Heavy Duty Multi-Filament Polypropylene (HDMFPP)
Material Characteristics	Photodegradable	Photodegradable	Biodegradable	Photodegradable	Photodegradable
Sock Diameters	12" 18"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"
Mesh Opening	3/8"	3/8"	3/8"	3/8"	1/8"
Tensile Strength		26 psi	26 psi	44 psi	202 psi
Ultraviolet Stability % Original Strength (ASTM G-155)	23% at 1000 hr.	23% at 1000 hr.		100% at 1000 hr.	100% at 1000 hr.
Minimum Functional Longevity	6 months	9 months	6 months	1 year	2 years

Table 5.2 - Compost Standards Table

Organic matter content	25% - 100% (dry weight)
Organic portion	Fibrous and elongated
pH	6.0 – 8.0
Moisture content	30% - 60%
Particle size	100% passing a 1" screen and 10 - 50% passing a 3/8" screen
Soluble salt concentration	5.0 dS/m (mmhos/cm) maximum

Figure 5.2
Compost Filter Sock



STANDARD AND SPECIFICATIONS FOR DEWATERING DEVICE



Definition & Scope

An appurtenance to a sediment trapping structure such as a basin or trap that allows sediment laden water to pond allowing sediment to settle out while removing relatively clean water to a suitable, stable outlet.

Condition Where Practice Applies

Dewatering devices are appropriate where the discharge from a trap or basin will be by gravity flow through a riser and pipe outlet system. The skimmer dewatering device is the preferred option. A fixed pipe dewatering device, configured as a perforated vertical riser surrounded by filter fabric and stone material is an alternate option for small structures.

Design Criteria

Skimmer Device

1. Skimmers must be designed so as to float just beneath the water surface to remove the least sediment laden water effectively.
2. Skimmer shall be constructed with a 4 foot long flexible pipe elbow to allow for vertical movement of the skimmer for its designated range of operation.
3. The designer will provide a table that shows all required dimensions for the skimmer. An example of this table is shown in Figure 5.4 on page 5.12. See design example in Appendix B.
4. The skimmer will be provided with vertical travel guides and a resting stone pad set at the appropriate design elevation.

5. The orifice plate will be at the "T" intersection of the perforated skimmer section with the non-perforated extension arm.

Riser-Pipe Device

1. The riser-pipe device is constructed as a fixed rigid structure with a larger diameter pipe as the vertical riser connected to a smaller diameter horizontal pipe barrel.
2. The joint of these two conduits will be anchored by means of a concrete block or welded steel plate to prevent flotation.
3. The riser will be perforated above the bottom of the dewatering zone elevation and wrapped with a geotextile filter fabric to filter out sediment.
4. The filter fabric shall be covered with stone graded as NYSDOT #1, #2, or a blend of both, to protect the fabric from deterioration.
5. An orifice plate shall be placed in the riser at the bottom of the dewatering zone elevation to control the dewatering rate.

Dewatering Drawdown

As a minimum, sediment traps and basins should have their temporary storage dewatered over a 48 hour period to maximize sediment retention. If the soils disturbed within the drainage area will have 60% - 80% fines the settling time should be increased to 4 days. Soils containing greater than 80% fines will need longer settling times but in no case longer than 7 days to maintain the hydraulic performance of the basin for recurring runoff events.

1. Skimmer orifices may be sized by using the design chart shown in Figure 5.3 on page 5.11.
2. Riser-pipe orifice sizes may be approximated by the following formula:

$$A_0 = \frac{A_s \times 2h^{0.5}}{T \times C_d \times 20,428}$$

Where:

A_0 = Areas of the dewatering orifice (ft²)

A_s = Surface area of the basin/trap (ft²)

h = head of water above the orifice (ft)

C_d = 0.6 (contraction coefficient of an orifice)

T = Detention time needed to dewater basin (48 hours minimum)

Therefore, the minimum A_o formula for 48 hrs. reduces to:

$$A_o = \frac{A_s \times 2h^{0.5}}{588,326}$$

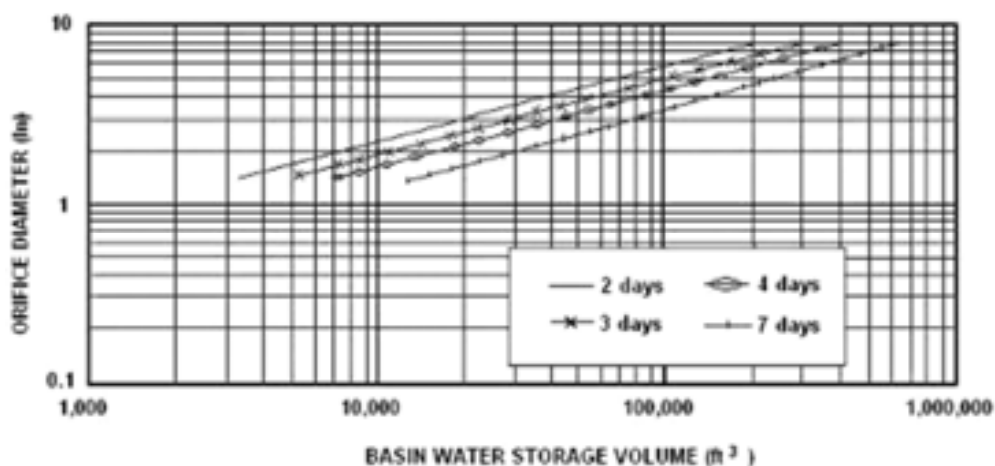
Material Specifications

1. Skimmer Devices - These devices shall be constructed with Schedule 40 PVC pipe with diameters of 4 to 6 inches. The flexible arm shall be equal diameter of non-perforated, corrugated, plastic tubing.
2. Riser-pipe Devices - These devices shall be constructed of Schedule 40 PVC if plastic pipe is used or galvanized corrugated steel or aluminum pipe. The minimum diameter shall be 6 inches if the device is used in conjunction with another permanent riser. All perforations will be at the interior of the corrugations.

Maintenance

1. Dewatering devices shall be inspected weekly and after each runoff event.
2. Filter fabric or media will be replaced as needed.
3. Any malfunctioning skimmer or its components shall be repaired or replaced within 24 hours of inspection notification.
4. Sediment shall be removed from the system when it reaches the level marked in a sediment cleanout stake or the top of the skimmer landing area.
5. The structure shall only be removed when the tributary area has been properly stabilized.

Figure 5.3 - Skimmer Orifice Design Chart

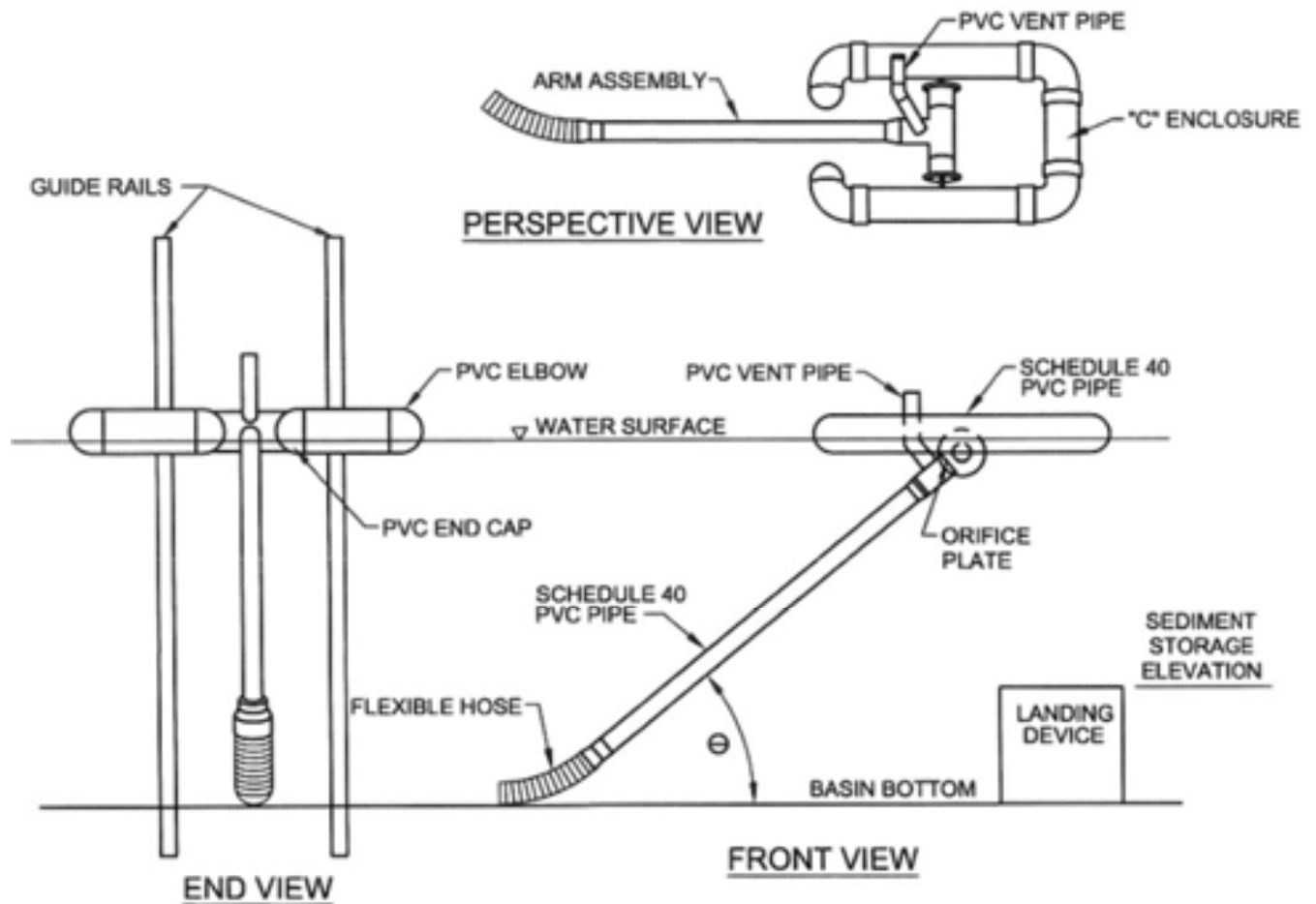


* Figure adapted from Penn State Agricultural and Biological Fact Sheet F-253

Notes:

1. Figure 5.3 is for use in designing the orifice plate for the skimmer shown in Figure 5.4. It assumes 3" to 5" head (depending upon the size of the skimmer). The required head for use of Figure 5.3 varies as follows: For a skimmer with a dewatering tube $\leq 2 \frac{1}{2}$ " diameter, use a 2" head. For a 3" diameter tube, use a 2.5" head; 4" tube, use 3.3" head, 5" tube use 4" head, and 6" diameter tube use 5" head.
2. Find the vertical line representing the basin's dewatering zone volume. At the intersection of the vertical line with the desired dewatering time, read horizontally to the left to find the required skimmer orifice diameter.

Figure 5.4
Skimmer Dewatering Device



* Figure adapted from Penn State Agricultural and Biological Fact Sheet F-253

Basin No.	Water Surface Elevation (ft.)	Arm Length* (ft.)	Arm Dia. (in.)	Orifice Size** (in.)	Top of Landing Device Elevation (ft.)	Flexible Hose Length (in.)	Flexible Hose Attachment Elevation (ft.)

* Minimum Arm length = Full design storage depth x 1.414 (for 45 degree angle)
 ** Must be equal to or less than arm diameter

Skimmer Construction Notes

1. Pipe flotation section shall be solvent welded to ensure an airtight assembly. The contractor is required to conduct a test to check for leaks prior to installation.
2. Skimmer section shall have 12 rows of 1/2" diameter holes, 1 1/4" on center. If additional filtration is necessary, the filtering media shall consist of a Type GD-II geotextile fabric wrapped around the perforated portion of the skimmer and attached with plastic snap ties, bands, etc.
3. Flexible pipe shall be inserted into solid pipe and fastened with 2 #8 wood screws.
4. At a minimum, the structure shall be inspected after each rain and repairs made as needed. If vandalism is a problem, more frequent inspection may be necessary.
5. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
6. The structure shall only be removed when the contributing drainage area has been properly stabilized.

Materials

(Note: materials for a 4" diameter arm assembly)

1. Solid Pipe - 4" Schedule 40 PVC
2. Perforated Pipe - 4" Schedule 40 PVC
3. 90° Tee (1 each) - 4" Schedule 40 PVC
4. 90° Elbow (4 each) - 4" Schedule 40 PVC
5. Cap (2 each) - 4" Schedule 40 PVC, solid
6. Flexible pipe - 4" Corrugated Plastic Tubing (non-perforated)

Figure 5.5
Riser Pipe Dewatering Device

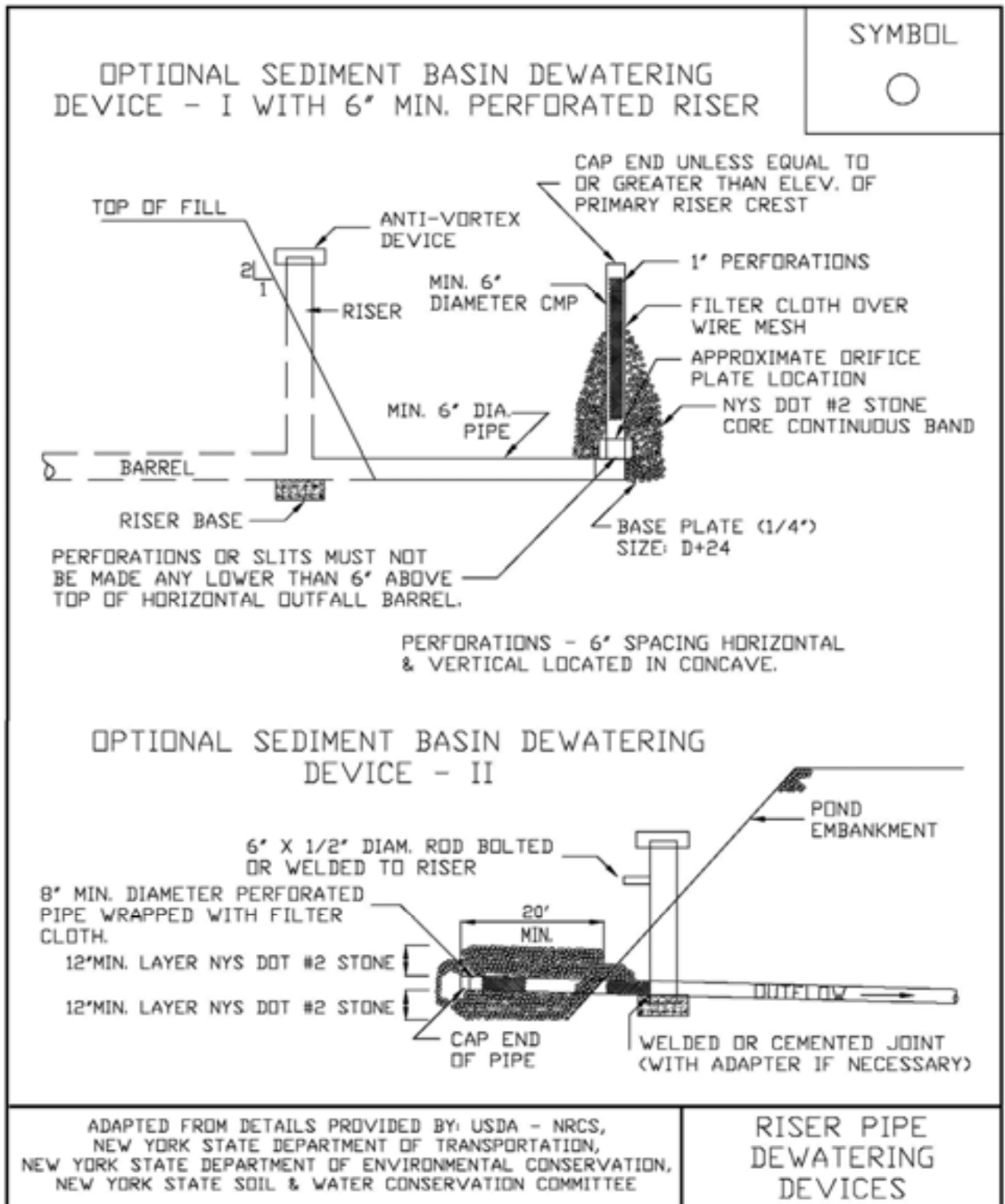


Figure 5.6

Riser Pipe Dewatering Device Construction Notes

Riser Pipe Construction Notes

1. Standpipe and connector pipe shall be a minimum of 6 inches diameter.
2. Metal pipe may be galvanized steel or aluminum; plastic pipe may be Schedule 40 PVC or HDPP.
3. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
4. The structure shall only be removed when the contributing drainage area has been properly stabilized.
5. All pipe connections shall be watertight. The lower portion of the standpipe, at a point above the barrel connection, shall be fitted with an internal orifice plate sized to release the volume of the basin no sooner than 48 hours.
6. The top 2/3 of the standpipe shall be perforated with 1 inch diameter hole or slit spaced 6 inches vertically and horizontally and placed in the concave portion of the pipe. No holes will be allowed within 6 inches of the horizontal connector pipe.
7. The riser shall be wrapped with a Type GD-II geotextile fabric. The fabric shall extend 6 inches above the highest hole and 6" below the lowest hole. Where ends of fabric come together, they shall be overlapped, folded and stapled to prevent bypass.
8. Straps or connecting bands shall be used to hold the fabric and wire mesh (as needed) in place. They shall be placed at the top and bottom of the cloth.
9. The standpipe shall be anchored with either concrete base or steel plate base to prevent flotation. Concrete bases shall be 12 inches thick with the standpipe embedded nine inches. Steel plate bases will be 1/4 inch minimum thickness attached to the standpipe by a continuous weld around the bottom to form a watertight connection. The plate shall have 2.5 feet of stone, gravel or tamped earth placed on it.
10. The perforated standpipe shall be surrounded by NYSDOT #1 or #2 stone or a blend of both to protect the filter fabric.

STANDARD AND SPECIFICATIONS FOR GEOTEXTILE FILTER BAG



Definition & Scope

A **temporary** portable device through which sediment laden water is pumped to trap and retain sediment prior to its discharge to drainageways or off-site.

Condition Where Practice Applies

On sites where space is limited such as urban construction or linear projects (e.g. roads and utility work) where rights-of-way are limited and larger de-silting practices are impractical.

Design Criteria

1. Location - The portable filter bag should be located to minimize interference with construction activities and pedestrian traffic. It should also be placed in a location that is vegetated, relatively level, and provides for ease of access by heavy equipment, cleanout, disposal of trapped sediment, and proper release of filtered water.

The filter bag shall also be placed at least 50 feet from all wetlands, streams or other surface waters.

2. Size - Geotextile filter bag shall be sized in accordance with the manufacturers recommendations based on the pump discharge rate.

Materials and Installation

1. The geotextile material will have the following attributes:

Minimum Grab Tensile Strength	200 lbs.
Minimum Grab Tensile Elongation	50 %
Minimum Trapezoid Tear Strength	80 lbs.
Mullen Burst Strength	380 psi
Minimum Puncture Strength	130 lbs
Apparent Opening Size	40 - 80 US sieve
Minimum UV Resistance	70%
Minimum Flow Thru Rate	70 gpm/sq ft

2. The bag shall be sewn with a double needle machine using high strength thread, double stitched "Joe" type capable of minimum roll strength of 100 lbs/inch (ASTM D4884).
3. The geotextile filter bag shall have an opening large enough to accommodate a 4 inch diameter discharge hose with an attached strap to tie off the bag to the hose to prevent back flow.
4. The geotextile shall be placed on a gravel bed 2 inches thick, a straw mat 4 inches thick, or a vegetated filter strip to allow water to flow out of the bag in all directions.

Maintenance

1. The geotextile filter bag is considered full when remaining bag flow area has been reduced by 75%. At this point, it should be replaced with a new bag.
2. Disposal may be accomplished by removing the bag to an appropriate designated upland area, cut open, remove the geotextile for disposal, and spread sediment contents and seeded and mulched according to the vegetative plan.

STANDARD AND SPECIFICATIONS FOR ROCK DAM



Definition & Scope

A rock embankment located to capture and retain sediment on the construction site and prevent sedimentation in offsite water bodies.

Conditions Where Practice Applies

The rock dam may be used instead of the standard sediment basin with barrel and riser. The rock dam is preferred when it is difficult to construct a stable, earthen embankment and rock materials are readily available. The site should be accessible for periodic sediment removal. This rock dam shall not be located in a perennial stream. The top of the dam will serve as the overflow outlet. The inside of the dam will be faced with smaller stone to reduce the rate of seepage so a sediment pool forms during runoff events.

Design Criteria

Drainage Area: The drainage area for this off stream structure is limited to 50 acres.

Location: The location of the dam should:

- provide a large area to trap sediment
- intercept runoff from disturbed areas
- be accessible to remove sediment
- not interfere with construction activities

Storage Volume: The storage volume behind the dam shall be at least 3,600 cubic feet per acre of drainage area to the dam. This volume is measured one foot below the crest of the dam.

Dam Section:

Top Width	5 feet minimum @ crest
Side Slopes	2:1 upstream slope 3:1 downstream slope
Height	6' max to spillway crest

Length of Crest: The crest length should be designed to carry the 10 yr. peak runoff with a maximum flow depth of 1 foot and 1 foot of freeboard.

Rock at the abutments should extend at least 2 feet above the spillway and be at least 2 feet thick. These rock abutments should extend at least one foot above the downstream slope to prevent abutment scour. A rock apron at least 1.5 feet thick should extend downstream from the toe of the dam a distance equal to the height of the dam to protect the outlet area from scour.

Rock Fill: The rock fill should be well graded, hard, erosion resistant stone with a minimum d_{50} size of 9 inches. A “key trench” lined with geotextile filter fabric should be installed in the soil foundation under the rock fill. The filter fabric must extend from the key trench to the downstream edge of the apron and abutments to prevent soil movement and piping under the dam.

The upstream face of the dam should be covered with a fine washed gravel (NYS-DOT #1 or #1A gravel, crushed stone or equal) a minimum 3 feet thick to reduce the drainage rate.

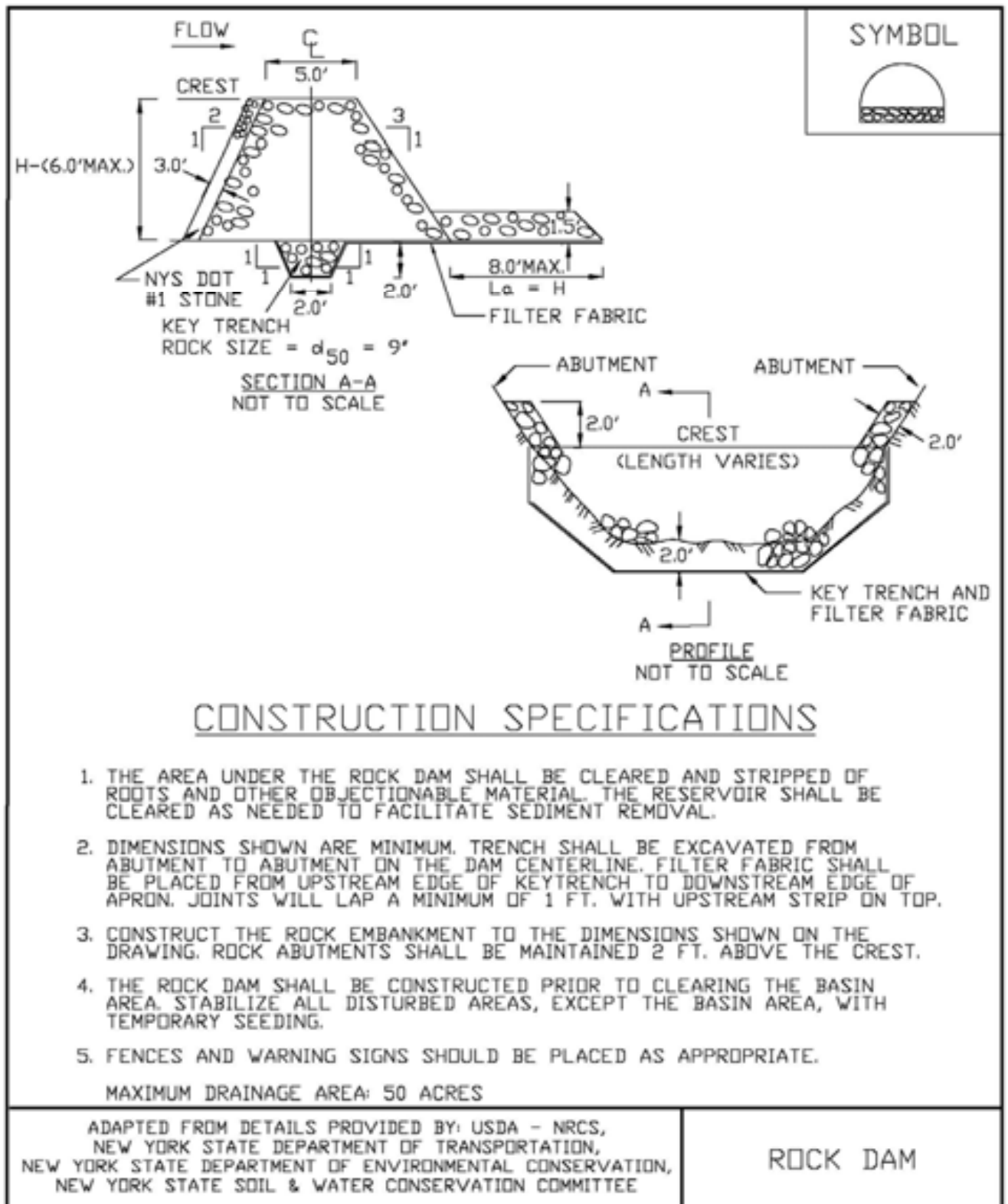
Trapping Efficiency: To obtain maximum trapping efficiency, design for a long detention period. Usually a minimum of eight (8) hours before the basin is completely drained. Maximize the length of travel of sediment laden water from the inlet to the drain for a minimum length to width ratio of 2 to 1 or greater. Achieve a surface area equal to 0.01 acres per cfs (inflow) based on the 10-year storm. See Figure 5.7 on page 5.18 for details.

Maintenance

Check the basin area after each rainfall event. Remove sediment and restore original volume when sediment accumulates to one-half the design volume. Check the structure for erosion, piping, and rock displacement after each significant event and replace immediately.

Remove the structure and any sediment immediately after the construction area has been permanently stabilized. All water should be removed from the basin prior to the removal of the rock dam. Sediment should be placed in designated disposal areas and not allowed to flow into streams or drainage ways during structure removal.

Figure 5.7
Rock Dam



STANDARD AND SPECIFICATIONS FOR SEDIMENT BASIN



Definition & Scope

A **temporary** basin with a barrier or dam constructed across a drainage way or at other suitable locations to intercept sediment-laden runoff and reduce the amount of sediment leaving the disturbed area in order to protect drainageways, properties, and rights-of-way below the sediment basin.

Conditions Where Practice Applies

A sediment basin is appropriate where physical site conditions or land ownership restrictions preclude the installation of other control measures to adequately control runoff, erosion, and sedimentation. However, it is required that other erosion control measures be used with the sediment basin. The basin may be used below construction operations which expose critical areas to soil erosion. The basin shall be maintained until the disturbed area is protected against erosion by permanent stabilization.

This standard applies to the installation of temporary sediment basins on sites where: (a) failure of the structure would not result in loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities; (b) the drainage area does not exceed 50 acres; and (c) the basin is to be removed within 36 months after the beginning of construction of the basin.

Permanent (to function more than 36 months) sediment basins, or structures that temporarily function as a sediment basin but are intended for use as a permanent pool shall be classified as **permanent** structures and shall conform to criteria appropriate for permanent structures. These structures shall be designed and constructed to conform to NRCS Standard And Specification No. 378 for Ponds in the National Handbook of Conservation Practices and the New York State Department of Environmental Conservation, "Guidelines for the Design of Dams."

Design Criteria

Compliance with Laws and Regulations

Design and construction shall comply with state and local laws, ordinances, rules and regulations, including permits.

Location - Maximum Drainage Area = 50 acres

The sediment basin should be located to obtain the maximum storage benefit from the terrain and for ease of cleanout of the trapped sediment. It should be located to minimize interference with construction activities and construction of utilities. Whenever possible, sediment basins should be located so that storm drains may outfall or be diverted into the basin. **Do not locate basins in perennial streams.**

Size and Shape of the Basin

The sediment basin will contain two separate zones. The lowest zone is the sediment storage zone. This zone is sized for a volume equal to 1,000 cubic feet per disturbed acre over the course of the life of the project, contributing to the basin as measured from the bottom of the basin to the bottom of the dewatering zone. It shall have a minimum depth of 1 foot. Layered above this zone is the dewatering zone. This zone is sized for a minimum volume equal to 3,600 cubic feet per each acre draining to the basin. This volume is temporarily stored between the sediment storage zone and the crest of the principal spillway. This zone should be a minimum of 3 feet deep. See Figures 5.8 and 5.9 on pages 5.26 and 5.27. This 3,600 cubic feet per acre is equivalent to one inch of sediment per acre of drainage area. The entire drainage area is used for this computation, rather than the disturbed area above, to maximize trapping efficiency. The length to width ratio shall be 2:1 or greater, where length is the distance between the inlet and outlet. A wedge shape shall be used with the inlet located at the narrow end. See Figure 5.22 on page 5.41.

Surface Area

Research studies (Barfield and Clar 1985; Pitt, 2003) indicate that the following relationship between surface area and peak inflow rate gives a trapping efficiency of 75% for silt loam soils, and greater than 90% for loamy sand soils:

$$A = 0.01 Q_p \text{ or, } A = 0.015x \text{ D.A. (whichever is greater)}$$

where,

A = the basin surface area, acres, measured at the service spillway crest; and

Qp = the peak inflow rate for the design storm. (The minimum design storm will be a 10 year, 24 hour storm under construction conditions).

D.A. = contributing drainage area.

Sediment basins shall be cleaned out when the sediment storage zone volume described above is reduced by 50 percent, except in no case shall the sediment level be permitted to build up higher than one foot below the bottom of the dewatering zone. At this elevation, cleanout shall be performed to restore the original design volume to the sediment storage zone.

The elevation corresponding to the maximum allowable sediment level shall be determined and shall be stated in the design data as a distance below the top of the riser and shall be clearly marked on the riser.

The basin dimensions necessary to obtain the required basin volume as stated above shall be clearly shown on the plans to facilitate plan review, construction, and inspection.

Spillway Design

Runoff shall be computed by standard accepted hydrologic methods noted previously in this book of standards. **Runoff computations shall be based upon the worst 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 spillway shall be sufficient to pass the peak rate of runoff from a ten (10) year frequency, 24 hour duration storm.

1. Principal spillway: A spillway consisting of a vertical pipe or box type riser joined (watertight connection) to a pipe (barrel) which shall extend through the embankment and outlet beyond the downstream toe of the fill. The minimum capacity of the principal spillway shall be 0.2 cfs 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 the capacity to handle the peak flow from a ten-year frequency rainfall event. The minimum size of the barrel shall be 8 inches in diameter. See Figures 5.10, 5.11 and 5.12 on pages 5.28, 5.29, and 5.30 for principal spillway sizes and capacities.

- A. Crest elevation: When used in combination with an emergency spillway, the crest elevation of the riser shall be a minimum one foot below the elevation of the control section of the emergency spillway.

- B. Watertight riser and barrel assembly: The riser and all pipe connections shall be completely watertight except for the inlet opening at the top, or a dewatering opening. There shall not be other holes, leaks, rips, or perforations in the structure.

- C. Dewatering the basin:

1) Preferred Method- The preferred method for dewatering sediment basins is by using surface skimmers to decant the cleaner top surface water from the basin as the sediment settles out. See Dewatering Device Standard, page 5.10.

2) Alternative Method- A fixed vertical riser pipe configured with perforations and filter fabric with a cone of pea gravel or small crushed stone is an alternative option for use. See Figure 5.5 on page 5.14.

The sediment basin dewatering system shall be designed to release the dewatering zone volume between 2 to 7 days in watersheds not impaired by sediment, and 4-7 days in sediment impaired watersheds (check the NYSDEC Waterbody Inventory/Priority Waterbody List - <http://www.dec.ny.gov/chemical/36730.html>, to see if your site is in an impaired watershed). The design performance range will depend on the percent of silt and clay in the soils tributary to the basin. If the performance of the basin does not meet water quality objectives after 7 days, chemical treatment may be necessary.

- D. Anti-vortex device and trash rack:

An anti-vortex device and trash rack shall be securely installed on top of the riser and shall be the concentric type as shown in Figure 5.13 and 5.14 on pages 5.31 and 5.32.

- E. Base:

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 for risers ten feet or less in height are: 1) a concrete base 18 in. thick with the riser embedded 9 in. in the base, and 2) a 1/4" minimum thickness steel plate attached to the riser by a continuous weld around the circumference of the riser to form a watertight connection. The plate shall have 2.5 feet of stone, gravel, or compacted earth placed on it to prevent flotation. In either case, each side of the square base shall be twice the riser diameter.

For risers greater than ten feet high, computations

shall be made to design a base which will prevent flotation. The minimum factor of safety shall be 1.20 (Downward forces = 1.20 x upward forces). See Figure 5.15 on page 5.33 for details.

- F. Anti-Seep Collars: Anti-seep collars shall be installed around all conduits through earth fills of impoundment structures according to the following criteria:

- 1) Collars shall be placed to increase the seepage length along the conduit by a minimum of 15 percent of the pipe length located within the saturation zone.
- 2) Collar spacing shall be between 5 and 14 times the vertical projection of each collar.
- 3) All collars shall be placed within the saturation zone.
- 4) The assumed normal saturation zone (phreatic line) shall be determined by projecting a line at a slope of 4 horizontal to 1 vertical from the point where the normal water (riser crest) elevation touches the upstream slope of the fill to a point where this line intersects the invert of the pipe conduit. All fill located within this line may be assumed as saturated.

$$2(N)(P) = 1.15(L_s) \quad N = (0.075)(L_s) / P$$

When anti-seep collars are used, the equation for revised seepage length becomes:

Where: L_s = Saturated length is length, in feet, of pipe between riser and intersection of phreatic line and pipe invert.

N = number of anti-seep collars.

P = vertical projection of collar from pipe, in feet.

- 5) All anti-seep collars and their connections shall be watertight. See Figures 5.16 and 5.17 on pages 5.34 and 5.35 for anti-seep collar design and Figure 5.18 on page 5.36 for construction details. Seepage diaphragms may be used in lieu of anti-seep collars. They shall be designed in accordance to USDA NRCS Pond Standard 378.

- G. Outlet: An outlet shall be provided, including a means of conveying the discharge in an erosion free manner to an existing stable channel. Where

discharge occurs at the property line, drainage easements will be obtained in accordance with local ordinances. Adequate notes and references will be shown on the erosion and sediment control plan.

Protection against scour at the discharge end of the pipe spillway shall be provided. Measures may include basin, riprap, revetment, excavated plunge pools, or other approved methods. See Standard and Specification for Rock Outlet Protection, Section 3, page 3.39.

2. Emergency Spillways: The entire flow area of the emergency spillway shall be constructed in undisturbed ground (not fill). The emergency spillway cross-section shall be trapezoidal with a minimum bottom width of eight feet. This spillway channel shall have a straight control section of at least 20 feet in length; and a straight outlet section for a minimum distance equal to 25 feet.
 - A. Capacity: The minimum capacity of the emergency spillway shall be that required to pass the peak rate of runoff from the 10 year 24-hour frequency storm, less any reduction due to flow in the pipe spillway. Emergency spillway dimensions may be determined by using the method described in Figure 5.19 on page 5.37 and the Design Tables in Figures 5.20 and 5.21 on pages 5.38 and 5.39.
 - B. Velocities: The velocity of flow in the exit channel shall not exceed 5 feet per second for vegetated channels. For channels with erosion protection other than vegetation, velocities shall be within the non-erosive range for the type of protection used.
 - C. Erosion Protection: Erosion protection shall be provided for by vegetation as prescribed in this publication or by other suitable means such as riprap, asphalt or concrete.
 - D. Freeboard: Freeboard is the difference between the design high water elevation in the emergency spillway and the top of the settled embankment. If there is no emergency spillway, it is the difference between the water surface elevation required to pass the design flow through the pipe and the top of the settled embankment. Freeboard shall be at least one foot.

Embankment Cross-Section

1. The maximum height of dam = 15 feet (measured from the low point of original ground at the downstream toe to the top of the dam).
2. Minimum top width of dam = 10 feet.

3. Side slopes shall be 2.5 to 1 or flatter.

Entrance of Runoff into Basin

Points of entrance of surface runoff into excavated sediment basins shall be protected to prevent erosion. Considerable care should be given to the major points of inflow into basins. In many cases the difference in elevation of the inflow and the bottom of the basin is considerable, thus creating a potential for severe gully and sediment generation. Often a riprap drop at major points of inflow would eliminate gully and sediment generation.

Diversions, grade stabilization structures or other water control devices shall be installed as necessary to ensure direction of runoff and protect points of entry into the basin. Points of entry should be located so as to ensure maximum travel distance of entering runoff to point of exit (the riser) from the basin.

Disposal

The sediment basin plans shall indicate the method (s) of disposing of the sediment removed from the basin. The sediment shall be placed in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the basin, adjacent to a stream or floodplain. Disposal sites will be covered by an approved sediment control plan.

The sediment basins plans shall also show the method of disposing of the sediment basin after the drainage area is stabilized, and shall include the stabilization of the sediment basin site. Water contained within the storage areas shall be removed from the basin by pumping, cutting the top of the riser, or other appropriate method prior to removing or breaching the embankment. **Sediment shall not be allowed to flush into a stream or drainageway.**

Chemical Treatment

Precipitation of sediment is enhanced with the use of specific chemical flocculants that can be applied to the sediment basin in liquid, powder, or solid form. Flocculants include anionic polyelectrolytes such as polyacrylamides, aluminum sulfate (alum), polyaluminum chloride and chitosan. Cationic polyelectrolytes have a greater toxicity to fish and other aquatic organisms than anionic polyelectrolytes because they bind to the gills of fish resulting in respiratory failure (Pitt, 2003).

Chemical treatment shall not be substituted for proper erosion and sediment control. To reduce the need for flocculants, proper controls include planning, phasing, sequencing and practice design in accordance to NY Standards. **Chemical applications shall not be applied without written approval from the NYSDEC.**

Safety

Sediment basins are attractive to children and can be very dangerous. Local ordinances and regulations must be adhered to regarding health and safety. The developer or owner shall check with local building officials on applicable safety requirements. If fencing of sediment basins is required, the location of and type of fence shall be shown on the plans.

Construction Specifications

Site Preparation

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

Cutoff-Trench

A cutoff trench shall be excavated along the centerline of earth fill embankments. The minimum depth shall be two feet. The cutoff trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be four feet, but wide enough to permit operation of excavation and 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 dewatered during the back-filling/compaction operations.

Embankment

The fill material shall be taken from approved areas shown on the plans. It shall be clean mineral soil free of roots, woody vegetation, oversized stones, rocks, or other objectionable material. Relatively pervious materials such as sand or gravel (Unified Soil Classes GW, GP, SW & SP) shall not be placed in the embankment. Areas on which fill is to be placed shall be scarified prior to placement of fill. The fill material shall contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of a ball, it is too wet for proper compaction. Fill material shall be placed in six to eight-inch thick continuous layers over the entire length of the fill. Compaction shall be obtained by routing and hauling the construction equipment over the fill so that the entire surface of each layer of the fill is traversed by at least one

wheel or tread track of the equipment or by the use of a compactor. The embankment shall be constructed to an elevation 10 percent higher than the design height to allow for settlement.

Pipe Spillway

The riser shall be securely attached to the barrel or barrel stub by welding the full circumference making a watertight structural connection. The barrel stub must be attached to the riser at the same percent (angle) of grade as the outlet conduit. The connection between the riser and the riser base shall be watertight. All connections between barrel sections must be achieved by approved watertight bank assemblies. The barrel and riser shall be placed on a firm, smooth foundation of impervious soil. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the pipe or anti-seep collars. The fill material around the pipe spillway shall be placed in four-inch layers and compacted under and around the pipe to at least the same density as the adjacent embankment.

A minimum depth of two feet of hand compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment. Steel base plates on risers shall have at least 2 ½ feet of compacted earth, stone, or gravel placed over it to prevent flotation.

Emergency Spillway

The emergency spillway shall be installed in undisturbed ground. The achievement of planned elevations, grades, design width, entrance and exit channel slopes are critical to the successful operation of the emergency spillway and must be constructed within a tolerance of +/- 0.2 feet.

Vegetative Treatment

Stabilize the embankment and emergency spillway in accordance with the appropriate vegetative standard and specification immediately following construction. In no case shall the embankment remain unstabilized for more than three (3) days.

Erosion and Pollution Control

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

Safety

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

Maintenance

1. Repair all damages caused by soil erosion and construction equipment at or before the end of each working day.
2. Sediment shall be removed from the basin when it reaches the specified depth for cleanout noted on the plans which will not exceed 50% of the capacity of the sediment storage zone. This sediment shall be placed in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the embankment, adjacent to a stream or floodplain.

Final Disposal

When temporary structures have served their intended purpose 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 approved sediment control plan. The proposed use of a sediment basin site will often dictate final disposition of the basin and any sediment contained therein. If the site is scheduled for future construction, then the basin material and trapped sediments must be removed, safely disposed of, and backfilled with a structural fill. When the basin area is to remain open space, the pond may be pumped dry, graded, and backfilled.

Information to be Submitted

Sediment basin designs and construction plans submitted for review to a local municipality, New York State DEC, New York City DEP, Soil and Water Conservation District, or other agency shall include the following:

1. Specific location of the basin.
2. Plan view of the storage basin and emergency spillway, showing existing and proposed contours.
3. Cross section of dam, principal spillway, emergency spillway, and profile of emergency spillway.
4. Details of pipe connections, riser to pipe connections, riser base, anti-seep control, trash rack cleanout elevation, and anti-vortex device.
5. Runoff calculations for 1 and 10-year frequency storms, if required.
6. Storage Computations
 - A. Zones total required
 - B. Zones total Available
 - C. Elevation of sediment at which cleanout shall be required; also stated as a distance from the riser

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

Computed by _____ Date _____ Checked by _____ Date _____
Project _____ Basin # _____
Location _____ Total Area draining to basin (≤ 50 Ac.) _____ Acres

BASIN SIZE DESIGN

1. Sediment storage zone volume = 1,000 cu. ft. x number of disturbed acres = _____ cu. ft., Top of Zone Elev. _____
2. Dewatering zone volume = 3,600 cu. ft. x number of drainage area acres = _____ cu. ft., Top of Zone Elev. _____
3. Length to width ratio = _____
4. A. Cleanout at 50% of sediment storage zone volume, Elev. _____
B. Distance below top of riser _____ feet
5. Minimum surface area is larger of $0.01 Q_{(10)}$ _____ or, $0.015 DA$ = _____ use _____ acres

DESIGN OF SPILLWAYS & ELEVATIONS

Runoff

6. $Q_{p(10)}$ = _____ cfs (Attach runoff computation sheets)

Pipe Spillway (Q_{ps})

7. Min. pipe spillway cap., $Q_{ps} = 0.2 \times$ _____ Drainage Area, acres = _____ cfs
Note: If there is no emergency spillway, then required $Q_{ps} = Q_{p(10)}$ = _____ cfs.
8. H, head = _____ ft. Barrel length = _____ ft
9. Barrel: Diam. _____ inches; $Q_{ps} = (Q)$ _____ x (cor.fac.) _____ = _____ cfs.
10. Riser: Diam. _____ inches; Length _____ ft.; h = _____ ft. Crest Elev. _____
11. Trash Rack: Diameter = _____ inches; H, height = _____ inches

Emergency Spillway Design

12. Emergency Spillway Flow, $Q_{es} = Q_p - Q_{ps} =$ _____ - _____ = _____ cfs.
13. Width _____ ft.; H_p _____ ft. Crest elevation _____; Design High Water Elev. _____
Entrance channel slope _____ % ; Top of Dam Elev. _____
Exit channel slope _____ %

ANTI-SEEP COLLAR/SEEPAGE DIAPHRAGM DESIGN

Collars:

14. $y =$ _____ ft.; $z =$ _____ :1; pipe slope = _____ %, $L_s =$ _____ ft.
Use _____ collars, _____ - _____ inches square; projection = _____ ft.

Diaphragms:

_____ width _____ ft. height _____ ft.

DEWATERING ORIFICE SIZING

(Determined from the Dewatering Device Standard)

15. Dewatering orifice diameter = _____ inches. Skimmer ____ or Riser ____ (check one)
16. Design dewatering time _____ days (Min. 2 days required)

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

INSTRUCTIONS FOR USE OF FORM

1. Minimum required sediment storage zone volume is 1,000 cubic feet per acre from each disturbed acre within the total drainage area. Minimum required dewatering zone volume is 3,600 cubic feet per total area draining to the basin.
2. The volume of a naturally shaped basin (no excavation in basin) may be approximated by the formula $V = (0.4)(A)(d)$, where V is in cubic feet, A is the surface area of the basin, in square feet, and d is the maximum depth of the basin, in feet. 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 the required zone volumes.
4. The minimum surface area of the basin pool at the storage volume elevation will be the larger of the two elevations shown.
5. Use of the NRCC hydrologic data at www.precip.net with an appropriate hydrologic model, is the preferred process for runoff computation. Runoff curve numbers will be computed for the drainage area that reflects the maximum construction condition.
6. Required minimum discharge from pipe spillway equals 0.2 cfs/ac. times total drainage area. (This is equivalent to a uniform runoff of 5 in. per 24 hours). The pipe shall be designed to carry Q_p if site conditions preclude installation of an emergency spillway to protect the structure.
7. Determine value of "H" from field conditions; "H" is the interval between the centerline of the outlet pipe and the emergency spillway crest, or if there is no emergency spillway, to the design high water.
8. See Pipe Flow Charts, Figures 5.11 and 5.12 on pages 5.29 and 5.30.
9. See Riser Inflow Curves, Figure 5.10 on page 5.28.
10. Compute the orifice size required to dewater the basin over a minimum 48 hour period. See the Dewatering Device Standard on page 5.10.
11. See Trash Rack and Anti-Vortex Device Design, Figures 5.13 and 5.14 on pages 5.31 and 5.32.
12. Compute Q_{es} by subtracting actual flow carried by the pipe spillway from the total inflow, Q_p .
13. 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 (s).
14. See Anti-Seep Collar / Seepage Diaphragm Design (see figures 5.16, 5.17 and 5.18 on pages 5.34, 5.35 and 5.36).
15. Fill in design elevations. The emergency spillway crest must be set no closer to riser crest than value of h , which causes pipe spillway to carry the minimum, required Q . Therefore, the elevation difference between spillways shall be equal to the value of h , or one foot, whichever is greater. 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 10-year storm. Minimum top of dam elevation requires 1.0 ft. of freeboard above design high water.

To use charts for pipe spillway design:

1. Enter chart, Figures 5.11 or 5.12 on pages 5.29 and 5.30 with H and required discharge.
2. Find diameter of pipe conduit that provides equal or greater discharge
3. Enter chart, Figure 5.10 on page 5.28 with actual pipe discharge. Read across to select smallest riser that provides discharge within weir flow portion of rating curve. Read down to find corresponding h required. This h must be 1 foot or less.

Figure 5.8
Pipe Spillway Design

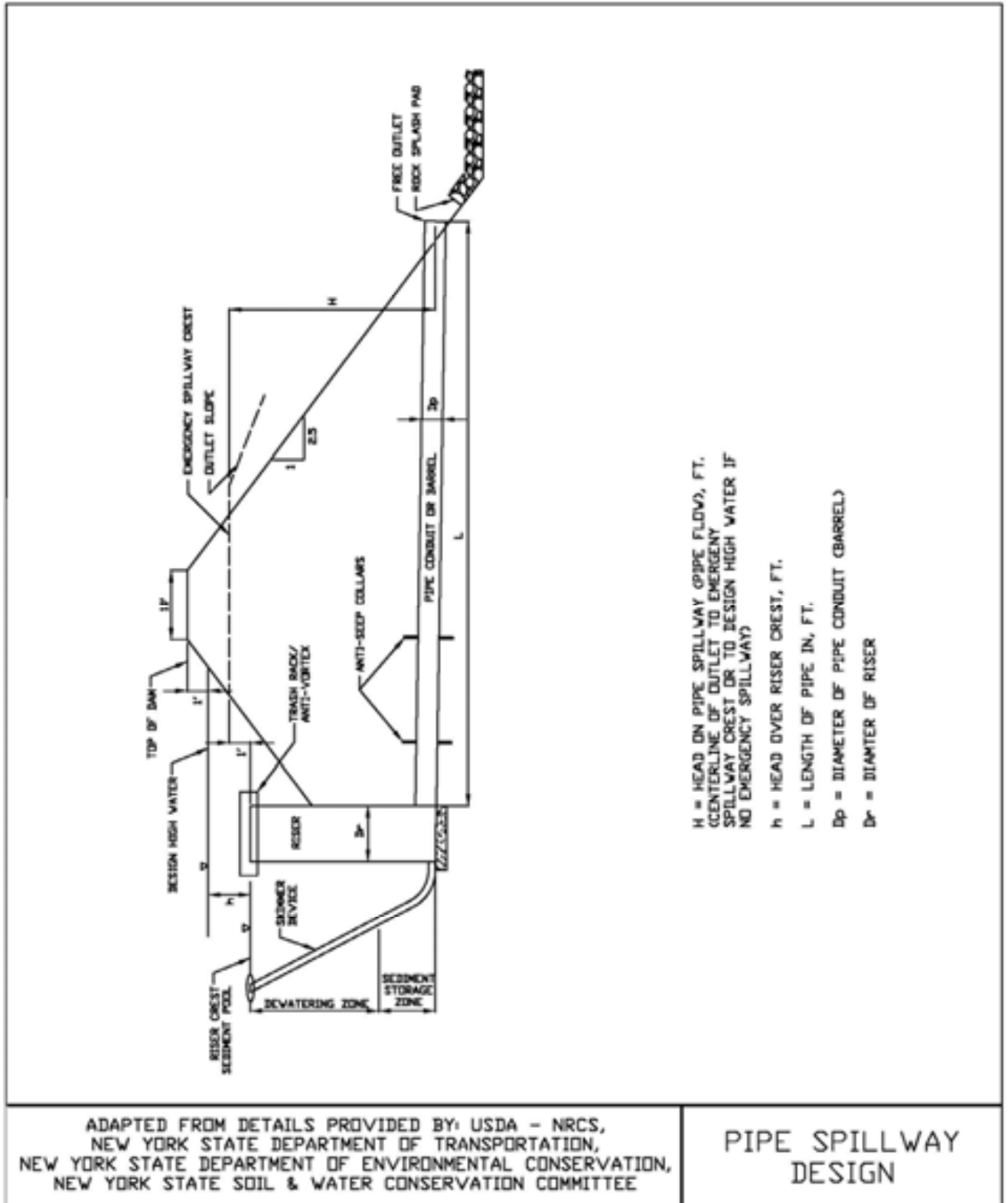


Figure 5.9
Sediment Basin

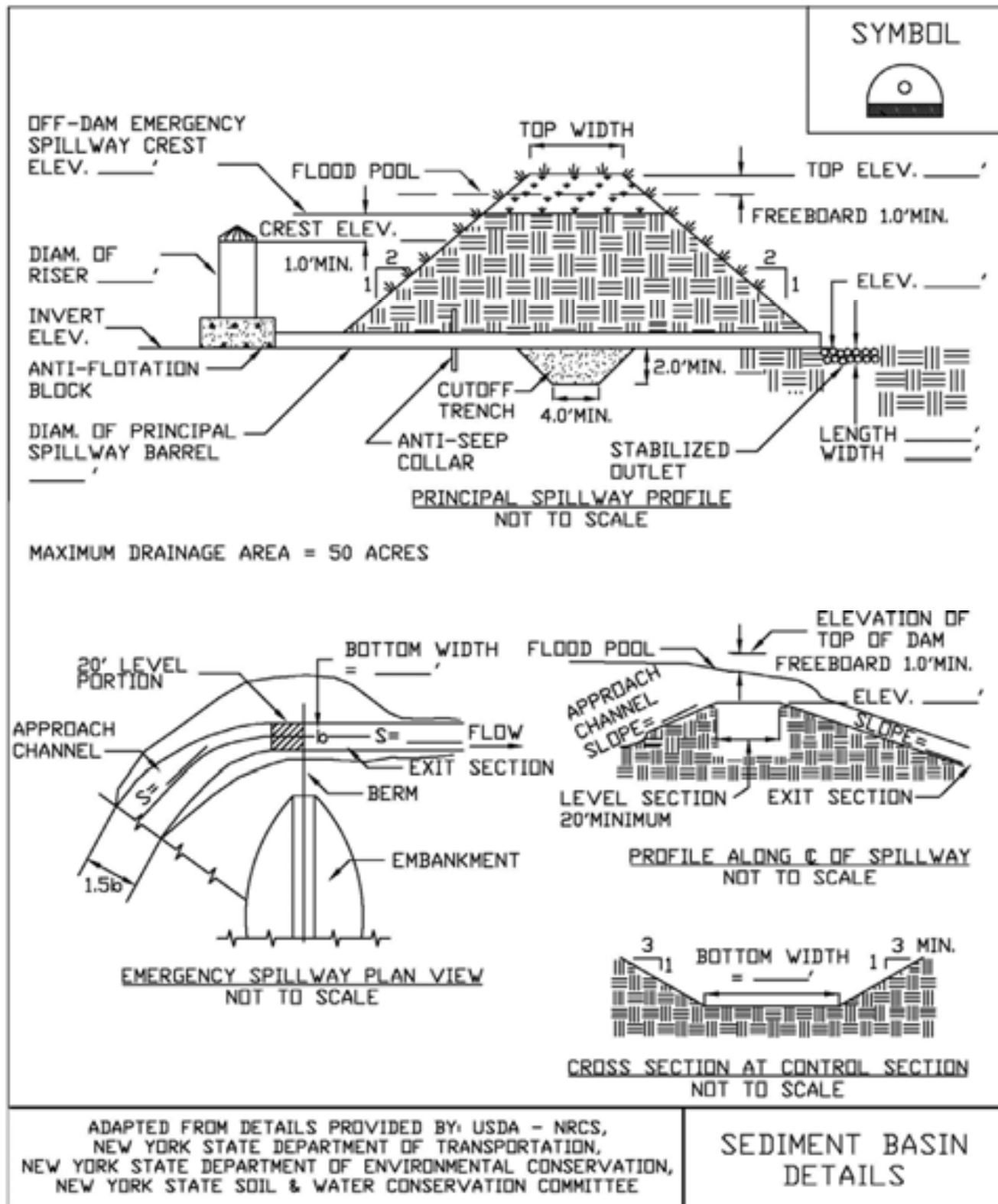


Figure 5.10
Riser Inflow Chart (USDA - NRCS)

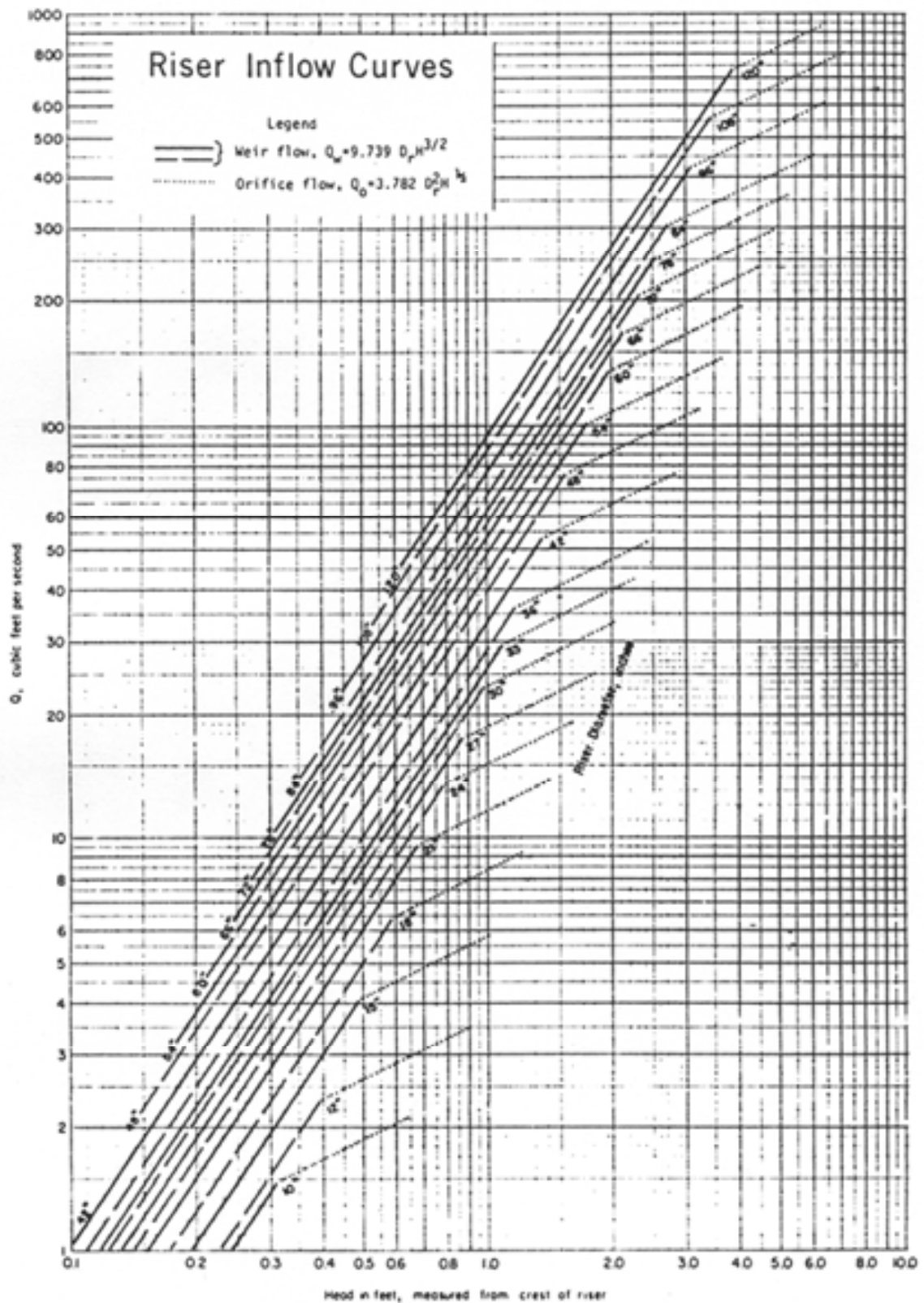


Figure 5.11
Pipe Flow Chart; “n” = 0.025 (USDA - NRCS)

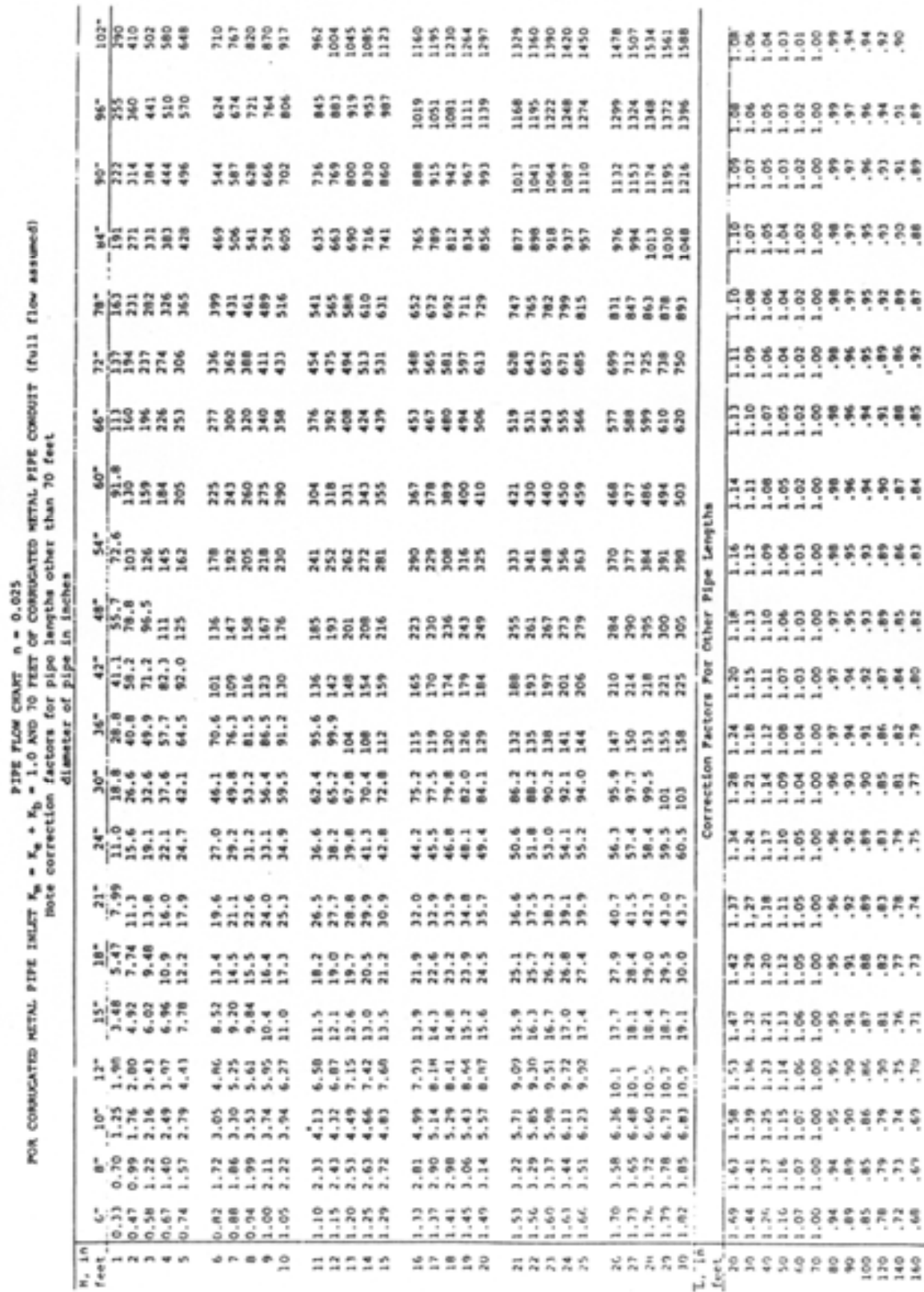


Figure 5.12
Pipe Flow Chart; “n” = 0.013 (USDA - NRCS)

		PIPE FLOW CHART n = 0.013 FOR REINFORCED CONCRETE PIPE INLET $K_H = K_B + K_D = 1.00$ AND 70 FEET OF REINFORCED CONCRETE PIPE CONDUIT (full flow assumed) Note correction factors for pipe lengths other than 70 feet															
		diameter of pipe in inches															
N, in feet	13"	15"	18"	21"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	102"
1	3.27	5.44	8.29	11.8	15.9	26.0	38.6	53.8	71.4	91.5	114	139	167	197	229	264	347
2	4.55	7.69	11.7	16.7	22.5	36.8	54.6	76.0	101	129	161	197	236	278	324	374	483
3	5.17	8.42	14.4	20.4	27.5	45.0	66.9	93.1	124	159	198	241	289	341	397	458	592
4	6.43	10.9	16.6	23.5	31.8	52.0	77.3	108	143	183	228	278	334	394	459	529	683
5	7.19	12.2	18.5	26.3	35.5	58.1	86.4	120	160	205	255	311	373	440	513	591	764
6	7.88	13.3	20.3	28.8	38.9	63.7	94.6	132	175	224	280	341	409	482	562	647	837
7	8.51	14.4	21.9	31.1	42.0	68.8	102	142	189	242	302	368	441	521	607	699	904
8	9.10	15.4	23.5	33.3	44.9	73.5	109	152	202	259	323	394	472	557	645	748	966
9	9.65	16.3	24.9	35.3	47.7	78.0	116	161	214	275	342	418	500	588	680	793	1025
10	10.2	17.2	26.2	37.2	50.2	82.2	122	170	226	289	361	440	527	622	725	836	1080
11	10.7	18.0	27.5	39.0	52.7	86.2	128	178	237	304	379	462	553	653	761	877	1133
12	11.1	18.9	28.7	40.8	55.0	90.1	134	186	247	317	395	482	578	682	794	916	1184
13	11.6	19.6	29.9	42.4	57.3	93.7	139	194	257	330	411	502	601	710	827	953	1232
14	12.0	20.4	31.0	44.1	59.4	97.3	145	201	267	342	427	521	624	736	856	989	1278
15	12.5	21.1	32.1	45.6	61.5	101	150	208	277	354	442	539	646	762	888	1024	1323
16	12.9	21.8	33.2	47.1	63.5	104	155	215	286	364	457	557	667	787	917	1057	1367
17	13.3	22.4	34.2	48.5	65.5	107	159	222	294	377	471	574	688	812	946	1090	1409
18	13.7	23.1	35.2	49.9	67.4	110	164	228	303	388	484	591	708	835	973	1121	1450
19	14.0	23.7	36.1	51.3	69.2	113	168	234	311	399	497	607	727	858	1000	1152	1489
20	14.4	24.3	37.1	52.6	71.0	116	173	240	319	409	510	623	746	880	1026	1182	1528
21	14.7	24.9	38.0	53.9	72.8	119	177	246	327	419	523	638	764	902	1051	1211	1566
22	15.1	25.5	38.9	55.2	74.5	122	181	252	335	429	535	653	782	923	1076	1240	1603
23	15.4	26.1	39.8	56.5	76.2	125	186	258	342	439	547	668	800	944	1100	1260	1639
24	15.8	26.7	40.6	57.7	77.8	127	189	263	350	448	559	682	817	964	1123	1295	1674
25	16.1	27.2	41.5	58.9	79.4	130	193	269	357	458	571	696	834	984	1147	1322	1708
26	16.4	27.7	42.3	60.0	81.0	133	197	274	364	467	582	710	850	1004	1169	1348	1742
27	16.7	28.3	43.1	61.2	82.5	135	201	279	371	476	593	723	867	1023	1182	1373	1775
28	17.0	28.8	43.9	62.3	84.1	138	204	285	378	484	604	737	883	1041	1214	1399	1808
29	17.3	29.3	44.7	63.4	85.5	140	208	290	384	493	615	750	898	1060	1235	1423	1840
30	17.6	29.8	45.4	64.5	87.0	142	212	294	391	501	625	763	913	1078	1256	1448	1871
L, in feet	Correction Factors For Other Pipe Lengths																
20	1.30	1.24	1.21	1.18	1.15	1.12	1.10	1.08	1.07	1.06	1.05	1.04	1.04	1.04	1.03	1.03	1.03
30	1.22	1.18	1.15	1.13	1.12	1.09	1.08	1.06	1.05	1.05	1.04	1.04	1.03	1.02	1.02	1.02	1.02
40	1.15	1.13	1.11	1.10	1.08	1.07	1.05	1.05	1.04	1.03	1.03	1.02	1.02	1.02	1.01	1.01	1.01
50	1.09	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01
60	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	.96	.97	.97	.97	.98	.98	.98	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
90	.93	.94	.94	.95	.95	.96	.97	.97	.98	.98	.98	.98	.98	.98	.98	.98	.98
100	.90	.91	.92	.93	.93	.95	.95	.96	.97	.97	.97	.98	.98	.98	.98	.98	.98
120	.84	.86	.87	.89	.90	.91	.93	.94	.94	.96	.96	.96	.96	.97	.97	.97	.98
140	.80	.82	.83	.85	.86	.88	.90	.91	.92	.93	.94	.94	.95	.95	.96	.96	.96
160	.76	.78	.80	.82	.83	.86	.88	.89	.90	.91	.92	.93	.94	.94	.95	.95	.96

Figure 5.13
Concentric Trash Rack and Anti-Vortex Device (USDA - NRCS)

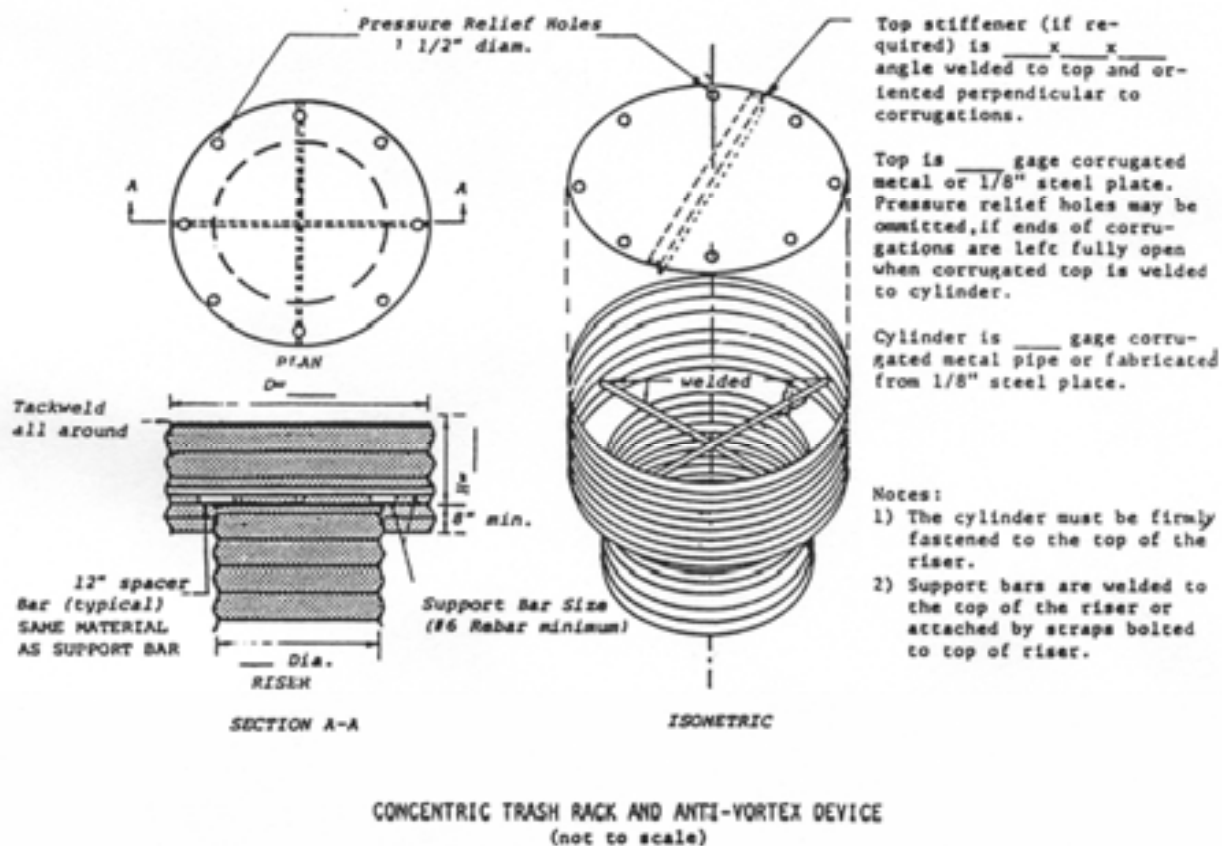
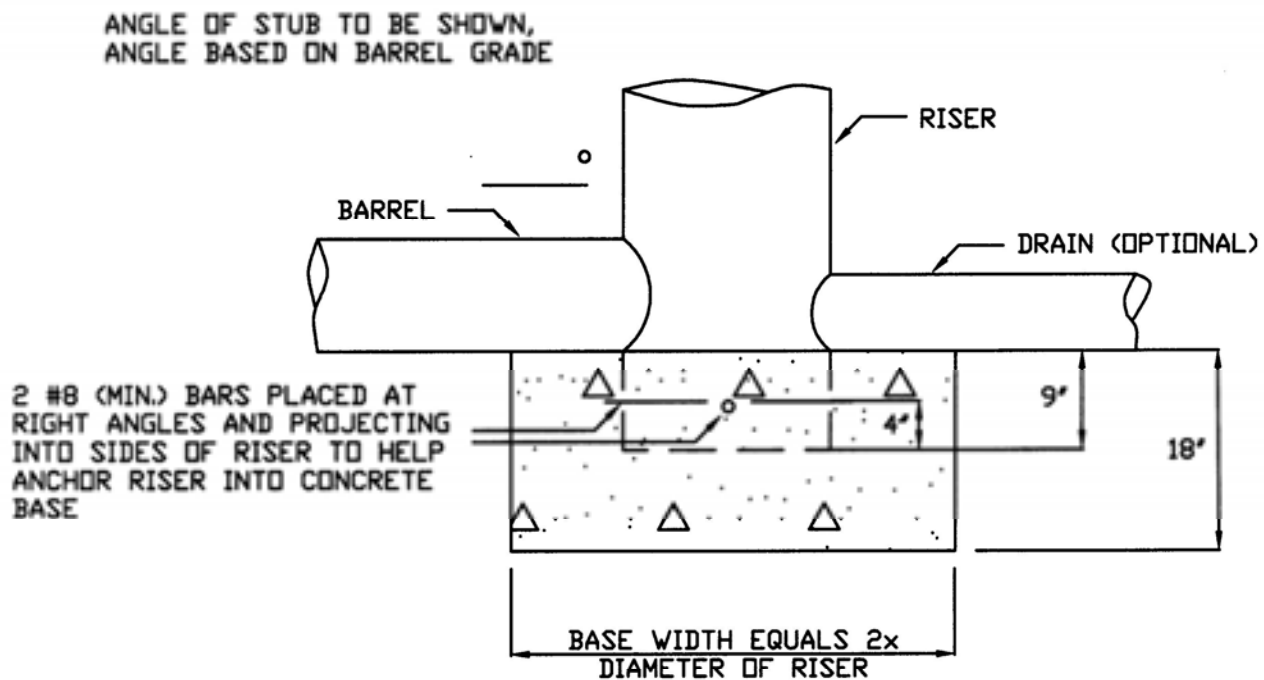


Figure 5.14
Concentric Trash Rack and Anti-Vortex Device Design Table
(USDA - NRCS)

Riser Diam.(in.)	Cylinder Diam.(in.)	Thick. Gage	H.(in.)	Minimum Size Support Bar	Minimum Top	
					Thickness	Stiffener
12	18	16	6	#6 Rebar	16 ga.	—
15	21	16	7	#6 Rebar	16 ga.	—
18	27	16	8	#6 Rebar	16 ga.	—
21	30	16	11	#6 Rebar	16 ga.	—
24	36	16	13	#6 Rebar	14 ga.	—
27	42	16	15	#6 Rebar	14 ga.	—
36	54	14	17	#8 Rebar	12 ga.	—
42	60	14	19	#8 Rebar	12 ga.	—
48	72	12	21	1 1/4" pipe or 1 1/4x1 1/4x1/4 angle	10 ga.	—
54	78	12	25	See 48" Riser	10 ga.	—
60	90	12	29	1 1/2" pipe or 1 1/2x1 1/2x1/2 angle	8 ga.	—
66	96	10	33	2" pipe or 2x2x3/16 angle	8 ga. w/stiffener	2x2x1/4 angle
72	102	10	36	———See 66" Riser———		2 1/2x2 1/2x1/4 angle
78	114	10	39	2 1/2" pipe or 2x2x1/4 angle	See 72" Riser	See 72" Riser
84	120	10	42	2 1/2" pipe or 2 1/2x2 1/2x1/4 angle	See 72" Riser	2 1/2x 2 1/2x 5/16 angle

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

Figure 5.15
Riser Base Details



CONSTRUCTION SPECIFICATIONS

1. THE CONCRETE BASE SHALL BE POURED IN SUCH A MANNER TO INSURE THAT THE CONCRETE FILLS THE BOTTOM OF THE RISER TO THE INVERT OF THE OUTLET PIPE TO PREVENT THE RISER FROM BREAKING AWAY FROM THE BASE.
2. WITH ALUMINUM OR ALUMINIZED PIPE, THE EMBEDDED SECTION MUST BE PAINTED WITH CHROMATE OR EQUIVALENT.
3. RISER BASE MAY BE SIZED AS COMPUTED USING FLOATATION WITH A FACTOR OF SAFETY OF 1.2.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS,
NEW YORK STATE DEPARTMENT OF TRANSPORTATION,
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION,
NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE

**RISER BASE DETAIL
SEDIMENT BASIN**

Figure 5.16 Anti-Seep Collar Design

This procedure provides the anti-seep collar dimensions for only temporary sediment basins to increase the seepage length by 15% for various pipe slopes, embankment slopes and riser heights.

The first step in designing anti-seep collars is to determine the length of pipe within the saturated zone of the embankment. This can be done graphically or by the following equation, assuming that the upstream slope of the embankment intersects the invert of the pipe at its upstream end. (See embankment-invert intersection on the drawing below:

$$L_s = y (z + 4) \left[1 + \frac{\text{pipe slope}}{0.25 - \text{pipe slope}} \right]$$

Where: L_s = length of pipe in the saturated zone (ft.)

y = distance in feet from upstream invert of pipe to highest normal water level expected to occur during the life of the structure, usually the top of the riser.

z = slope of upstream embankment as a ratio of z ft. horizontal to one ft. vertical.

pipe slope = slope of pipe in feet per foot.

This procedure is based on the approximation of the phreatic line as shown in the drawing below:

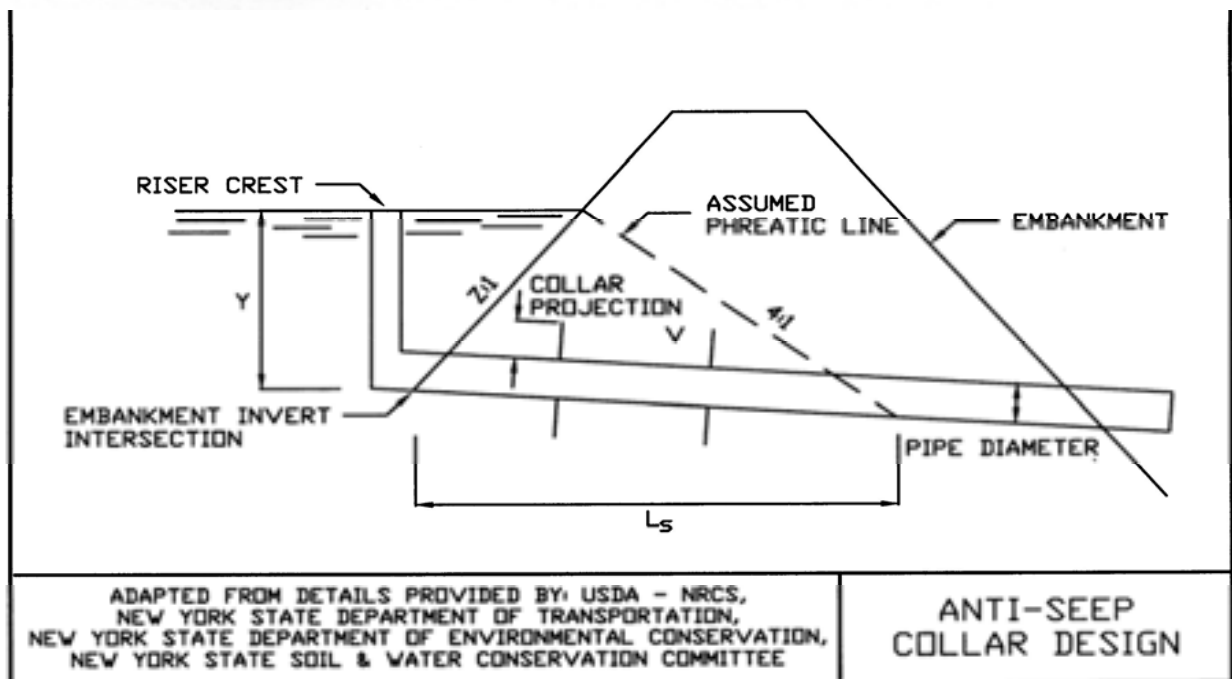


Figure 5.17
Anti-Seep Collar Design Charts (USDA - NRCS)

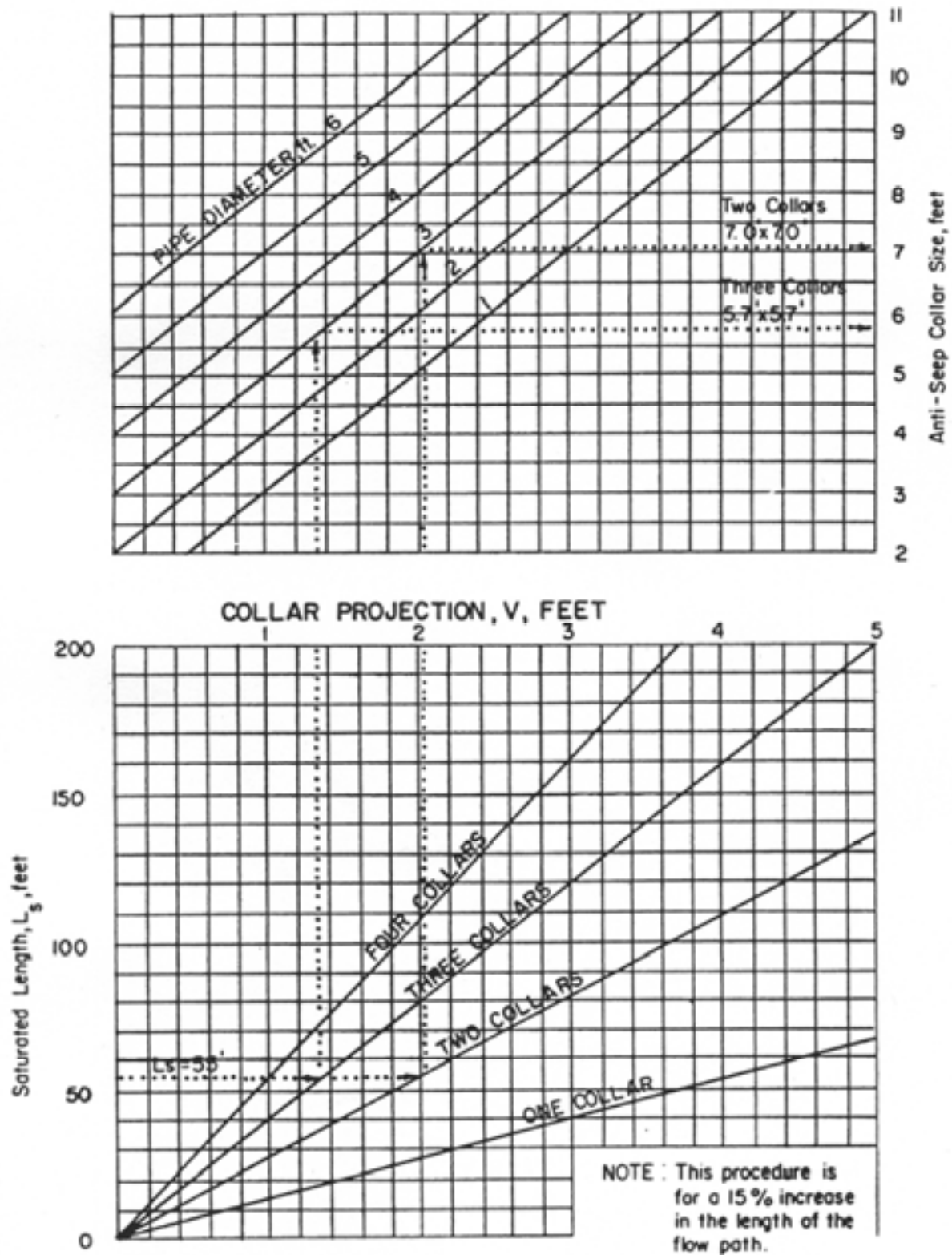


Figure 5.18
Anti-Seep Collar

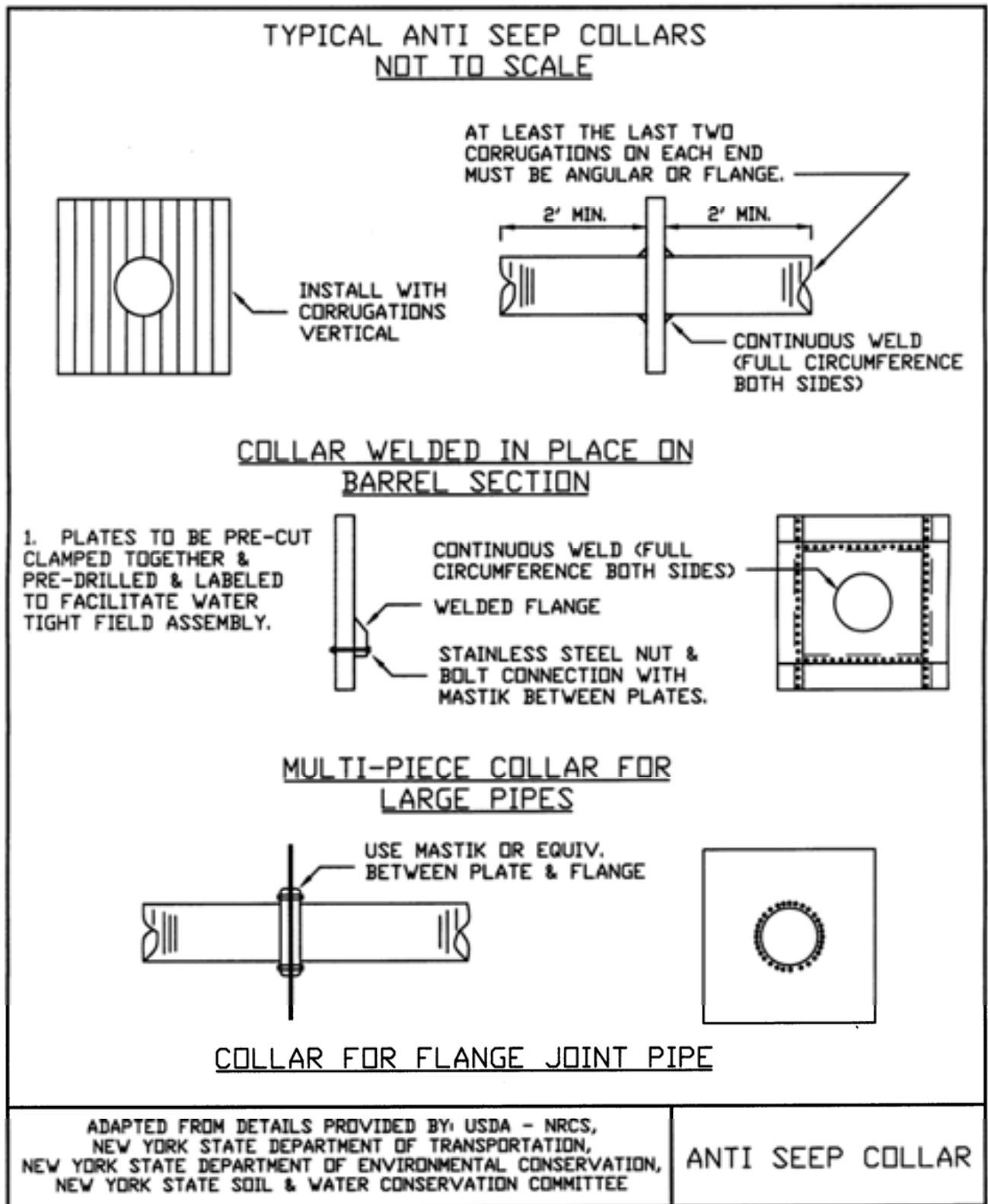


Figure 5.19
Design Data for Earth Spillways

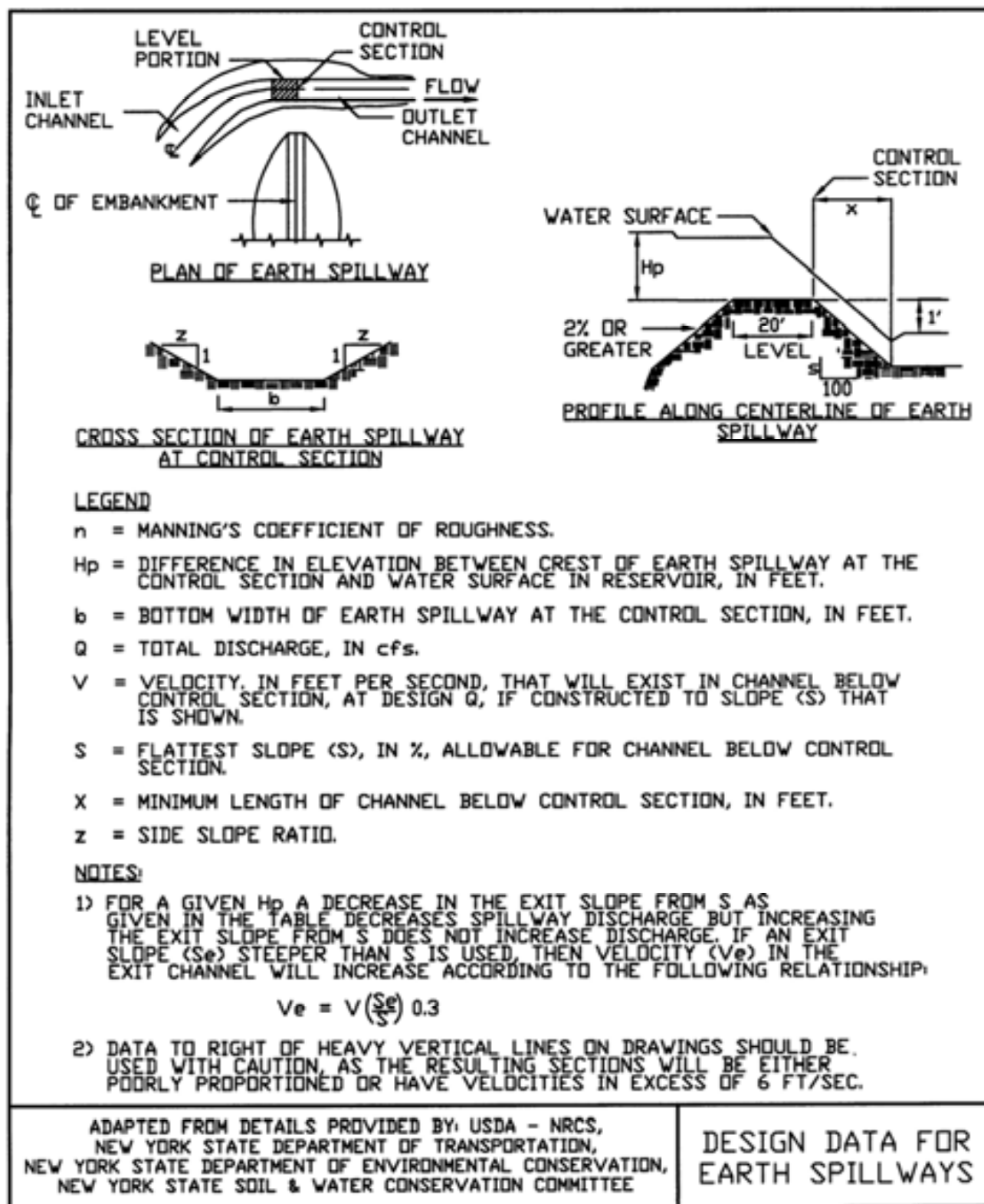


Figure 5.20
Design Table for Vegetated Earth Spillways in
Erosion Resistant Soils, K=0.1 - 0.35, Side Slopes = 3:1

Discharge Q CFS	Slope Range		Bottom Width Feet	Stage Feet	Discharge Q CFS	Slope Range		Bottom Width Feet	Stage Feet	
	Minimum Percent	Maximum Percent				Minimum Percent	Maximum Percent			
15	3.3	12.2	8	.83	80	2.8	5.2	24	1.24	
	3.5	18.2	12	.89		2.8	5.9	28	1.14	
20	3.1	8.9	8	.97		2.9	7.0	32	1.06	
	3.2	13.0	12	.81	90	2.5	2.6	12	1.84	
	3.3	17.3	16	.70		2.5	3.1	16	1.61	
25	2.9	7.1	8	1.09		2.6	3.8	20	1.45	
	3.2	9.9	12	.91		2.7	4.5	24	1.32	
	3.3	13.2	16	.79		2.8	5.3	28	1.22	
	3.3	17.2	20	.70		2.8	6.1	32	1.14	
30	2.9	6.0	8	1.20	100	2.5	2.8	16	1.71	
	3.0	8.2	12	1.01		2.6	3.3	20	1.54	
	3.0	10.7	16	.88		2.6	4.0	24	1.41	
	3.3	13.8	20	.78		2.7	4.8	28	1.30	
35	2.8	5.1	8	1.30		2.7	5.3	32	1.21	
	2.9	6.9	12	1.10		2.8	6.1	36	1.13	
	3.1	9.0	16	.94	120	2.5	2.8	20	1.71	
	3.1	11.3	20	.85		2.6	3.2	24	1.56	
3.2	14.1	24	.77	2.7		3.8	28	1.44		
40	2.7	4.5	8	1.40		2.7	4.2	32	1.34	
	2.9	6.0	12	1.18		2.7	4.8	36	1.26	
	2.9	7.6	16	1.03		140	2.5	2.7	24	1.71
	3.1	9.7	20	.91	2.5		3.2	28	1.58	
3.1	11.9	24	.83	2.6	3.6		32	1.47		
45	2.6	4.1	8	1.49	2.6		4.0	36	1.38	
	2.8	5.3	12	1.25	2.7		4.5	40	1.30	
	2.9	6.7	16	1.09	160		2.5	2.7	28	1.70
	3.0	8.4	20	.98		2.5	3.1	32	1.58	
	3.0	10.4	24	.89		2.6	3.4	36	1.49	
50	2.7	3.7	8	1.57		2.6	3.8	40	1.40	
	2.8	4.7	12	1.33		2.7	4.3	44	1.33	
	2.8	6.0	16	1.16		180	2.4	2.7	32	1.72
	2.9	7.3	20	1.03	2.4		3.0	36	1.60	
	3.1	9.0	24	.94	2.5		3.4	40	1.51	
60	2.6	3.1	8	1.73	2.6		3.7	44	1.43	
	2.7	3.9	12	1.47	200		2.5	2.7	36	1.70
	2.7	4.8	16	1.28			2.5	2.9	40	1.60
	2.9	5.9	20	1.15		2.5	3.3	44	1.52	
	2.9	7.3	24	1.05		2.6	3.6	48	1.45	
3.0	8.6	28	.97	220		2.4	2.6	40	1.70	
70	2.5	2.8	8			1.88	2.5	2.9	44	1.61
	2.6	3.3	12		1.60	2.5	3.2	48	1.53	
	2.6	4.1	16		1.40	240	2.5	2.6	44	1.70
	2.7	5.0	20		1.26		2.5	2.9	48	1.62
	2.8	6.1	24		1.15		2.6	3.2	52	1.54
2.9	7.0	28	1.05	260	2.4		2.6	48	1.70	
80	2.5	2.9	12		1.72	2.5	2.9	52	1.62	
	2.6	3.6	16		1.51	280	2.4	2.6	52	1.70
	2.7	4.3	20	1.35	2.5		2.6	56	1.69	

Figure 5.21
Design Table for Vegetated Earth Spillways in
Very Erodible Soils, K = 0.36 - 0.80, Side Slopes = 3:1
 (USDA - NRCS)

Discharge Q CFS	Slope Range		Bottom Width Feet	Stage Feet
	Minimum Percent	Maximum Percent		
10	3.5	4.7	8	.68
15	3.4	4.4	12	.69
	3.4	5.9	16	.80
20	3.3	3.3	12	.80
	3.3	4.1	16	.70
	3.5	5.3	20	.62
25	3.3	3.3	16	.79
	3.3	4.0	20	.70
	3.5	4.9	24	.64
30	3.3	3.3	20	.78
	3.3	4.0	24	.71
	3.4	4.7	28	.65
	3.4	5.5	32	.61
35	3.2	3.2	24	.77
	3.3	3.9	28	.71
	3.5	4.6	32	.66
	3.5	5.2	36	.62
40	3.3	3.3	28	.76
	3.4	3.8	32	.71
	3.4	4.4	36	.67
	3.4	5.0	40	.64
45	3.3	3.3	32	.76
	3.4	3.8	36	.71
	3.4	4.3	40	.67
	3.4	4.8	44	.64
50	3.3	3.3	36	.75
	3.3	3.8	40	.71
	3.3	4.3	44	.68
60	3.2	3.2	44	.75
	3.2	3.7	48	.72
70	3.3	3.3	52	.75
80	3.1	3.1	56	.78

Procedure for Determining or Altering Sediment Basin Shape

As specified in the Standard and Specification, the pool area at the elevation of the crest of the principal spillway shall have a length to width ratio of at least 2.0 to 1. The purpose of this requirement is to minimize the “short circuiting” effect of the sediment laden inflow to the riser and thereby increase the effectiveness of the sediment basin. The purpose of this procedure is to prescribe the parameters, procedures, and methods of determining and modifying the shape of the basin.

The length of the flow path (L) is the distance from the point of inflow to the riser (outflow point). The point of inflow is the point that the stream enters the normal pool (pool level at the riser crest elevation). The pool area (A) is the area of the normal pool. The effective width (W_e) is found by the equation:

$$W_e = A/L \text{ and } L:W \text{ ratio} = L/W_e$$

In the event there is more than one inflow point, any inflow point that conveys more than 30 percent of the total peak inflow rate shall meet the length to width ratio criteria.

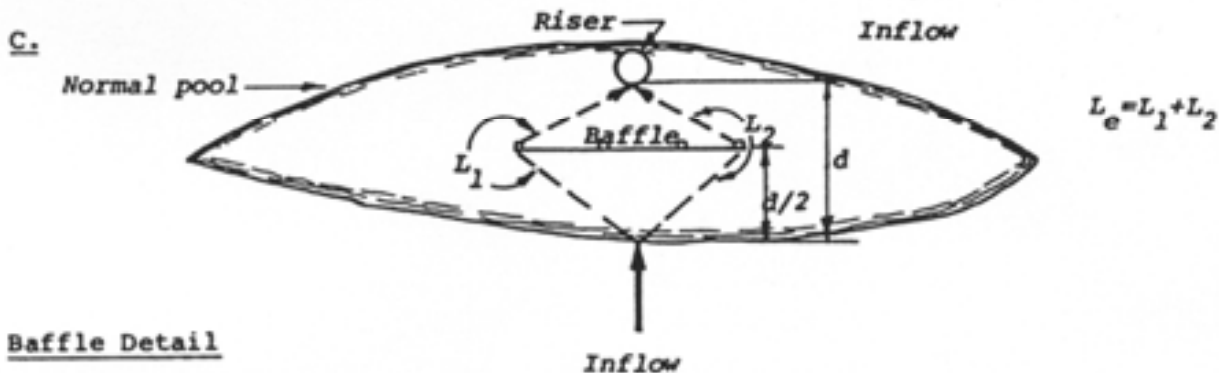
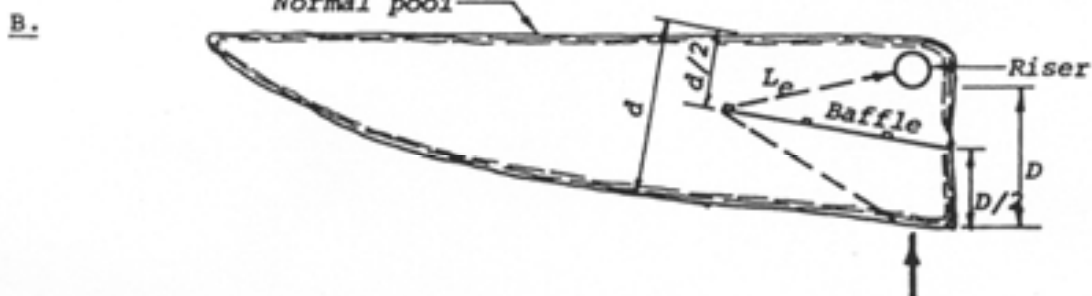
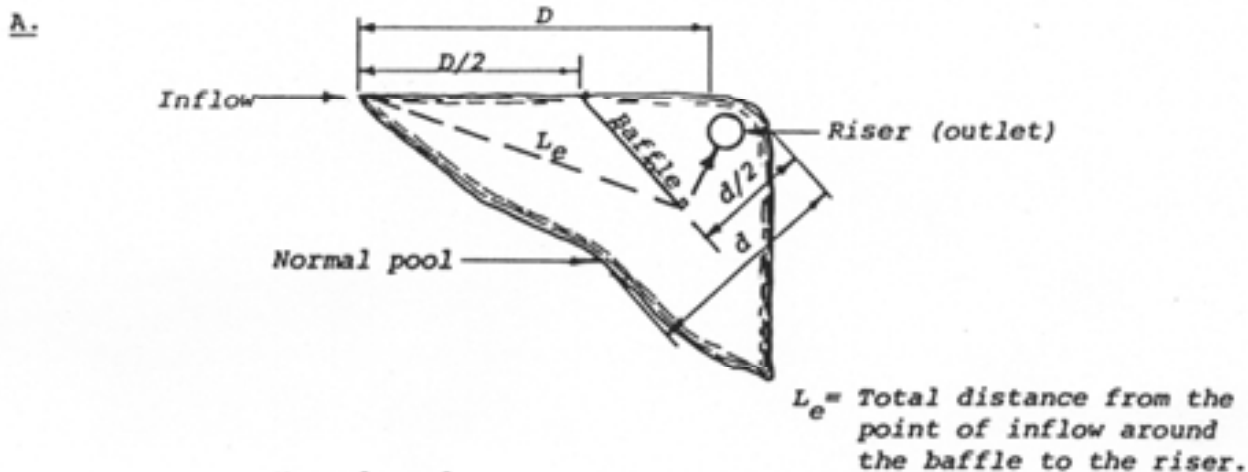
The required basin shape may be obtained by proper site selection, by excavation, or by constructing a baffle in the basin. The purpose of the baffle is to increase the effective flow length from the inflow point to the riser. Baffles (see Figure 5.22 on following page) shall be placed midway between the inflow point around the end of the baffle to the outflow point. Then:

$$W_e = A/L_e \text{ and } L:W \text{ ratio} = L_e/W_e$$

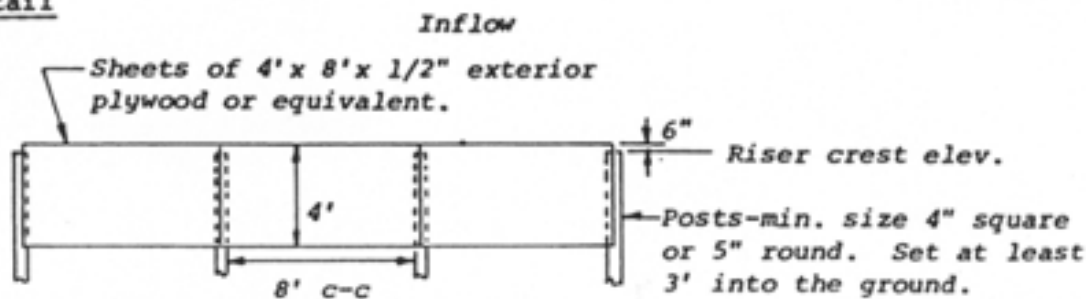
Three examples are shown on the following page. Note that for the special case in example C the water is allowed to go around both ends of the baffle and the effective length, $L_e = L_1 + L_2$. Otherwise, the length to width ratio computations are the same as shown above. This special case procedure for computing L_e is allowable only when the two flow paths are equal, i.e., when $L_1 = L_2$. A baffle detail is also shown in Figure 5.22 on page 5.41.

Figure 5.22
Sediment Basin Baffle Details (USDA - NRCS)

Examples: Plan Views - not to scale



Baffle Detail



STANDARD AND SPECIFICATIONS FOR SEDIMENT DIKE



Definition & Scope

A **temporary** earth dike with an excavated trench on the upslope toe placed across a slope to capture sediment laden flow from small disturbed drainage areas and allowing sediment to settle out by ponding.

Condition Where Practice Applies

This practice can be used on slopes and in areas where it is difficult to place and maintain silt fence. This practice acts as a smaller sediment trap for linear type applications. This practice will handle sheet and rill erosion for small tributary areas.

Design Criteria

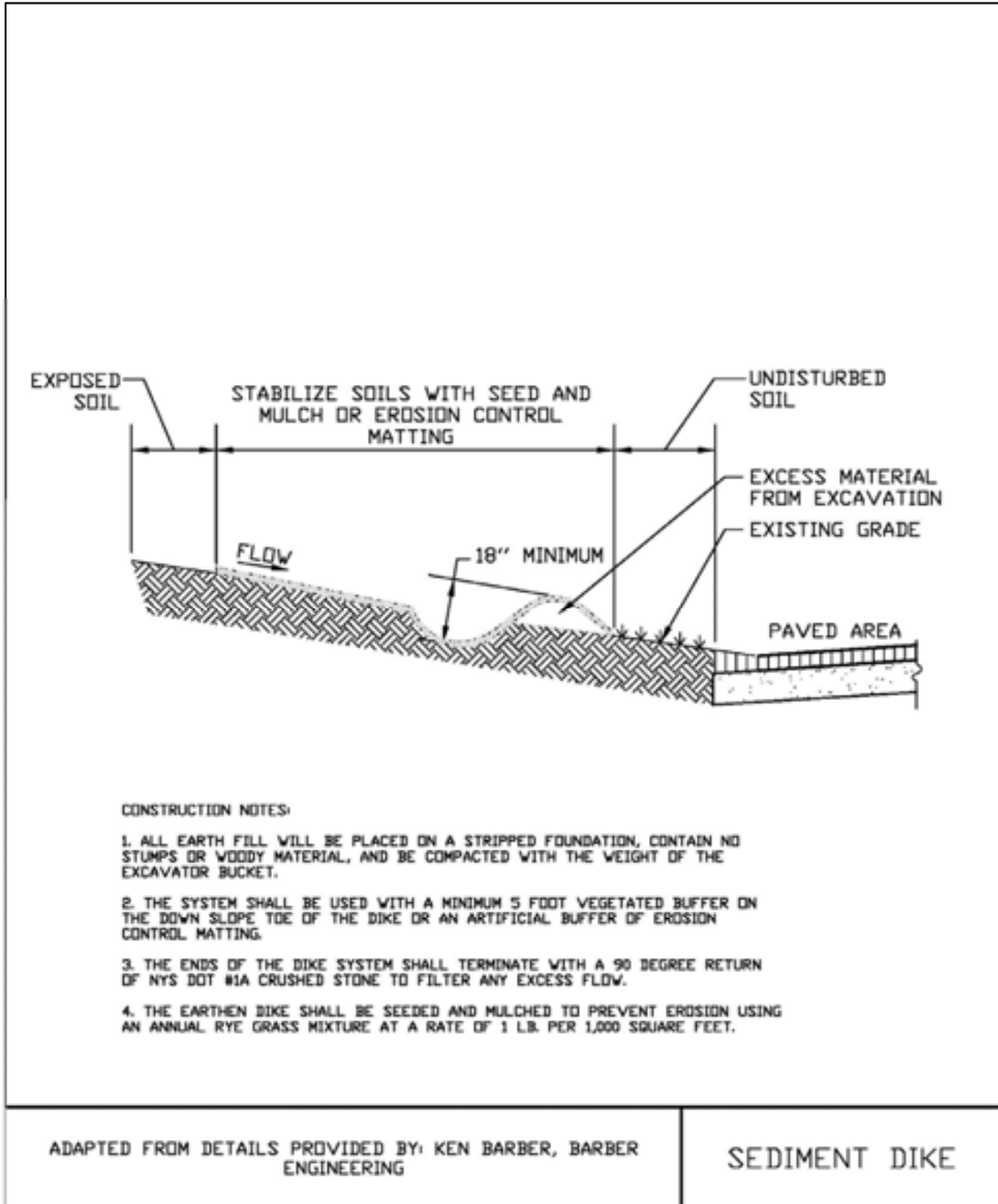
1. The earth dike will be a maximum of 2 feet high with a 2 foot top width and 2:1 side slopes.
2. All earth fill will be placed on a stripped foundation, contain no stumps or woody material, and be compacted with the weight of the excavator bucket.
3. The interior capture trench will be a minimum 1.5 feet deep, 2 feet wide, with 1:1 side slopes and with a near level bottom. In areas where linear slopes exceed 4% the sediment dike system shall be segmented to maintain capture volume and ponding.
4. The system shall be used with a minimum 5 foot vegetated buffer on the down slope toe of the dike or an artificial buffer of erosion control matting.
5. The maximum ponding depth behind the dike shall be 1/2 the height of the constructed dike at its lowest elevation.

6. The ends of the dike system shall terminate with a 90° return of NYS DOT #1A crushed stone to filter any excess flow.
7. The maximum drainage area tributary to this practice shall not exceed 0.5 acres per 100 feet of dike, for slopes less than 10%. For slopes greater than 10%, the drainage area shall be 0.25 acres per 100 feet of dike.
8. The earthen dike shall be seeded and mulched to prevent erosion using an annual rye grass mixture at a rate of 1 lb. per 1,000 square feet.

Maintenance

1. No traffic will be allowed on the dike.
2. Dike system will be inspected weekly and after each runoff event.
3. Sediment in the system will be removed when the interior trench has filled to 75% capacity.
4. Sediment will be disposed of on-site as specified in the Erosion and Sediment Control Plan.
5. Upon stabilization of the tributary drainage area, the trench will be filled, excess dike fill removed, and the area graded and stabilized in accordance with the Erosion and Sediment Control Plan.

Figure 5.23
Sediment Dike



STANDARD AND SPECIFICATIONS FOR SEDIMENT TANK - PORTABLE



Definition & Scope

A sediment tank is a compartmented tank or vessel container to which sediment laden water is pumped to trap and retain the sediment prior to releasing the water to drainage-ways, and rights-of-way below the sediment tank site.

Conditions Where Practice Applies

A sediment tank is to be used on sites where excavations are deep, and space is limited, such as urban construction, where direct discharge of sediment laden water to stream and storm drainage systems is to be avoided.

Design Criteria

Location

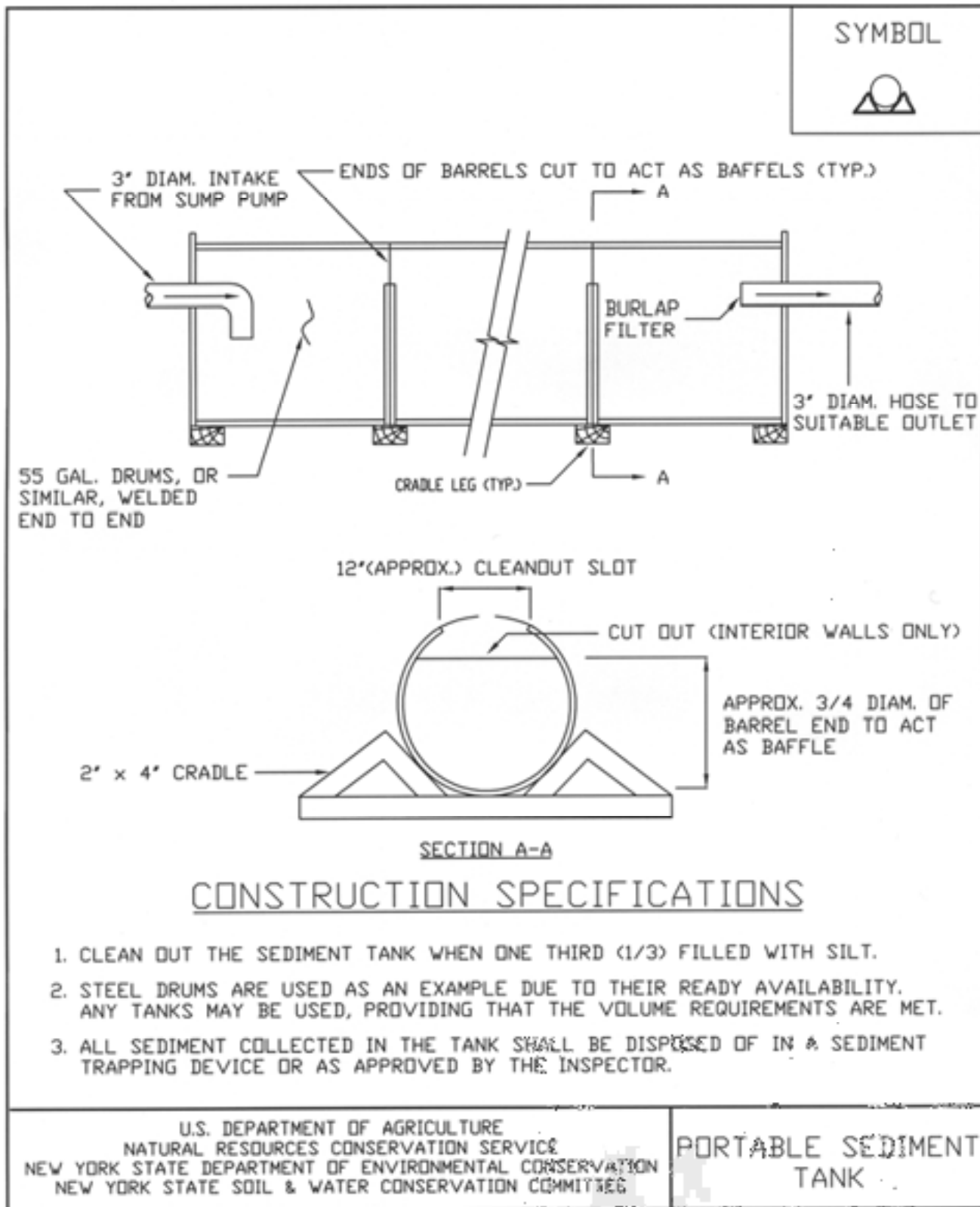
The sediment tank shall be located for ease of clean-out and disposal of the trapped sediment, and to minimize the interference with construction activities and pedestrian traffic.

Tank Size

The following formula should be used in determining the storage volume of the sediment tank; pump discharge (G.P.M.) x 16 = Cubic Foot Storage.

An example of a typical sediment tank is shown on Figure 5.24 on page 5.45. Other container designs can be used if the storage volume is adequate and approval is obtained from the local approving agency. Commercially manufactured tanks are also available.

Figure 5.24
Portable Sediment Tank



STANDARD AND SPECIFICATIONS FOR SEDIMENT TRAP



Definition & Scope

A **temporary** sediment control device formed by excavation and/or embankment to intercept sediment-laden runoff and trap the sediment in order to protect drainageways, properties, and rights-of-way below the sediment trap from sedimentation.

Conditions Where Practice Applies

A sediment trap is usually installed in a drainageway, at a storm drain inlet, or other points of collection from a disturbed area for one construction season.

Sediment traps should be used to artificially break up the natural drainage area into smaller sections where a larger device (sediment basin) would be less effective.

Design Criteria

If the drainage area to the proposed trap location exceeds 5 acres, or the trap is in place beyond one construction season, or any of the additional design criteria presented here cannot be met, a full Sediment Basin must be used. See Standard and Specification for Sediment Basin on page 5.19.

Drainage Area

The maximum drainage area for all sediment traps shall be 5 acres.

Location

Sediment traps shall be located so that they can be installed prior to grading or filling in the drainage area they are to protect. Traps must **not be located any closer than 20 feet** from a proposed building foundation if the trap is to func-

tion during building construction. Locate traps to obtain maximum storage benefit from the terrain and for ease of cleanout and disposal of the trapped sediment.

Trap Size

The volume of a sediment trap as measured at the elevation of the crest of the outlet shall be at least 3,600 cubic feet per acre of drainage area. A minimum length to width ratio of 2:1 should be provided. The volume of a constructed trap shall be calculated using standard mathematical procedures. The volume of a natural sediment trap may be approximated by the equation: Volume (cu.ft.) = 0.4 x surface area (sq.ft.) x maximum depth (ft.).

Trap Cleanout

Sediment shall be removed and the trap restored to the original dimensions when the sediment has accumulated to $\frac{1}{2}$ of the design depth of traps I-II, and $\frac{1}{3}$ the depth for trap III. Sediment removed from the trap shall be deposited in a protected area and in such a manner that it will not erode.

Embankment

All earth embankments for sediment traps shall not exceed five (5) feet in height as measured at the low point of the original ground along the centerline of the embankment. Embankments shall have a minimum four (4) foot wide top and side slopes of 2:1 or flatter. The embankment shall be compacted by traversing with equipment while it is being constructed. The embankment shall be stabilized with seed and mulch as soon as it is completed.

The elevation of the top of any dike directing water to any sediment trap will equal or exceed the maximum height of the outlet structure along the entire length of the trap.

Excavation

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Excavated portions of sediment traps shall have 1:1 or flatter slopes.

Outlet

The outlet shall be designed, constructed, and maintained in such a manner that sediment does not leave the trap and that erosion at or below the outlet does not occur.

Sediment traps must outlet onto stabilized (preferable undisturbed) ground, into a watercourse, stabilized channel, or into a storm drain system. Distance between inlet and outlet should be maximized to the longest length practicable.

All traps must be seeded and mulched immediately after construction.

Trap Details Needed on Erosion and Sediment Control Plans

Each trap shall be delineated on the plans in such a manner that it will not be confused with any other features. Each trap on a plan shall indicate all the information necessary to properly construct and maintain the structure. If the drawings are such that this information cannot be delineated on the drawings, then a table shall be developed. If a table is developed, then each trap on a plan shall have a number and the numbers shall be consecutive.

The following information shall be shown for each trap in a summary table format on the plans.

1. Trap number
2. Type of trap
3. Drainage area
4. Storage required
5. Storage provided (if applicable)
6. Outlet length or pipe sizes
7. Storage depth below outlet or cleanout elevation
8. Embankment height and elevation (if applicable)

Type of Sediment Traps

There are three (3) specific types of sediment traps which vary according to their function, location, or drainage area.

- I. Pipe Outlet Sediment Trap
- II. Stone Outlet Sediment Trap
- III. Compost Filter Sock Sediment Trap

I. Pipe Outlet Sediment Trap

A Pipe Outlet Sediment Trap consists of a trap formed by embankment or excavation. The outlet for the trap is through a perforated riser and a pipe through the embankment. The outlet pipe and riser shall be made of steel, corrugated metal or other suitable material. The top of the embankment shall be at least 1 ½ feet above the crest of the riser. The preferred method of dewatering the sediment trap is by surface skimmer. See Dewatering Device Standard, page 5.10. If the riser alone is used for dewatering, the top 2/3 of the riser shall be perforated with one (1) inch nominal diameter holes or slits spaced six (6) inches vertically and horizontally placed in the concave portion of the corrugated pipe.

No holes or slits will be allowed within six (6) inches of the top of the horizontal barrel. All pipe connections shall be watertight. The riser shall be wrapped with ½ to ¼ inch hardware cloth wire then wrapped with filter cloth with a sieve size between #40-80 and secured with strapping or connecting band at the top and bottom of the cloth. The

cloth shall cover an area at least six (6) inches above the highest hole and six (6) inches below the lowest hole. The top of the riser pipe shall not be covered with filter cloth. The riser shall have a base with sufficient weight to prevent flotation of the riser. Two approved bases are:

1. A concrete base 12 in. thick with the riser embedded 9 in. into the concrete base, or
2. One quarter inch, minimum, thick steel plate attached to the riser by a continuous weld around the circumference of the riser to form a watertight connection. The plate shall have 2.5 feet of stone, gravel, or earth placed on it to prevent flotation. In either case, each side of the square base measurement shall be the riser diameter plus 24 inches.

Pipe outlet sediment traps shall be limited to a five (5) acre maximum drainage area. Pipe outlet sediment trap is interchangeable in the field with stone outlet provided that these sediment traps are constructed in accordance with the detail and specifications for that trap.

Select pipe diameter from the following table:
See details for Pipe Outlet Sediment Trap ST-I in Figure 5.25 and 5.26 on pages 5.49 and 5.50.

Optional sediment trap dewatering devices are shown on Figure 5.29 on Page 5.53.

Minimum Sizes

Barrel Diameter¹ (in.)	Riser Diameter¹ (in.)	Maximum Drainage Area (ac.)
12	15	1
15	18	2
18	21	3
21	24	4
21	27	5
¹ Barrel diameter may be same size as riser diameter		



II. Stone Outlet Sediment Trap

A Stone Outlet Sediment Trap consists of a trap formed by an embankment or excavation. The outlet of this trap is over a stone section placed on level ground. The minimum length (feet) of the outlet shall be equal to four (4) times the drainage area (acres).

Required storage shall be 3,600 cubic feet per acre of drainage area.

The outlet crest (top of stone in weir section) shall be level, at least one (1) foot below top of embankment and no more than one (1) foot above ground beneath the outlet. Stone used in the outlet shall be small riprap (4 in. x 8 in.). To provide more efficient trapping effect, a layer of filter cloth should be embedded one (1) foot back into the upstream face of the outlet stone or a one (1) foot thick layer of two (2) inch or finer aggregate shall be placed on the upstream face of the outlet.

Stone Outlet Sediment Traps may be interchangeable in the field with pipe outlet sediment traps provided they are constructed in accordance with the detail and specifications for those traps. Stone outlet sediment traps shall be limited to a five (5) acre maximum drainage area.

See details for Stone Outlet Sediment Trap ST-II in Figure 5.27 on page 5.51



III. Compost Sock Sediment Trap

A compost sock sediment trap consists of a trap formed by creating an enclosure of geotextile mesh tubes filled with a compost filter media. These traps are used in locations where there is no opportunity to direct runoff into larger traps or well vegetated areas. This could occur at site entrances and access points or in tight areas due to construction boundary limits.

Surface runoff can be directed to the trap with standard conveyance practices. Groundwater or surface ponding in low areas can be pumped into the compost sock sediment trap with appropriate energy dissipation at the pump outlet to prevent scour.

Design criteria for Compost Sock Sediment Trap

1. The maximum drainage area tributary to the trap shall be 5 acres.
2. The minimum settled height above ground shall be 2.0 feet formed by staking 3 compost filter socks in a pyramid as shown in Figure 5.28 on page 5.52.
3. The storage volume provided in the compost sock sediment trap shall be 3,600 cubic feet per tributary drainage acre.
4. If necessary, additional storage area can be created by excavating a sump 1 foot deep beginning at least 5 feet away from the inside sock.
5. All compost filter sock materials, mesh, and compost, will meet the material specifications listed in the Compost Filter Sock standard. No spillway is required.
6. Compost filter sock sediment traps shall be inspected weekly and after every rainfall event. Sediment shall be removed when it reaches one third, $\frac{1}{3}$, the height of the trap.
7. The maximum limit of use for a compost sock sediment trap is one (1) year. The existing trap shall be replaced if there is a need for a trap beyond that time limit.
8. Upon completion of the work, the compost sock sediment trap shall be removed. The compost within the socks may be used during cleanup as a vegetative growth medium in accordance with the site stabilization plan.



Figure 5.25
Pipe Outlet Sediment Trap: ST-I

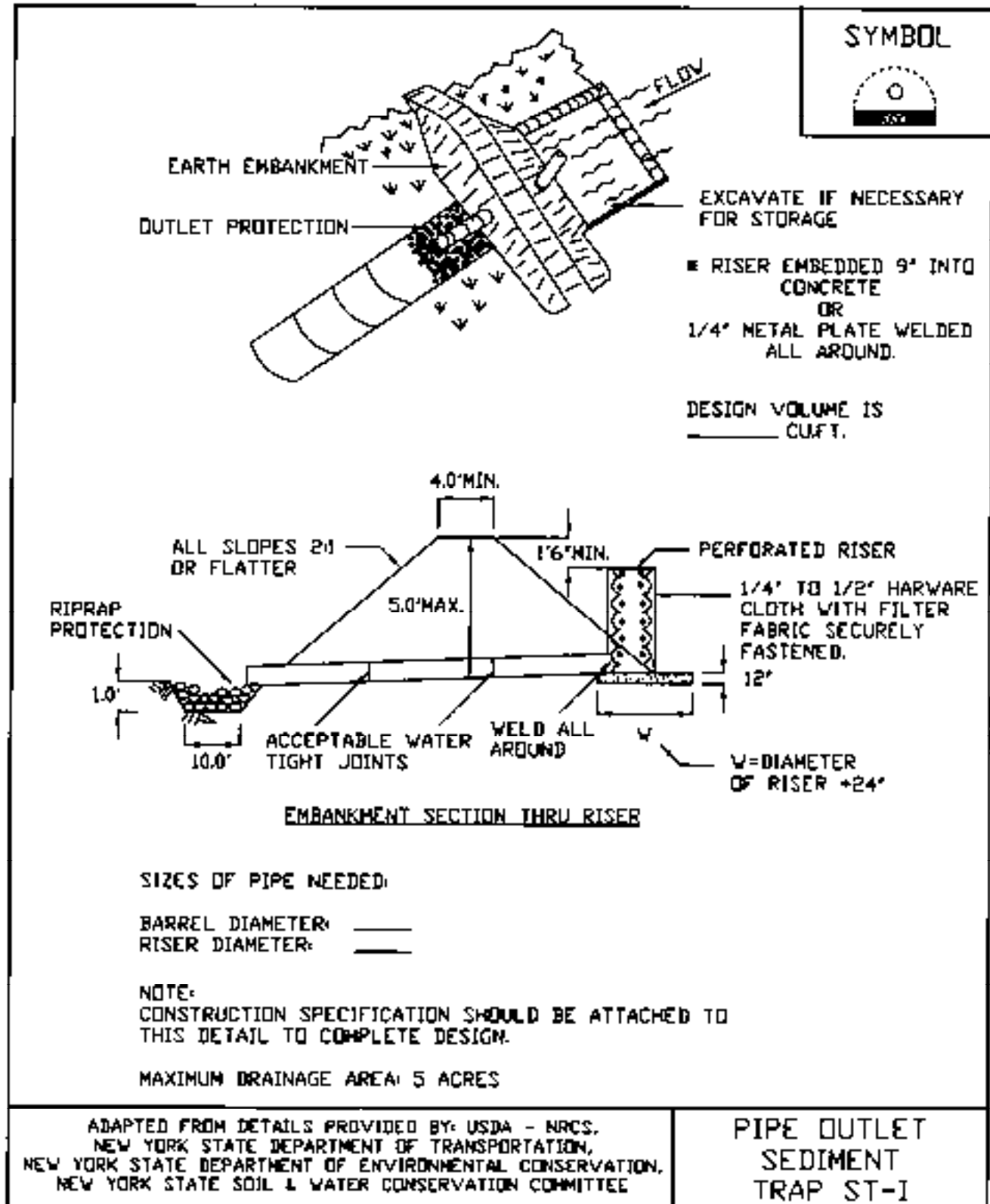


Figure 5.26
Pipe Outlet Sediment Trap: ST-I - Construction Specifications


<p style="text-align: center;"><u>CONSTRUCTION SPECIFICATIONS</u></p>	<p style="text-align: center;">SYMBOL</p> 
<ol style="list-style-type: none"> 1. AREA UNDER EMBANKMENT SHALL BE CLEARED, GRUBBED AND STRIPPED OF ANY VEGETATION AND ROOT MAT. THE POOL AREA SHALL BE CLEARED. 2. THE FILL MATERIAL FOR THE EMBANKMENT SHALL BE FREE OF ROOTS OR OTHER WOODY VEGETATION AS WELL AS OVER-SIZED STONES, ROCKS, ORGANIC MATERIAL, OR OTHER OBJECTIONABLE MATERIAL. THE EMBANKMENT SHALL BE COMPACTED BY TRAVERSING WITH EQUIPMENT WHILE IT IS BEING CONSTRUCTED. 3. VOLUME OF SEDIMENT STORAGE SHALL BE 3600 CUBIC FEET PER ACRE OF CONTRIBUTORY DRAINAGE. 4. SEDIMENT SHALL BE REMOVED AND TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO 1/2 THE DESIGN DEPTH OF THE TRAP. REMOVED SEDIMENT SHALL BE DEPOSITED IN A SUITABLE AREA AND STABILIZED. 5. THE STRUCTURE SHALL BE INSPECTED AFTER EACH RAIN AND REPAIRS MADE AS NEEDED. 6. CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND SEDIMENT ARE CONTROLLED. 7. THE STRUCTURE SHALL BE REMOVED AND AREA STABILIZED WHEN THE DRAINAGE AREA HAS BEEN PROPERLY STABILIZED. 8. ALL FILL SLOPES SHALL BE 2:1 OR FLATTER; CUT SLOPES 1:1 OR FLATTER. 9. ALL PIPE CONNECTIONS SHALL BE WATERTIGHT. 10. THE TOP 2/3 OF THE RISER SHALL BE PERFORATED WITH ONE (1) INCH DIAMETER HOLES OR SLITS SPACED SIX (6) INCHES VERTICALLY AND HORIZONTALLY AND PLACED IN THE CONCAVE PORTION OF PIPE. NO HOLES WILL BE ALLOWED WITHIN SIX (6) INCHES OF THE HORIZONTAL BARREL. 11. THE RISER SHALL BE WRAPPED WITH 1/4 TO 1/2 INCH HARDWARE CLOTH WIRE THEN WRAPPED WITH FILTER CLOTH (HAVING AN EQUIVALENT SIEVE SIZE OF 40-80). THE FILTER CLOTH SHALL EXTEND SIX (6) INCHES ABOVE THE HIGHEST HOLE AND SIX (6) INCHES BELOW THE LOWEST HOLE. WHERE ENDS OF THE FILTER CLOTH COME TOGETHER, THEY SHALL BE OVER-LAPPED, FOLDED AND STAPLED TO PREVENT BYPASS. 12. STRAPS OR CONNECTING BANDS SHALL BE USED TO HOLD THE FILTER CLOTH AND WIRE FABRIC IN PLACE. THEY SHALL BE PLACED AT THE TOP AND BOTTOM OF THE CLOTH. 13. FILL MATERIAL AROUND THE PIPE SPILLWAY SHALL BE HAND COMPACTED IN FOUR (4) INCH LAYERS. A MINIMUM OF TWO (2) FEET OF HAND COMPACTED BACKFILL SHALL BE PLACED OVER THE PIPE SPILLWAY BEFORE CROSSING IT WITH CONSTRUCTION EQUIPMENT. 14. THE RISER SHALL BE ANCHORED WITH EITHER A CONCRETE BASE OR STEEL PLATE BASE TO PREVENT FLOTATION. FOR CONCRETE BASE THE DEPTH SHALL BE TWELVE (12) INCHES WITH THE RISER EMBEDDED NINE (9) INCHES. A 1/4 INCH MINIMUM THICKNESS STEEL PLATE SHALL BE ATTACHED TO THE RISER BY A CONTINUOUS WELD AROUND THE BOTTOM TO FORM A WATERTIGHT CONNECTION AND THEN PLACE TWO (2) FEET OF STONE, GRAVEL, OR TAMPED EARTH ON THE PLATE. 	
<p>ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE</p>	<p style="text-align: center;">PIPE OUTLET SEDIMENT TRAP ST-I</p>

Figure 5.27
Stone Outlet Sediment Trap: ST-II

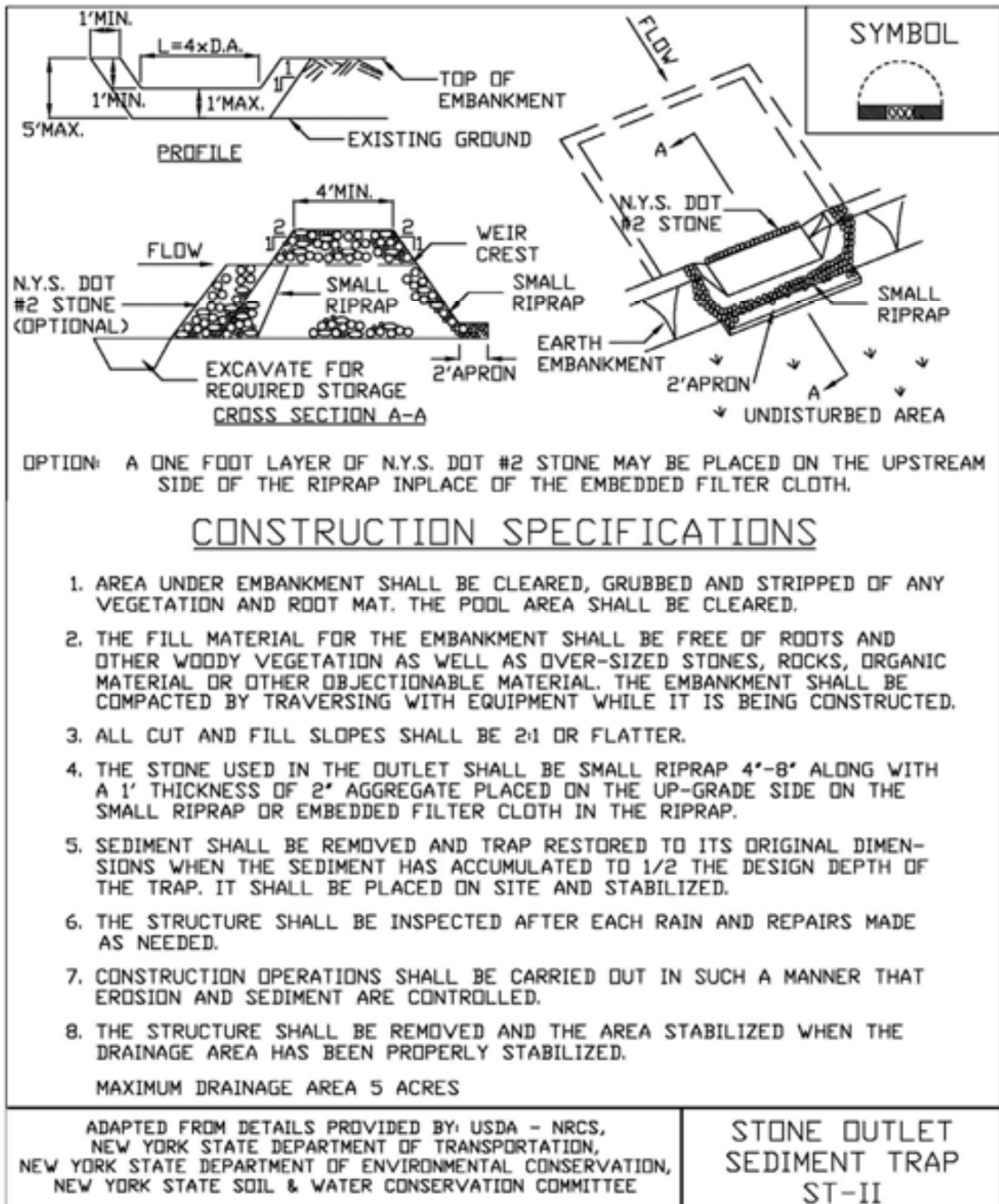
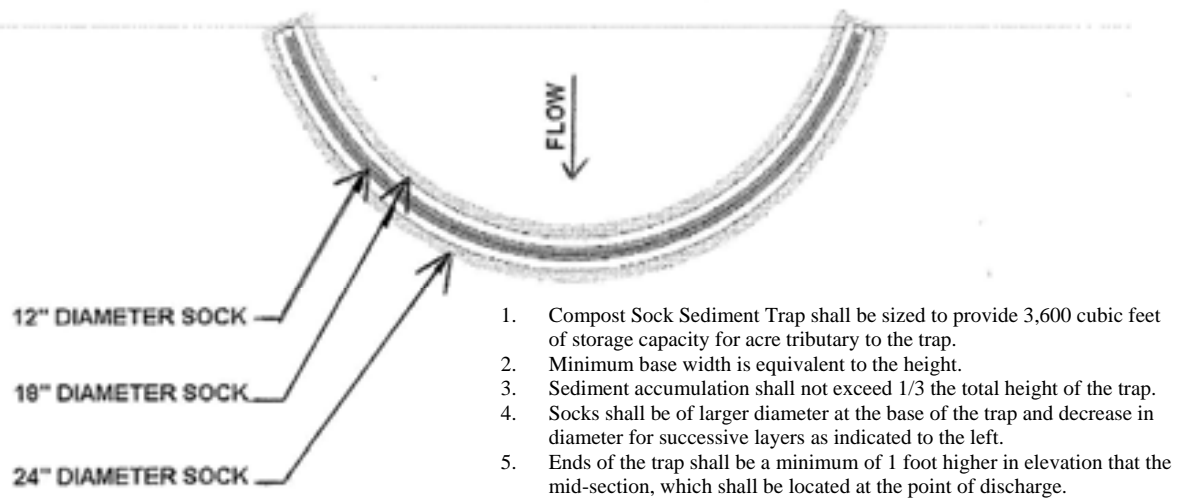
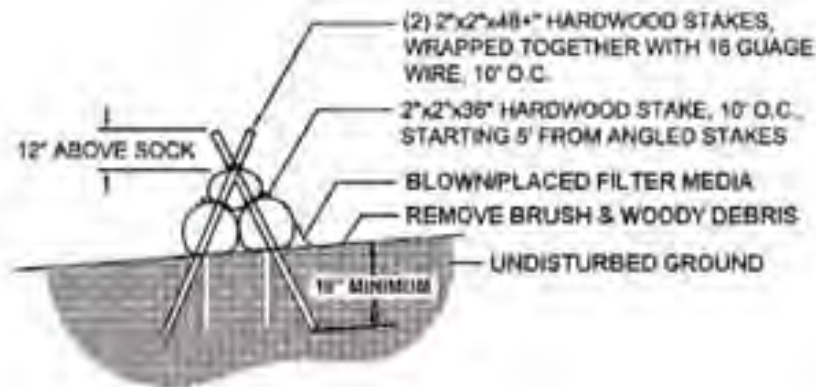


Figure 5.28 Compost Filter Sock Sediment Trap: ST-III

Plan View



Staking Detail

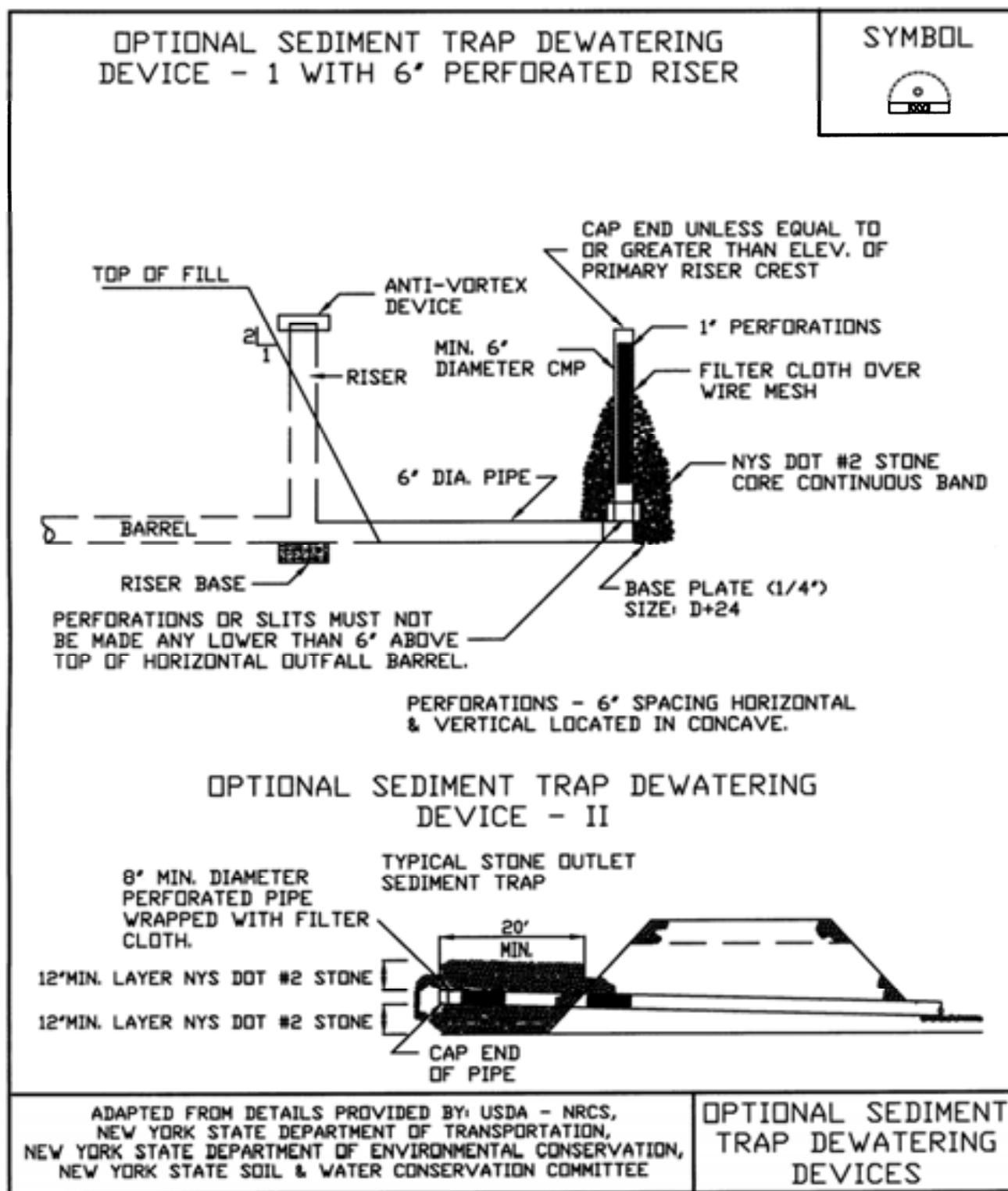


* Figures adapted from Filtrexx

Specifications:

1. Sock infill and filter media material shall meet the standards of Table 5.1 on page 5.8 . Compost shall meet the compost filter sock standard of Table 5.2 on page 5.8.
2. Compost sock sediment traps shall not exceed three socks in height and shall be stacked in pyramidal form as shown above. Minimum trap height is one 24 inch diameter sock. Additional storage may be provided by means of an excavated sump 12 inches deep extending 1 to 3 feet upslope of the socks along the lower side of the trap.
3. Compost sock sediment traps shall provide 3,600 cubic feet storage capacity with 12 inches of freeboard for each tributary drainage acreage. (See manufacturer for anticipated settlement.)
4. The maximum tributary drainage area is 5.0 acres. Since compost socks are "flow-through," no spillway is required.
5. Compost sock sediment traps shall be inspected weekly and after each runoff event. Sediment shall be removed when it reaches 1/3 the height of the socks.
6. Photodegradable and biodegradable socks shall not be used for more than 1 year.

Figure 5.29
Optional Sediment Trap Dewatering Devices
for Traps with <5 Acres Drainage Area



STANDARD AND SPECIFICATIONS FOR SILT FENCE



Definition & Scope

A **temporary** barrier of geotextile fabric installed on the contours across a slope used to intercept sediment laden runoff from small drainage areas of disturbed soil by temporarily ponding the sediment laden runoff allowing settling to occur. The maximum period of use is limited by the ultraviolet stability of the fabric (approximately one year).

Conditions Where Practice Applies

A silt fence may be used subject to the following conditions:

1. Maximum allowable slope length and fence length will not exceed the limits shown in the Design Criteria for the specific type of silt fence used ; and
2. Maximum ponding depth of 1.5 feet behind the fence; and
3. Erosion would occur in the form of sheet erosion; and
4. There is no concentration of water flowing to the barrier; and
5. Soil conditions allow for proper keying of fabric, or other anchorage, to prevent blowouts.

Design Criteria

1. Design computations are not required for installations of 1 month or less. Longer installation periods should be designed for expected runoff.
2. All silt fences shall be placed as close to the disturbed area as possible, but at least 10 feet from the toe of a slope steeper than 3H:1V, to allow for maintenance and

roll down. The area beyond the fence must be undisturbed or stabilized.

3. The type of silt fence specified for each location on the plan shall not exceed the maximum slope length and maximum fence length requirements shown in the following table:

		Slope Length/Fence Length (ft.)		
Slope	Steepness	Standard	Reinforced	Super
<2%	< 50:1	300/1500	N/A	N/A
2-10%	50:1 to 10:1	125/1000	250/2000	300/2500
10-20%	10:1 to 5:1	100/750	150/1000	200/1000
20-33%	5:1 to 3:1	60/500	80/750	100/1000
33-50%	3:1 to 2:1	40/250	70/350	100/500
>50%	> 2:1	20/125	30/175	50/250

Standard Silt Fence (SF) is fabric rolls stapled to wooden stakes driven 16 inches in the ground.

Reinforced Silt Fence (RSF) is fabric placed against welded wire fabric with anchored steel posts driven 16 inches in the ground.

Super Silt Fence (SSF) is fabric placed against chain link fence as support backing with posts driven 3 feet in the ground.

4. Silt fence shall be removed as soon as the disturbed area has achieved final stabilization.

The silt fence shall be installed in accordance with the appropriate details. Where ends of filter cloth come together, they shall be overlapped, folded and stapled to prevent sediment bypass. Butt joints are not acceptable. A detail of the silt fence shall be shown on the plan. See Figure 5.30 on page 5.56 for Reinforced Silt Fence as an example of details to be provided.

Criteria for Silt Fence Materials

1. Silt Fence Fabric: The fabric shall meet the following specifications unless otherwise approved by the appropriate erosion and sediment control plan approval authority. Such approval shall not constitute statewide acceptance.

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	110	ASTM D 4632
Elongation at Failure (%)	20	ASTM D 4632
Mullen Burst Strength (PSI)	300	ASTM D 3786
Puncture Strength (lbs)	60	ASTM D 4833
Minimum Trapezoidal Tear Strength (lbs)	50	ASTM D 4533
Flow Through Rate (gal/min/sf)	25	ASTM D 4491
Equivalent Opening Size	40-80	US Std Sieve ASTM D 4751
Minimum UV Residual (%)	70	ASTM D 4355

Super Silt Fence

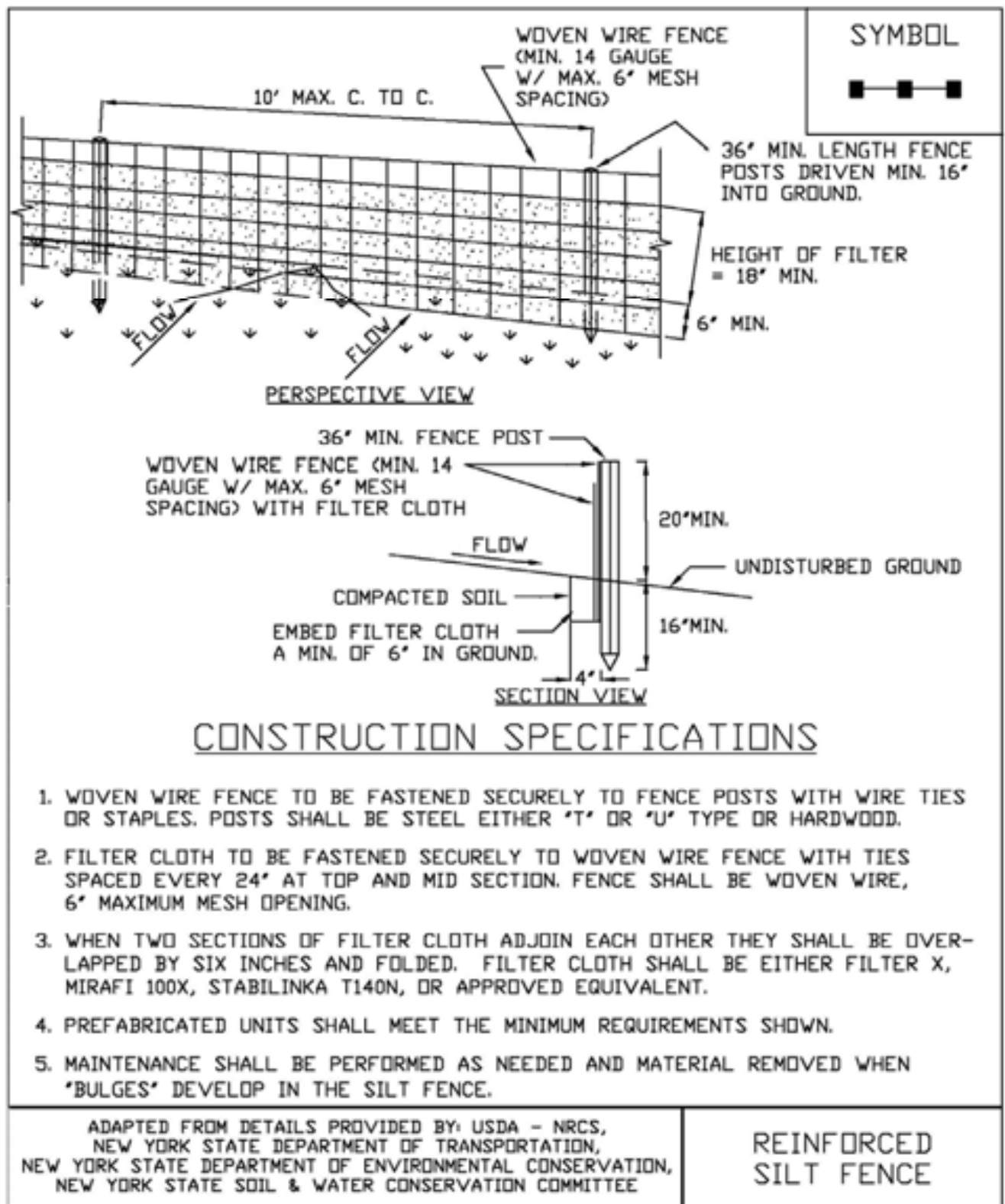


2. Fence Posts (for fabricated units): The length shall be a minimum of 36 inches long. Wood posts will be of sound quality hardwood with a minimum cross sectional area of 3.5 square inches. Steel posts will be standard T and U section weighing not less than 1.00 pound per linear foot. Posts for super silt fence shall be standard chain link fence posts.
3. Wire Fence for reinforced silt fence: Wire fencing shall be a minimum 14 gage with a maximum 6 in. mesh opening, or as approved.
4. Prefabricated silt fence is acceptable as long as all material specifications are met.

Reinforced Silt Fence



**Figure 5.30
Reinforced Silt Fence**



STANDARD AND SPECIFICATIONS FOR STORM DRAIN INLET PROTECTION



Definition & Scope

A **temporary** barrier with low permeability, installed around inlets in the form of a fence, berm or excavation around an opening, detaining water and thereby reducing the sediment content of sediment laden water by settling thus preventing heavily sediment laden water from entering a storm drain system.

Conditions Where Practice Applies

This practice shall be used where the drainage area to an inlet is disturbed, it is not possible to temporarily divert the storm drain outfall into a trapping device, and watertight blocking of inlets is not advisable. **It is not to be used in place of sediment trapping devices.** This practice shall be used with an upstream buffer strip if placed at a storm drain inlet on a paved surface. It may be used in conjunction with storm drain diversion to help prevent siltation of pipes installed with low slope angle.

Types of Storm Drain Inlet Practices

There are five (5) specific types of storm drain inlet protection practices that vary according to their function, location, drainage area, and availability of materials:

- I. Excavated Drop Inlet Protection
- II. Fabric Drop Inlet Protection
- III. Stone & Block Drop Inlet Protection
- IV. Paved Surface Inlet Protection
- V. Manufactured Insert Inlet Protection

Design Criteria

Drainage Area – The drainage area for storm drain inlets shall not exceed one acre. Erosion control/temporary stabilization measures must be implemented on the disturbed

drainage area tributary to the inlet. The crest elevations of these practices shall provide storage and minimize bypass flow.

Type I – Excavated Drop Inlet Protection

This practice is generally used during initial overlot grading after the storm drain trunk line is installed.

Limit the drainage area to the inlet device to 1 acre. Excavated side slopes shall be no steeper than 2:1. The minimum depth shall be 1 foot and the maximum depth 2 feet as measured from the crest of the inlet structure. Shape the excavated basin to fit conditions with the longest dimension oriented toward the longest inflow area to provide maximum trap efficiency. The capacity of the excavated basin should be established to contain 900 cubic feet per acre of disturbed area. Weep holes, protected by fabric and stone, should be provided for draining the temporary pool.

Inspect and clean the excavated basin after every storm. Sediment should be removed when 50 percent of the storage volume is achieved. This material should be incorporated into the site in a stabilized manner.

Type II – Fabric Drop Inlet Protection



This practice is generally used during final elevation grading phases after the storm drain system is completed.

Limit the drainage area to 1 acre per inlet device. Land area slope immediately surrounding this device should not exceed 1 percent. The maximum height of the fabric above the inlet crest shall not exceed 1.5 feet unless reinforced.

The top of the barrier should be maintained to allow overflow to drop into the drop inlet and not bypass the inlet to

unprotected lower areas. Support stakes for fabric shall be a minimum of 3 feet long, spaced a maximum 3 feet apart. They should be driven close to the inlet so any overflow drops into the inlet and not on the unprotected soil. Improved performance and sediment storage volume can be obtained by excavating the area.

Inspect the fabric barrier after each rain event and make repairs as needed. Remove sediment from the pool area as necessary with care not to undercut or damage the filter fabric. Upon stabilization of the drainage area, remove all materials and unstable sediment and dispose of properly. Bring the adjacent area of the drop inlet to grade, smooth and compact and stabilize in the appropriate manner to the site.

Type III – Stone and Block Drop Inlet Protection

This practice is generally used during the initial and intermediate overlot grading of a construction site.

Limit the drainage area to 1 acre at the drop inlet. The stone barrier should have a minimum height of 1 foot and a maximum height of 2 feet. Do not use mortar. The height should be limited to prevent excess ponding and bypass flow.

Recess the first course of blocks at least 2 inches below the crest opening of the storm drain for lateral support. Subsequent courses can be supported laterally if needed by placing a 2x4 inch wood stud through the block openings perpendicular to the course. The bottom row should have a few blocks oriented so flow can drain through the block to dewater the basin area.

The stone should be placed just below the top of the blocks on slopes of 2:1 or flatter. Place hardware cloth of wire mesh with ½ inch openings over all block openings to hold stone in place.

As an optional design, the concrete blocks may be omitted and the entire structure constructed of stone, ringing the outlet (“doughnut”). The stone should be kept at a 3:1 slope toward the inlet to keep it from being washed into the inlet. A level area 1 foot wide and four inches below the crest will further prevent wash. Stone on the slope toward the inlet should be at least 3 inches in size for stability and 1 inch or smaller away from the inlet to control flow rate. The elevation of the top of the stone crest must be maintained 6 inches lower than the ground elevation down slope from the inlet to ensure that all storm flows pass over the stone into the storm drain and not past the structure. Temporary diking should be used as necessary to prevent bypass flow.

The barrier should be inspected after each rain event and repairs made where needed. Remove sediment as necessary to provide for accurate storage volume for subsequent rains. Upon stabilization of contributing drainage area, remove all

materials and any unstable soil and dispose of properly.

Bring the disturbed area to proper grade, smooth, compact and stabilize in a manner appropriate to the site.

Type IV – Paved Surface Inlet Protection



This practice is generally used after pavement construction has been done while final grading and soil stabilization is occurring. These practices should be used with upstream buffer strips in linear construction applications, and with temporary surface stabilization for overlot areas, to reduce the sediment load at the practice. This practice includes sand bags, compost filter socks, geo-tubes filled with ballast, and manufactured surface barriers. Pea gravel can also be used in conjunction with these practices to improve performance. When the inlet is not at a low point, and is offset from the pavement or gutter line, protection should be selected and installed so that flows are not diverted around the inlet.



The drainage area should be limited to 1 acre at the drain inlet. All practices will be placed at the inlet perimeter or beyond to maximize the flow capacity of the inlet. Practices shall be weighted, braced, tied, or otherwise anchored to prevent movement or shifting of location on paved surfaces. Traffic safety shall be integrated with the use of this practice. All practices should be marked with traffic safety cones as appropriate. Structure height shall not cause flooding or by-pass flow that would cause additional erosion.

The structure should be inspected after every storm event. Any sediment should be removed and disposed of on the site. Any broken or damaged components should be replaced. Check all materials for proper anchorage and secure as necessary.

Type V - Manufactured Insert Inlet Protection



The drainage area shall be limited to 1 acre at the drain inlet. All inserts will be installed and anchored in accordance with the manufacturers recommendations and design details. The fabric portion of the structure will equal or exceed the performance standard for the silt fence fabric. The inserts will be installed to preserve a minimum of 50 percent of the open, unobstructed design flow area of the storm drain inlet opening to maintain capacity for storm events.

Figure 5.31
Excavated Drop Inlet Protection

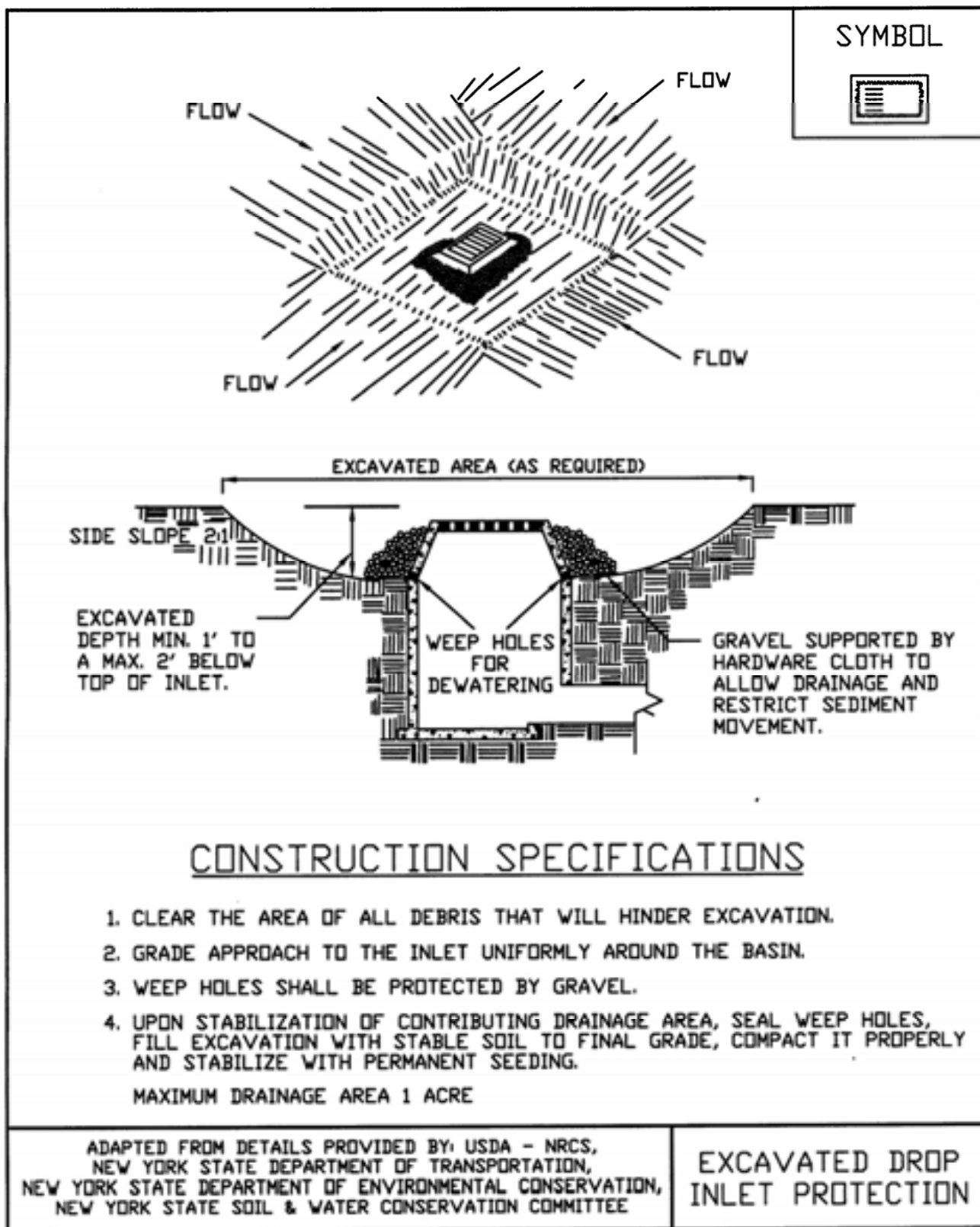


Figure 5.32
Fabric Drop Inlet Protection

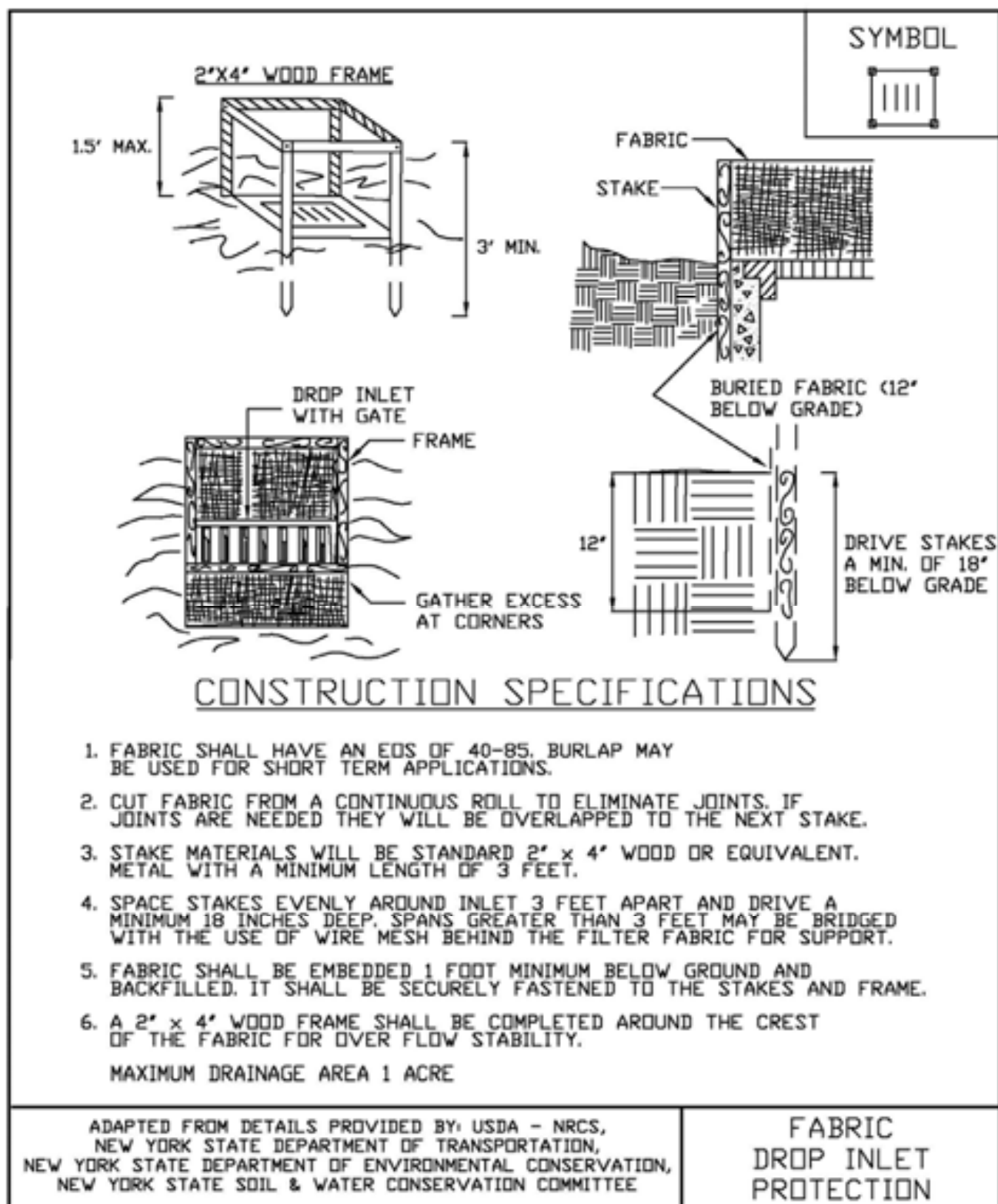
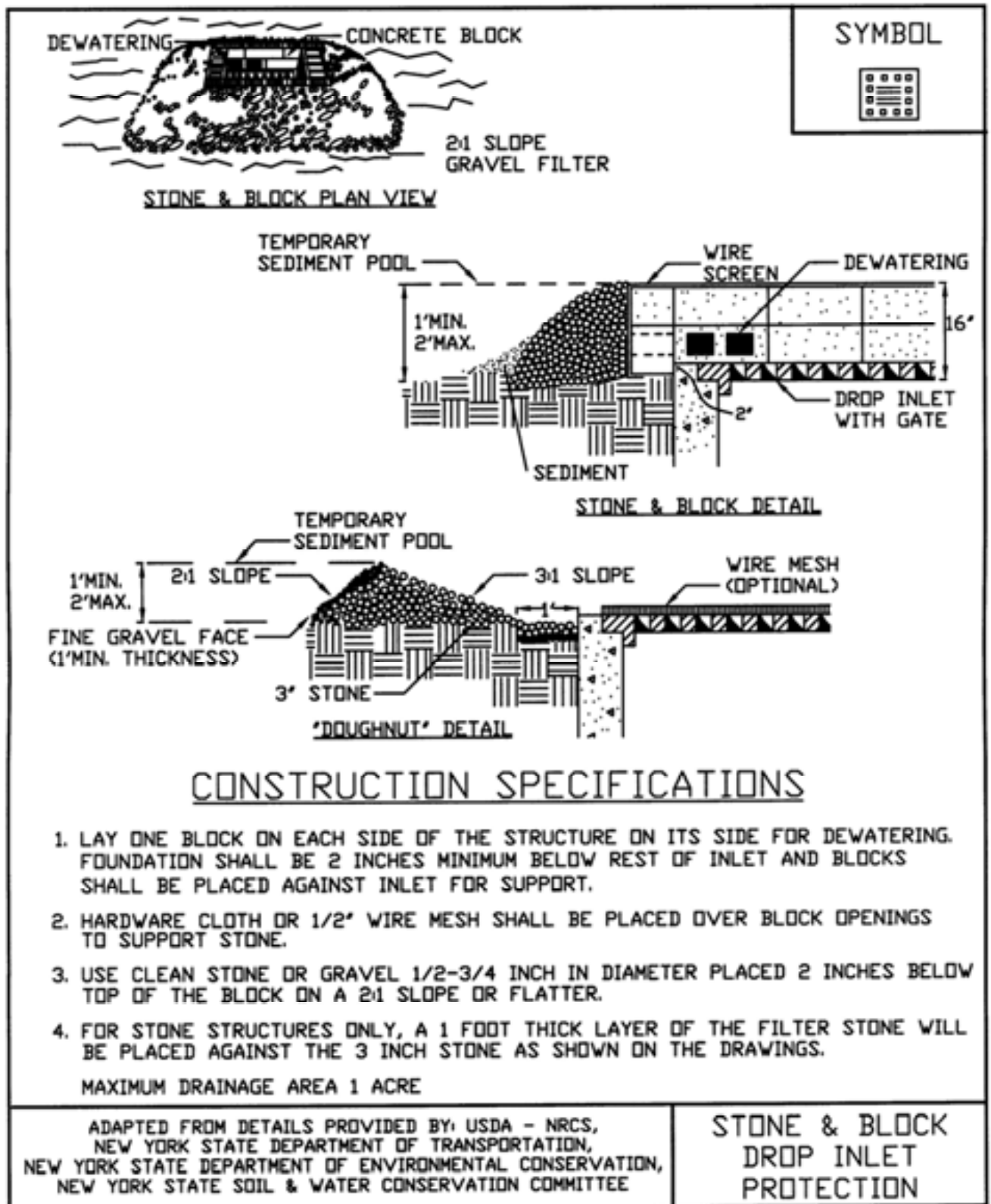


Figure 5.33
Stone & Block Drop Inlet Protection



STANDARD AND SPECIFICATIONS FOR STRAW BALE DIKE



quarter of an acre per 100 feet of dike and the length of slope above the dike shall be less than 100 feet.

Design Criteria

The above table is adequate, in general, for a one-inch rain-fall event. Larger storms could cause failure of this practice. Use of this practice in sensitive areas for longer than one month should be specifically designed to store expected runoff. All bales shall be placed on the contour with cut edge of bale adhering to the ground. See Figure 5.34 on page 5.64 for details.

Definition & Scope

A **temporary** barrier of straw, or similar material, used to intercept sediment laden runoff from small drainage areas of disturbed soil to reduce runoff velocity and effect deposition of the transported sediment load. Straw bale dikes have an estimated design life of three (3) months.

Condition Where Practice Applies

The straw bale dike is used where:

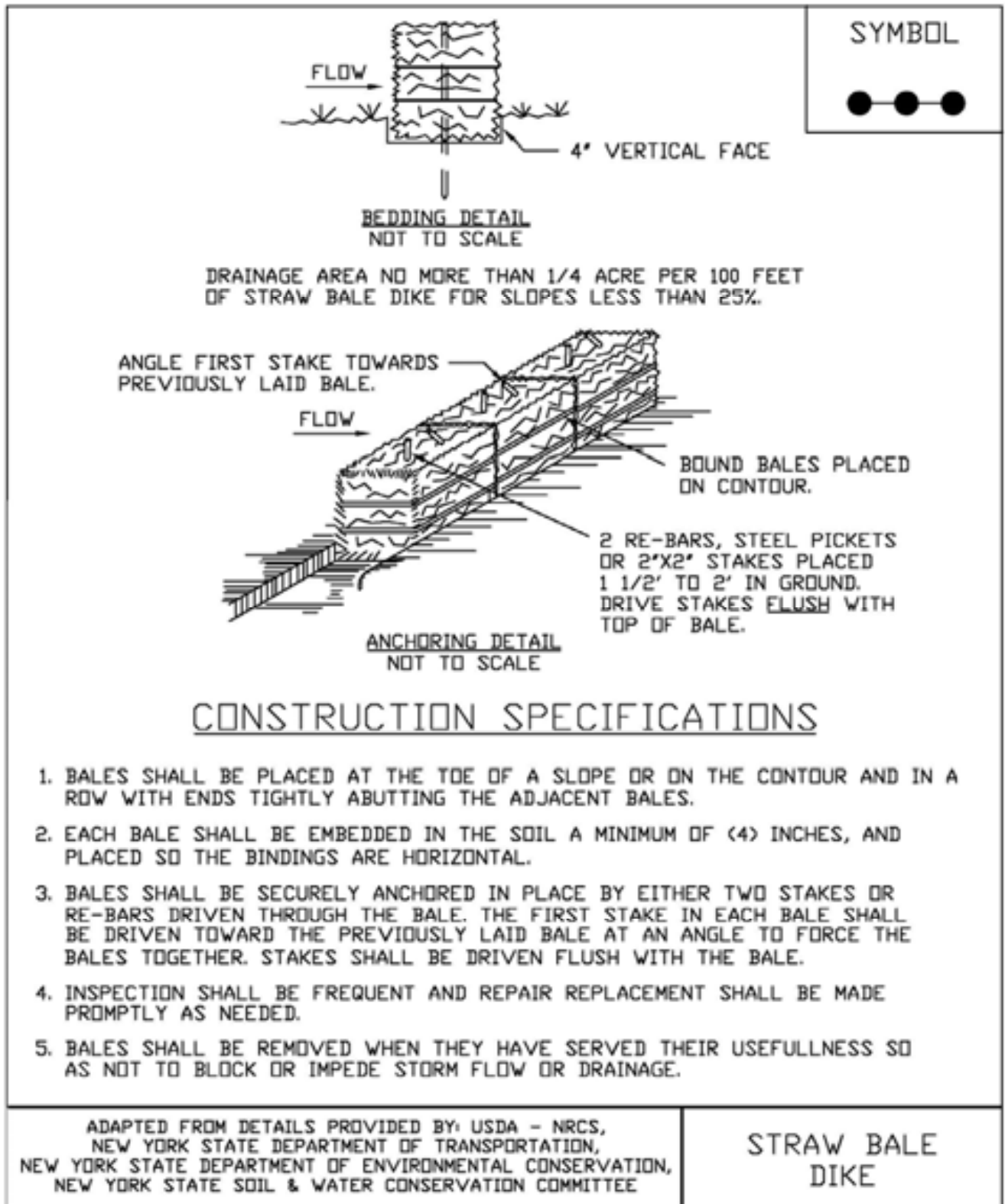
1. No other practice is feasible.
2. There is no concentration of water in a channel or other drainageway above the barrier.
3. Erosion would occur in the form of sheet erosion.
4. Length of slope above the straw bale dike does not exceed the following limits with the bale placed 10 feet from the toe of the slope:

Constructed Slope	Percent Slope	Slope Length (ft.)
2:1	50	25
3:1	33	50
4:1	25	75

Where slope gradient changes through the drainage area, steepness refers to the steepest slope section contributing to the straw bale dike.

The practice may also be used for a single family lot if the slope is less than 15 percent. The contributing drainage areas in this instance shall be less than one

Figure 5.34
Straw Bale Dike



STANDARD AND SPECIFICATIONS FOR TURBIDITY CURTAIN



Definition & Scope

A **temporary** flexible, impenetrable barrier used to trap sediment in water bodies. This curtain is weighted at the bottom to achieve closure while supported at the top through a flotation system and used to prevent the migration of silt from a work site in a water environment into the larger body of water. Top bar float has to support weight of curtain material. Bottom anchor has to be flexible so that it will lie along the contour of the water body bottom.

Condition Where Practice Applies

A turbidity curtain is generally used when construction activity occurs within a waterbody or along its shoreline and is of short duration, generally less than one month. Curtains are used in calm water surfaces and not in areas of flowing water. **Turbidity curtains are not to be used across flowing watercourses.**

Design Criteria

The turbidity curtain shall be located beyond the lateral limits of the construction site and firmly anchored in place. The alignment should be set as close to the work area as possible but not so close as to be disturbed by applicable construction equipment. The height of the curtain shall be 20 percent greater than the depth of the water to allow for water level fluctuations. The area that the turbidity curtain protects shall not contain large culverts or drainage areas that if flows occur behind the curtain would cause a breach or lost contact at the bottom surface.

If water depths at the design alignment are minimal, the toe can be anchored in place by staking.

See Figure 5.35 on page 5.66.

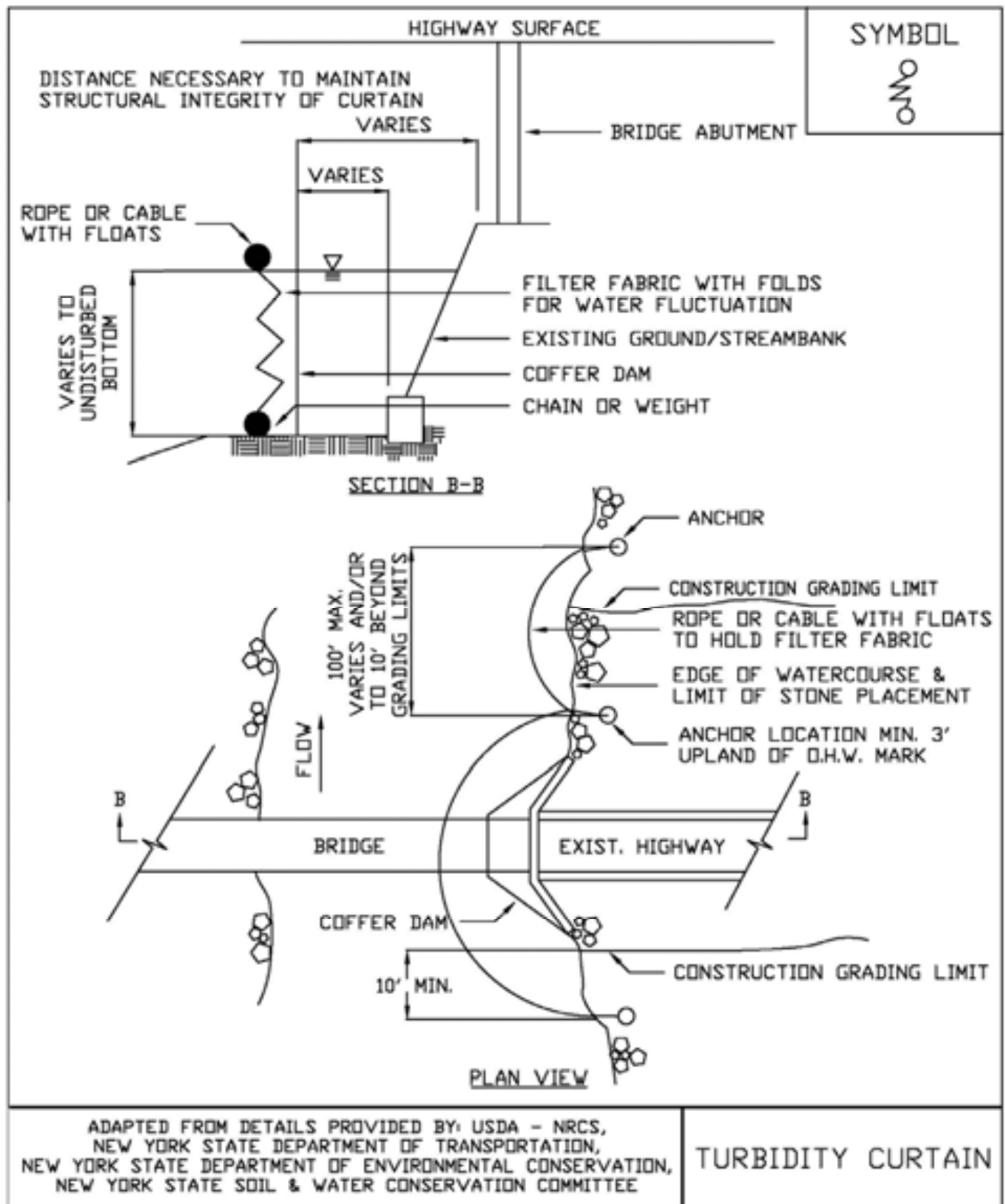
Construction Specifications

The area of proposed installation of the curtain shall be inspected for obstacles and impediments that could damage the curtain or impair its effectiveness to retain sediment. All materials shall be removed so they cannot enter the waterbody. Shallow installations can be made by securing the curtain by staking rather than using a flotation system. Supplemental anchors of the turbidity curtain toe shall be used, as needed, depending on water surface disturbances such as boats and wave action by winds.

Maintenance

The turbidity curtain shall be inspected daily and repaired or replaced immediately. It is not normally necessary to remove sediment deposited behind the curtain; but, when necessary, removal is usually done by hand prior to removal of the barrier. All removed silt is stabilized away from the waterbody. The barrier shall be removed by carefully pulling it toward the construction site to minimize the release of attached sediment. Any floating construction or natural debris shall be immediately removed to prevent damage to the curtain. If the curtain is oriented in a manner that faces the prevailing winds, frequent checks of the anchorage shall be made.

Figure 5.35
Turbidity Curtain



<div>APPENDIX A REVISED UNIVERSAL SOIL LOSS EQUATION (RUSLE)</div>
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REVISED UNIVERSAL SOIL LOSS EQUATION (RUSLE)

Introduction

The science of predicting soil erosion and sediment delivery has continued to be refined to reflect the importance of different factors on soil erosion and runoff. The Revised Universal Soil Loss Equation (RUSLE) has improved the effects of soil roughness and the effects of local weather on the prediction of soil loss and sediment delivery.

The importance of estimating erosion and sediment delivery has long been recognized to minimize pollution by sediments and the chemicals carried by soil particles. The visual effects of erosion include rills and gullies along with sediment blockages found in culverts or drainage ditches. A well planned, engineered and implemented erosion control and/or water management plan will alleviate many concerns about construction site erosion and potential pollution.

Why use RUSLE?

RUSLE is a science-based tool that has been improved over the last several years. RUSLE is a computation method which may be used for site evaluation and planning purposes and to aid in the decision process of selecting erosion control measures. It provides an estimate of the severity of erosion. It will also provide quantifiable results to substantiate the benefits of planned erosion control measures, such as the advantage of adding a diversion ditch or mulch. For example, a diversion may shorten the length of slope used in calculating a LS factor. Also, the application of mulch will break raindrop impact and reduce runoff (See discussion of L, S and C factors).

This section provides a method to calculate soil loss. Following the step-by-step procedure will provide estimated erosion in 'tons per acre per year', which can be converted to the more usable measurement, cubic yards of soil.

Other erosion prediction methods such as computer models are also available. Examples are the USDA-NRCS RUSLE 2 at http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm and USDA-ARS Water Erosion Prediction Project (WEPP) at <http://www.ars.usda.gov/News/docs.htm?docid=10621>.

Soil Erosion Estimates Using Revised Universal Soil Loss Equation For Sheet and Rill Erosion

As mentioned above, soil losses on construction sites can be predicted by using the Revised Universal Soil Loss Equation (RUSLE). The equation is as follows:
 $A = RK(LS)$ for bare ground conditions of graded areas of construction sites. Referring to the examples above, the

benefit of mulch can be predicted by multiplying the above by an appropriate cover or C-value. The benefit of a diversion ditch can be illustrated by comparing the original LS with the shorter slope length LS created when adding this practice.

Equation: $A = RK(LS)C$ Where:

A is the computed soil loss per acre per year in units of tons. This quantity may be converted to cubic yards by using conversion factors shown in Table A.3.

R is the rainfall value reflecting the energy factor multiplied by the intensity factor. The R-values for each county are provided in Figure A.3. EI is the abbreviation for energy and intensity and is called the Erosion Index. The energy component is related to the size of the raindrops while the intensity is the maximum intensity for a 30-minute interval and is measured in inches per hour. EI is frequently illustrated in graphs by showing the percent of EI that occurs within a period of days or months. From the index, one can determine the period when the most intense storms are likely to occur. See Figure A.1 and A.2.

K is the soil erodibility factor. The value for the subsoil condition, usually encountered in construction sites, can be determined based on soil texture (relative percent of sand, silt, and clay) or from most county soil surveys, found in the table providing Physical and Chemical Properties of Soils. However, K values for subsoils are not always available. If the soil survey does not list a subsoil K for the soil series encountered, use the surface K value unless there is an obvious change from sand or gravel to silt or clay. Contact the local SWCD or NRCS office for an appropriate K value when in question. Approximated K values for some representative soils on construction sites in NY can be found in Table A.1. The most current K values for all New York soils are contained in the USDA-NRCS soil database on their website at: <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.

L is the horizontal length of slope measured in feet. It is the point of origin where water will begin flowing down the slope to the point where concentrated flow begins, such as where water flows into a ditch, or deposition occurs and water disperses. S is the slope gradient. Slopes may be uniform, concave (flattening toward the lower end) or convex (steepening toward the lower end). Table A.2 assumes a uniform slope. If the slope is concave, the LS factor will be slightly lower. If convex, then the LS will be slightly higher. These factors are interrelated and the LS factor can be obtained from Table A.2. This LS table is specific for construction sites with little or no cover.

C is the factor to reflect the planned cover over the soil surface. Most construction sites are void of vegetation and

therefore would have a value of one (1). On construction sites where mulch or fabrics are used, the benefit derived from intercepting the erosive raindrop impact on the soil surface is calculated. For example, the value of two tons of straw uniformly covering a slope results in a C-value of 0.1. (see Tables A.5-A.7 at back of this section) Therefore, mulching can substantially reduce the predicted soil loss.

P is the factor that represents management operations and support practices on a construction site. Table A.8 lists P factors for surface conditions on construction sites in relation to bare soils.

Step-by-Step, How to Use RUSLE

1. Determine the County. Use Figure A.3 to determine the R-value.
2. Determine the soil erodibility factor based on the soil series or the texture. Determine the appropriate K-value for subsoil by using the estimated K values shown in Table A.1. Updated K values can be found using web soil survey or by contacting your local NRCS office.
3. Measure the horizontal length (plan view) of slope (in feet) from the top of the slope to the bottom. The bottom is either a ditch bank (concentration of water) or flatter slope where deposition occurs and water disperses (actual field measurement).
4. Determine the percent slope (actual topographic measurement).
5. Look up LS value in Table A.2. Interpolate if necessary to use the measured length and percent slope obtained by field measurement.
6. Determine the Cover (C) factor—Most construction sites are void of vegetation and therefore would have a value of one (1). For values of other cover conditions contact your local SWCD or NRCS office.
7. Multiply the $R \times K \times (LS)$ to obtain soil loss in tons/acre/year.
8. Convert to cubic yards if desired. Refer to the conversion factors based on soil texture (Table A.3).
9. Review the examples that follow for specific field conditions where RUSLE may be useful.

Examples

The following are examples showing how the Revised Universal Soil Loss Equation is used for estimating soil losses:

Assume Cortland, New York, as the locale of a construction site. The disturbed site is 50 acres in size, with an average gradient of 8% and an average slope length of 500 feet.

The soil is a Schoharie silt loam with a K value of 0.49 in both the B and C horizons (The K value is obtained from Table A.1). The LS value is 3.11 and is obtained from Table A.2.

1. Compute soil losses from this unprotected surface for a 12 month period. The average annual rainfall erosion index (R) is 80.

$$R = 80 \quad C = 1$$

$$K = 0.49$$

$$LS = 3.11 \text{ (Interpolate between 400' and 600' at 8\%)}$$

$$A = RK(LS)C = 122 \text{ T/ac/yr}$$

$$50 \text{ ac} \times 122 \text{ Tons/ac/yr} = 6100 \text{ Tons/yr}$$

$$\text{Convert to cu yds: } 6100 \text{ T/yr} \times 0.87 \text{ cu yds/Y} = 5307 \text{ cu yds/yr}$$

(0.87 cu yds/T is obtained from Table A.3, silt loam)

2. Compute soil losses from this unprotected surface for a 3 month period (June, July, August). This EI value is obtained as follows: Refer to the erosion index distribution curve applicable to Cortland, New York, Figure A.1. The EI reading for June 1 is 17% and for September 1 is 76%. The percent of average annual index for this period is 76% - 17% or 59%. Since the annual erosion index for this location is 80, the EI value for the 3 month period is 59% of 80 or 47.2.

$$R = 80$$

$$C = 1$$

$$K = 0.49$$

$$LS = 3.11$$

$$\text{Annual EI (R)} = 80$$

$$3 \text{ month EI} = 47.2$$

$$A = (EI)K(LS)C = 72 \text{ Tons/ac/3 mo.}$$

$$50 \text{ ac} \times 72 \text{ Tons/ac/3 mo.} = 3600 \text{ Tons/3 mo.}$$

$$\text{Convert to cu yds: } 0.87 \text{ cu yds/Tons} \times 3600 \text{ Tons/3 mo.} = 3132 \text{ cu yds/3 mo}$$

3. Compute soil losses for the 1 year out of 5 when the rainfall intensity (R) will increase from the normal average annual value of 80 to an annual value of 129 (the latter value is from Table A.4).

$$R = 129 \text{ (Change R from 80 to 129)} \quad K = 0.49$$

$$LS = 3.11$$

$$C = 1$$

$$A = RK(LS)C$$

$$A = 129 \times 0.49 \times 3.11 = 197 \text{ Tons/ac/yr}$$

$$50 \text{ ac} \times 197 \text{ Tons/ac/yr} = 9850 \text{ Tons/yr}$$

$$\text{Convert to cu yds} = 0.87 \text{ cu yds/Tons} \times 9850 \text{ Tons/yr} = 8570 \text{ cu yds/yr}$$

Examples (continued)

4. Compute soil losses for the 1 year out of 20 when the rainfall intensity (R) will increase from the average annual R of 80 to an R of 197 (the latter value is from Table A.4).

R = 197 (Change R from 80 to 197)

K = 0.49

LS = 3.11 C = 1

$$A = RK(LS)C = 300 \text{ Tons/ac/yr}$$

$$50 \text{ ac} \times 300 \text{ Tons/ac/yr} = 15,000 \text{ Tons/yr}$$

$$\text{Convert to cu yds} = 0.87 \text{ cu yds/Tons} \times 15,000 \text{ Tons/yr} = 13,050 \text{ cu yds/yr}$$

5. Compute soil losses from the expected magnitude of a single storm that may occur once in 5 years. Looking at Table A.4, the expected magnitude, or EI value, is 38.

EI (R) = 38 C = 1

K = 0.49

LS = 3.11

$$A = (EI)K(LS)C = 38 \times 0.49 \times 3.11 = 58 \text{ Tons/ac/yr}$$

$$50 \text{ ac} \times 58 \text{ Tons/ac/yr} = 2900 \text{ Tons/yr}$$

$$\text{Convert to cu yds} = 0.87 \text{ cu yds/Tons} \times 1650 \text{ Tons/yr} = 2523 \text{ cu yds/yr}$$

6. Compute soil losses from the expected magnitude of a single storm that may occur once in 10 years. The EI value of this storm is 51. (Obtained from Table A.4.)

EI (R) = 51 C = 1

K = 0.49

LS = 3.11

$$A = (EI)K(LS)C = 78 \text{ Tons/ac/yr}$$

$$50 \text{ ac} \times 78 \text{ Tons/ac/yr} = 3900 \text{ Tons/yr}$$

$$\text{Convert to cu yds} = 0.87 \text{ cu yds/Tons} \times 3900 \text{ Tons/yr} = 3393 \text{ cu yds/yr}$$

7. Compute soil losses from the expected magnitude of a single storm that may occur once in 20 years. The EI value of this storm is 65. (Obtained from Table A.4.)

EI (R) = 65 C = 1

K = 0.49

LS = 3.11

$$A = (EI)K(LS)C = 99 \text{ Tons/ac/yr}$$

$$50 \text{ ac} \times 99 \text{ Tons/ac/yr} = 4950 \text{ Tons/yr}$$

$$\text{Convert to cu yds} = 0.87 \text{ cu yds} \times 4950 \text{ Tons/yr} = 4307 \text{ cu yds/yr}$$

Sediment Yield—MUSLE

The Modified Universal Soil Loss Equation (MUSLE), developed by Williams and Berndt, 1976, can be used to calculate sediment yields from drainage basins to specific locations for selected storm events.

The formula is given as:

$$T = 95(V \times Qp)^{0.56} \times K \times LS \times C \times P$$

Where:

T = sediment yield per storm event in tons

V = volume of runoff per storm event in acre-feet

Qp = peak flow per storm event in cubic feet per second

K, LS, C, and P are MUSLE factors

Values for V and Qp are determined from the sites drainage analysis.

Example

Compute the sediment yield volume to a basin from a drainage area of 10 acres under construction (all disturbed) for a 2 inch rainfall.

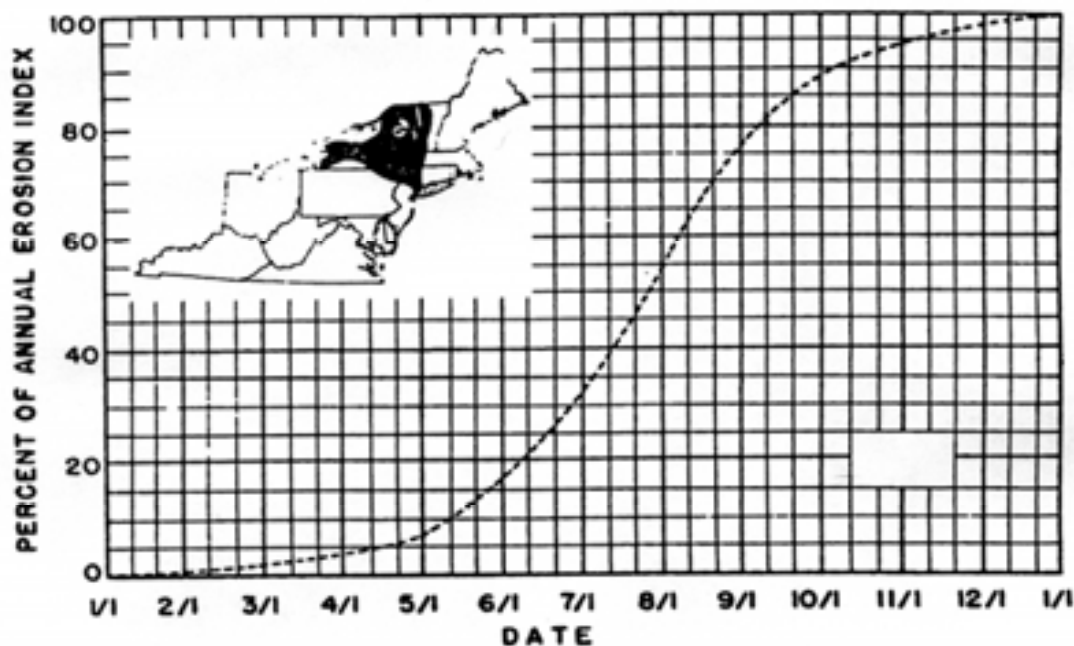
The soil (sandy loam) K = 0.43, LS = 2.34, the volume of runoff is 1.5 acre-feet and the peak discharge for the storm is 5 cubic feet per second.

$$T = 95(1.5 \times 5)^{0.56} (0.43)(2.34)(1)(1)$$

$$T = 295.4 \text{ tons}$$

$$295.4 \text{ tons} \times 0.70 \text{ cy/ton} = 206.99 \text{ cubic yards}$$

Figure A.1 (USDA - NRCS)
Monthly Percent of Annual Erosion Index—New York



New York State except Long Island

Figure A.2 (USDA - NRCS)
Monthly Percent of Annual Erosion Index—Long Island

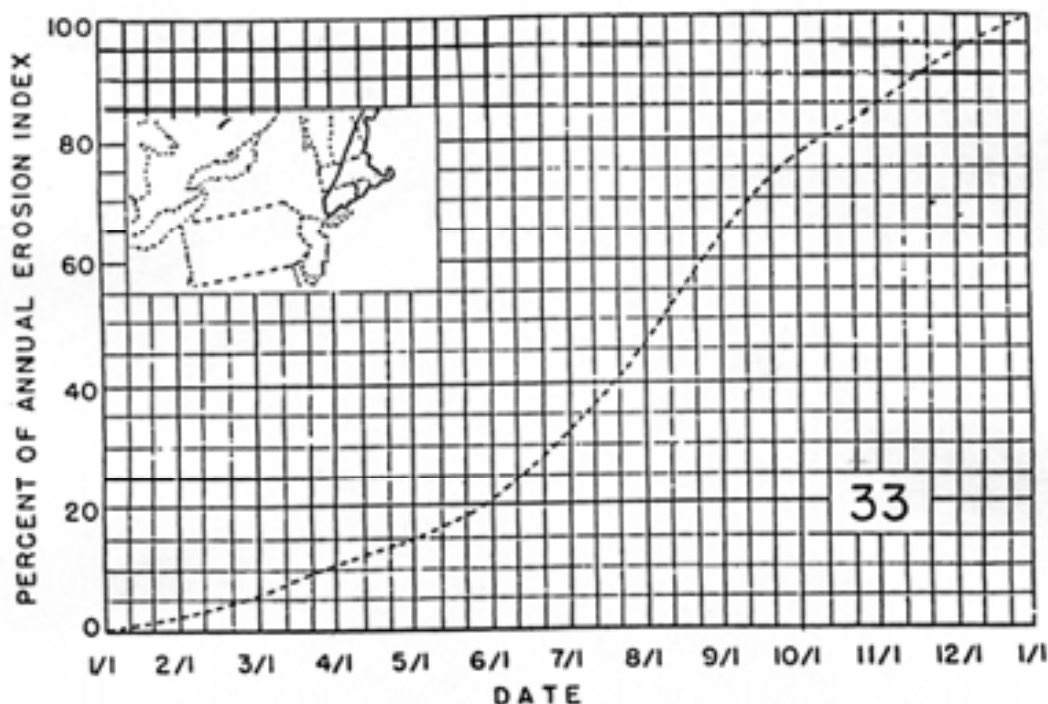


Figure A.3
Average Annual Rainfall - Runoff Erosivity Factor ®
For the Northeast

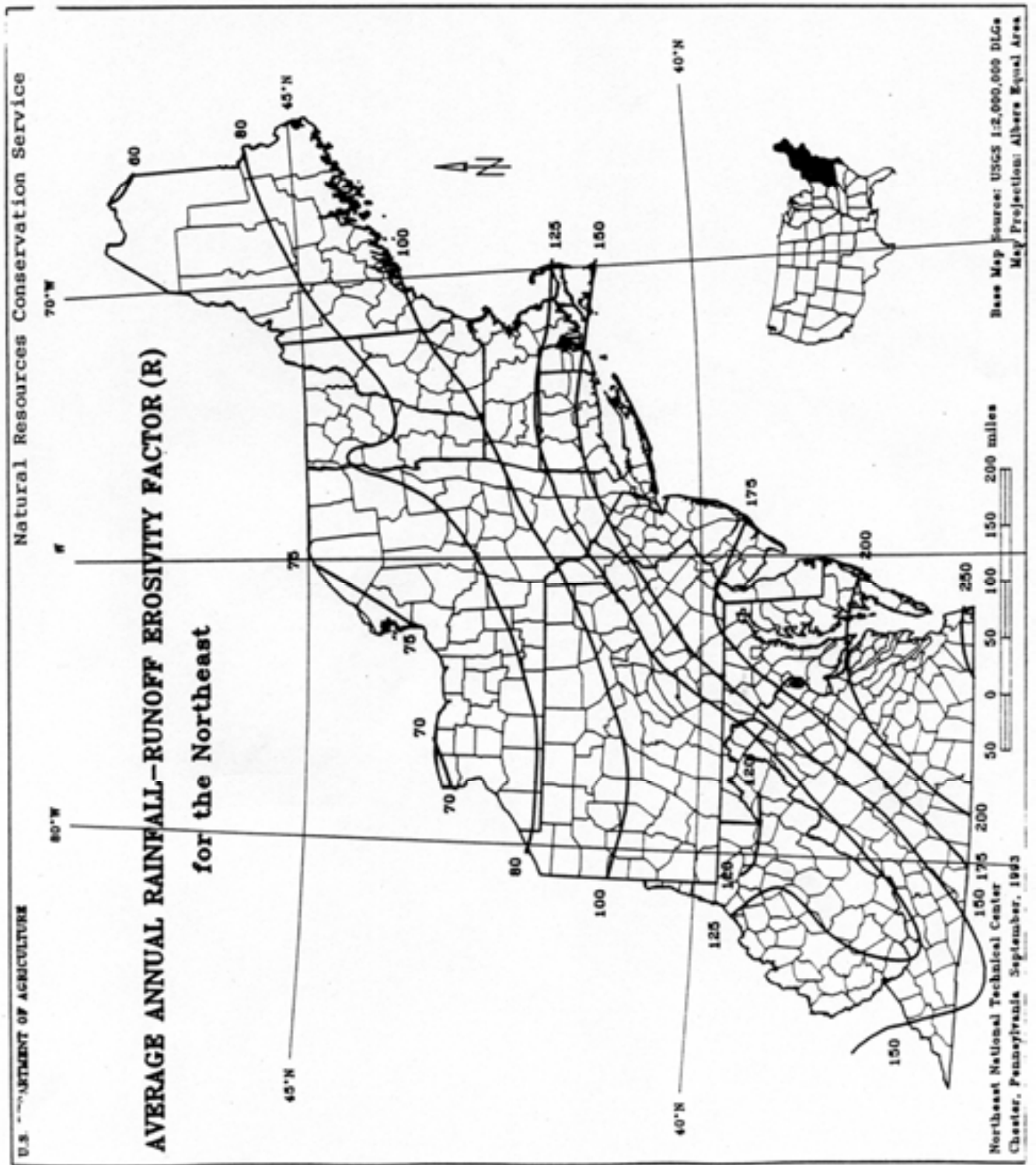


Table A.1
Approximated K Values for Some Representative Soils on
Construction Sites in New York

(These K values and K values for soils not shown in these tables should be verified at the USDA-NRCS website, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.)

Depositional Unit Family Texture Class and Representative Series	Hoizon ¹	Texture ² Class	Erosion Potential	Construction Site K Values
I. Glacial Till				
SANDY SKELETAL				
Glouster	A	sl	Low	.17
	B&C	vglcs	Low	
SANDY w/PAN				
Essex	A	sl	Low	20
	B	glcs	Low	
	Cx	glcs	Low	
COURSE LOAMY w/PAN				
Empeyville	A	stl	Medium	.17
	B	stsl	Medium	
	Bx	vstsl	Low	
	C	vstsl	Low	
Mardin	A	ch sil	Low	.28
	B	ch sil-1	Medium	
	Bx & C	v ch 1	Medium	
Paxton	A	fsl	Medium	.24
	B	gfsl	Medium	
	Cx	gfsl	High	
Crary	A	sil	Medium	.43
	B	vfsl	High	
	IIBx, Cx, C	st fsl	Medium	
COARSE LOAMY w/Bt				
Madrid	A	fsl	Medium	28
	Bt	gfsl	Medium	
	C	gfsl	Medium	
COARSE LOAM, 20 TO 40" over BEDROCK				
Lordstown	A	ch sil	Low	.43
	B	ch sil	High	
	C	v ch 1	Low	
	R		Siltstone or sandstone bedrock 20—40" below surface	

Table A.1 (cont'd)
Approximated K Values for Some Representative Soils on
Construction Sites in New York

(These K values and K values for soils not shown in these tables should be verified
at the USDA-NRCS website, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.)

Depositional Unit Family Texture Class and Representative Series	Hoizon ¹	Texture ² Class	Erosion Potential	Construction Site K Values
FINE LOAMY w/Bt				
Ontario	A	l	Medium	.28
	Bt	gl	Medium	
Cazenovia	C	gl	Medium	.43
	A	sil	High	
	Bt	sicl	High	
	C	gsil	Medium	
Nunda	Ap	ch sil	High	.49
	B2	ch sil	High	
	IIB2t	gcl	Medium	
	IIC	gl	Medium	
FINE				
Hornell	A	sil	Medium	.43
	B	sic	High	
	C	sh sic	Medium	
	R		Shale bedrock 20—40” below surface	
Remsen	A	sicl	High	.43
	Bt	c	Medium	
	C	c	High	
Churchville	A	sil	High	.49
	Bt	sic	Medium	
	IIC	gl	Medium	
COARSE LOAMY, NO PAN				
Charlton	A	fsl	Low	.43
	B	fsl	High	
	C	gfsl	Medium	
Nellis	A	l	Medium	.43
	B	l	High	
	C	gl	Medium	

Table A.1 (cont'd)
Approximated K Values for Some Representative Soils on
Construction Sites in New York

(These K values and K values for soils not shown in these tables should be verified
at the USDA-NRCS website, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.)

Depositional Unit Family Texture Class and Representative Series	Hoizon ¹	Texture ² Class	Erosion Potential	Construction Site K Values
COARSE LOAMY, NO PAN (Cont'd)				
Pittsfield	A	l	Medium	.43
	B	gfsl	Low	
	C	gfsl	High	
COARSE LOAMY/SAND or SANDY SKELETAL				
Canton	A	fsl	Medium	.64
	B	fsl	Very High	
	IIC	vgl	Low	
COARSE SILTY w/PAN				
Canaseraga	A	sil	High	.49
	B	sil	Very High	
	IIBx & C	ch	High	
LOAMY SKELETAL				
Manlius	A	ch sil	Medium	.28
	B	vsh sil	Low	
	C	fract'd shales w/ silty fines	Low	
	R		Shale bedrock 20-40" below surface	
FINE LOAMY w/PAN				
Volusia	A	ch sil	Low	.43
	Bx	ch sil	High	
	C	vch l	Medium	
FINE LOAMY, NO PAN				
Kendaia	A	sil	Medium	.28
	B	gsil	Medium	
	C	gl	Medium	

Table A.1 (cont'd)
Approximated K Values for Some Representative Soils on
Construction Sites in New York

(These K values and K values for soils not shown in these tables should be verified
at the USDA-NRCS website, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.)

Depositional Unit Family Texture Class and Representative Series	Hoizon ¹	Texture ² Class	Erosion Potential	Construction Site K Values
II. Glacial Outwash and Water Worked Morainic Deposits				
SANDY SKELETAL				
Hinckley	A	gls	Low	.17
	B	gls	Low	
	C	gls	Low	
SANDY				
Colonie	A	lfs	Medium	.24
	B	fs	Low	
	C	fs	Low	
LOAMY SKELETAL				
Chenango	A	gl	Low	.24
	B	vgl	Low	
	C	gls	Low	
FINE LOAMY/SANDY or SANDY SKELETAL				
Palmyra	A	gl	Medium	.28
	B	gl	Low	
	IIC	g & s	Low	
LOAMY SKELETAL/CLAYEY				
Varysburg	A	gl	Low	.28
	B2t	vgl	Low	
	IIB2t	sic	Medium	
	IIC	layered sic, sil sicl	High	
COARSE LOAMY				
Riverhead	A	sl	Low	.17
	B	sl	Low	
	C	s w/ thin layers of g	Low	

Table A.1 (cont'd)
Approximated K Values for Some Representative Soils on
Construction Sites in New York

(These K values and K values for soils not shown in these tables should be verified
at the USDA-NRCS website, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.)

Depositional Unit Family Texture Class and Representative Series	Hoizon ¹	Texture ² Class	Erosion Potential	Construction Site K Values
II. Glacial Outwash and Water Worked Morainic Deposits (Cont'd)				
COARSE LOAMY/SANDY or SANDY SKELETAL				
Haven	A	l	High	.43
	B	l	High	
	IIC	gs	Low	
III. Lacustrine or Stream Terrace Deposits				
COARSE SILTY				
Unadilla	A	sil	High	.64
	B	sil	Very High	
	C	sil	Very High	
COARSE SILTY w/FRAGIPAN				
Williamson	A	sil	High	.64
	Bx	sil	Very High	
	C	sil	Very High	
COARSE SILTY/SANDY or SANDY SKELETAL				
Allard	A	sil	High	.64
	B	sil	Very High	
	IIC	vgl's	Low	
FINE SILTY w/Bt				
Collamer	A	sil	High	.64
	Bt	sil	High	
	C	Layers of sl, vfs	Very High	
FINE				
Schoharie	A	sicl	High	.49
	Bt	sic	Medium	
	C	sic	High	

Table A.1 (cont'd)
Approximated K Values for Some Representative Soils on
Construction Sites in New York

(These K values and K values for soils not shown in these tables should be verified
at the USDA-NRCS website, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>.)

Depositional Unit Family Texture Class and Representative Series	Hoizon ¹	Texture ² Class	Erosion Potential	Construction Site K Values
III. Lacustrine or Stream Terrace Deposits (Con't)				
VERY FINE				
Vergennes	A	c	High	.49
	Bt	c	Low	
	C	c	Low	
SANDY o/CLAYEY				
Claverack	A	lfs	Medium	.43
	B	lfs	Low	
	IIC	sic	High	
	R			
COARSE LOAMY o/CLAYEY				
Elmwood	A	fsl	Medium	.43
	B	sl	Low	
	C	sicl	High	
1 The thickest B and C horizons in the official series were used in making the K value determinations.				
2 Soil texture class abbreviations:				
Gravel.....g Very coarse sand.....vcos Coarse sand.....cos Sand.....s Fine sand.....fs Very fine sand.....vfs Loamy coarse sand.....lcos Loamy sand.....ls Loamy fine sand.....lfs Silty clay loam.....sisl	Fine sandy loam.....fsl Very fine sandy loam....vfsl Gravelly sandy loam.....gs Loam.....g Gravelly loam.....gl Stoney loam.....stl Silt.....si Silt loam.....sil Clay loam.....cl		Sandy clay loam.....scl Stoney clay loam.....stcl Silty clay.....sic Clay.....c Channery.....ch Shaly.....sh Very channery.....vch Very shaly.....vsh Sandy loam.....sl	

Table A.2 (USDA - NRCS)
Values for Topographic Factor, LS,
for High Ratio of Rill to Interrill Erosion¹

Slope <3 (%)		Horizontal slope length (ft)																
		6	9	12	15	25	50	75	100	150	200	250	300	400	600	800	1000	
0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
0.5	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	
1.0	0.09	0.09	0.09	0.09	0.09	0.10	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.22	0.24	0.26	0.27	
2.0	0.13	0.13	0.13	0.13	0.16	0.21	0.25	0.28	0.33	0.37	0.40	0.43	0.48	0.56	0.63	0.69		
3.0	0.17	0.17	0.17	0.17	0.21	0.30	0.36	0.41	0.50	0.57	0.64	0.69	0.80	0.96	1.10	1.23		
4.0	0.20	0.20	0.20	0.20	0.26	0.38	0.47	0.55	0.68	0.79	0.89	0.98	1.14	1.42	1.65	1.86		
5.0	0.23	0.23	0.23	0.23	0.31	0.46	0.58	0.68	0.86	1.02	1.16	1.28	1.51	1.91	2.25	2.55		
6.0	0.26	0.26	0.26	0.26	0.36	0.54	0.69	0.82	1.05	1.25	1.43	1.60	1.90	2.43	2.89	3.30		
8.0	0.32	0.32	0.32	0.32	0.45	0.70	0.91	1.10	1.43	1.72	1.99	2.24	2.70	3.52	4.24	4.91		
10.0	0.35	0.37	0.38	0.39	0.40	0.57	0.91	1.20	1.46	1.92	2.34	2.72	3.09	3.75	4.95	6.03	7.02	
12.0	0.36	0.41	0.45	0.47	0.49	0.71	1.15	1.54	1.88	2.51	3.07	3.60	4.09	5.01	6.87	8.17	9.57	
14.0	0.38	0.45	0.51	0.55	0.58	0.85	1.40	1.87	2.31	3.09	3.81	4.48	5.11	6.30	8.45	10.40	12.23	
16.0	0.39	0.49	0.56	0.62	0.67	0.96	1.64	2.21	2.73	3.68	4.56	5.37	6.15	7.60	10.26	12.69	14.96	
20.0	0.41	0.56	0.67	0.76	0.84	1.24	2.10	2.86	3.57	4.85	6.04	7.16	8.23	10.24	13.94	17.35	20.57	
25.0	0.45	0.64	0.80	0.93	1.04	1.56	2.67	3.67	4.59	6.30	7.88	9.38	10.81	13.53	18.57	23.24	27.66	
30.0	0.48	0.72	0.91	1.08	1.24	1.86	3.22	4.44	5.58	7.70	9.67	11.55	13.35	16.77	23.14	29.07	34.71	
40.0	0.53	0.85	1.13	1.37	1.59	2.41	4.24	5.89	7.44	10.35	13.07	15.67	18.17	22.95	31.89	40.29	48.29	
50.0	0.58	0.97	1.31	1.62	1.91	2.91	5.16	7.20	9.13	12.75	16.16	19.42	22.57	28.60	39.95	50.63	60.84	
60.0	0.63	1.07	1.47	1.84	2.19	3.36	5.97	8.37	10.63	14.89	18.92	22.78	26.51	33.67	47.18	59.93	72.15	

¹Such as for freshly prepared construction and other highly disturbed soil conditions with little or no cover (not applicable to thawing soil)

Table A.3 (USDA - NRCS)

Factors for Converting Soil Losses (Air-Dry) from Tons (T) to Cubic Yards (Cu. Yds.)

Sands, loamy sands)
Sandy loam) - Multiply soil losses in T by 0.70 (105) ¹
Fine sandy loam)
Loams, sandy clay loams)
Sandy clay) - Multiply soil losses in T by 0.87 (85)
Silt loam)
Silty clay loam, silty clay)
Clay loam) - Multiply soil losses in T by 1.06 (70)
Clay)

¹The number in parentheses is the air-dry weight of the soil in pounds per cubic foot. The conversion factors were calculated from these air-dry weights using: soil loss (tons) x (2000 lbs/ton) x (ft³/dry density lbs) x (cubic yard/27ft³).

Table A.4
EI Values of Certain Key Cities in the New York Area¹

<u>Location²</u>	EI Values at 20% and 5% Probability Levels Probability (EI)		Expected Magnitude of a Single Storm EI Value Normally Exceeded Once in—		
	<u>20%*</u>	<u>5%**</u>	<u>5 Years</u>	<u>10 Years</u>	<u>20 Years</u>
New York					
Albany	114	159	38	47	56
Binghamton	106	146	36	47	58
Buffalo	96	139	36	49	61
Geneva	106	152	—	—	—
Marcellus	112	167	38	49	62
Rochester	101	151	38	54	75
Salamanca	106	157	32	40	49
Syracuse	129	197	38	51	65
Pennsylvania					
Erie	181	331	—	—	—
Scranton	140	188	44	53	63
Vermont					
Burlington	114	178	35	47	58
Connecticut					
New Haven	222	310	73	96	122
New Jersey					
Atlantic City	229	311	77	97	117
Marlboro	254	343	85	111	136
Trenton	216	308	76	102	131
* Once each five years ** Once each twenty years ¹ From Agricultural Handbook No. 537 ² For additional cities, refer to Agricultural Handbook 537, Tables 17 & 18.					

Table A.5
Construction Site Mulching C Factors
(Data from Wischmeier and Smith 1978, Pitt 2004)

Type of Mulch	Mulch Rate (tons per acre)	Land Slope (%)	Mulching C Factor	Length Limit (ft) ¹
None	0	all	1.0	n/a
Straw or hay, tied down by anchoring and tacking equipment	1.0	1-5	0.20	200
	1.0	6-10	0.20	100
	1.5	1-5	0.12	300
	1.5	6-10	0.12	150
	2.0	1-5	0.06	400
	2.0	6-10	0.06	200
	2.0	11-15	0.07	150
	2.0	16-20	0.11	100
	2.0	21-25	0.14	75
	2.0	26-33	0.17	50
	2.0	34-50	0.20	35
Wood Chips	7	<16	0.08	75
	7	16-20	0.08	50
	12	<16	0.05	150
	12	16-20	0.05	100
	12	21-33	0.05	75
	25	<16	0.02	200
	25	16-20	0.02	150
	25	21-33	0.02	100
	25	34-50	0.02	75
¹ Maximum slope lengths for which the specified mulch rate is considered effective. If these limits are exceeded, either a higher application rate or mechanical shortening of the effective slope length is required (such as with terracing).				

Table A.6
Cover Factor C Values for Different Growth Periods for Planted Cover Crops for
Erosion Control at Construction Sites
 (Data from Wischmeier and Smith 1978, Pitt 2004)

	SB (seedbed prepara- tion)	Period 1 (establishment)	Period 2 (development)	Period 3a (maturing crop)	Period 3b (maturing crop)	Period 3c (maturing crop)
Crop Canopy ¹	0-10%	10-50%	50-75%	75-80%	80-90%	90-96%
Seeding on topsoil, without mulch	0.79	0.62	0.42	0.17	0.11	0.06
Seeding on a desur- faced area, where residual effects of prior vegetation are no longer significant	1.0	0.75	0.50	0.17	0.11	0.06
Sod	0.01	0.01	0.01	0.01	0.01	0.01
¹ Percent canopy cover is the percentage of the land surface that would not be hit by directly falling rain drops because the drops would be intercepted by the plant. It is the portion of the soil surface that would be covered by shadows if the sun were directly overhead.						

Table A.7
Cover Factor C Values for Existing Established Plants
 (data from NRCS NEH Chapter 3 and Wischmeier and Smith 1978)

	Percentage of surface covered by residue in contact with the soil							
	Percent Cover¹	Plant Type	0%	20	40	60	80	95+
C factor for grass, grasslike plants, or decaying compacted plant litter	0	Grass	0.45	0.20	0.10	0.042	0.013	0.0003
C factor for broadleaf herbaceous plants (including most weeds with little lateral root networks), or un- decayed residues	0	Weeds	0.45	0.24	0.15	0.091	0.043	0.011
Tall weeds or short brush with average drop height ² of =20 inches	25	Grass	0.36	0.17	0.09	0.038	0.013	0.003
		Weeds	0.36	0.20	0.13	0.083	0.041	0.011
	50	Grass	0.26	0.13	0.07	0.035	0.012	0.003
		Weeds	0.26	0.16	0.11	0.076	0.039	0.011
	75	Grass	0.17	0.12	0.09	0.068	0.038	0.011
		Weeds	0.17	0.12	0.09	0.068	0.038	0.011
Mechanically prepared sites, with no live vegetation and no topsoil, and no litter mixed in.	0	None	0.94	0.44	0.30	0.20	0.10	Not given
¹ Percent cover is the portion of the total area surface that would be hidden from view by canopy if looking straight downward. ² Drop height is the average fall height of water drops falling from the canopy to the ground.								

Table A.8 (USDA-NRCS)
Construction Site P Practice Factors

Surface Condition		P Factor
Bare Soil Loose		1.0
Freshly disked or rough irregular surface		0.9
Compact smooth by equipment up and down hill		1.3
Compact smooth by equipment across slope		1.2
Contoured Furrows:		
Slope (%)	Maximum Downslope Length (ft)	P Factor
1-2	350	0.6
3-5	250	0.5
6-8	200	0.5
9-12	125	0.6
13-16	75	0.7
17-20	60	0.8
>20	50	0.8
Maximum slope lengths for which the specified mulch rate is considered effective. If these limits are exceeded, either a higher application rate or mechanical shortening of the effective slope length is required (such as with terracing).		

Source: USDA-NRCS; HDI, 1987; Wischmeier and Smith, 1978

References

1. Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE). USDA-Agricultural Research Service Agric. Hdbk. No. 703. Renard, K.G., G. R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder. 1997.
2. (data from Wischmeier and Smith 1978)
3. Construction Site Erosion and Sediment Controls: Planning, Design and Performance. R. Pitt, S. Clark, and D. Lake. 2007.
4. USDA-NRCS, web soil survey database at www.websoilsurvey.sc.egov.usda/App/HomePage.htm.

<p style="text-align: center;">APPENDIX B DESIGN EXAMPLES FOR SELECTED EROSION AND SEDIMENT CONTROL PRACTICES</p>
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APPENDIX B

DESIGN EXAMPLES FOR SELECTED EROSION AND SEDIMENT CONTROL PRACTICES

Background

Standard details and drawings for temporary erosion and sediment control practices have been used since the early 1970's. Many of these details were developed by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS), now known as the Natural Resources Conservation Service (NRCS). These details were incorporated into many state design manuals. These practices included the following:

- Earth Dike
- Construction Ditch
- Perimeter Dike/Swale
- Flow Spreader
- Pipe Slope Drain
- Straw Bale Dike
- Silt Fence

What made the use of these details attractive was that they were sized based upon the drainage area, and no extensive engineering calculations were needed for design. For example, if we needed to design a construction ditch to control the runoff from 8 acres above a disturbed construction area by sloping the swale at 3 percent, we would look at page 3.4 and select Ditch B, with a channel treatment of seed and straw mulch. The Ditch B cross section is a 6-foot bottom width, 1-foot design depth, and 2:1 side slopes.

This selection process is independent of location in New York State as well as the design rainfall amount. As a result, individuals have often wondered what level of protection is actually being provided.

Site specific practice design depends on a number of variables. These include drainage area, hydrologic soil group, cover, topography, rainfall amount, and intensity or distribution.

The following design examples illustrate how these variables can be incorporated into site specific design process.

Determining Stormwater Runoff

Stormwater runoff volumes and peak discharges should be calculated using current hydrologic data. As noted in Section 1, the hydrologic data published by the Northeast Regional Climate Center (NRCC), provides updated rainfall values for a wide range on frequencies and durations on

their website, <http://precip.eas.comell.edu/>. These data combined with construction site runoff curve numbers are then used with appropriate software to calculate peak rates of runoff, runoff volumes, and flow durations.

A detailed example of this process is presented in the design example for Sediment Basin Design.

Runoff Control Practices Design Examples

This method of designing a practice or evaluating the performance of a proposed practice, is applicable to most of the temporary runoff practices. The first example evaluates the effectiveness of the construction ditch.

Example 1: Case 1 - Construction Ditch A

Given:

Drainage Area = 4.9 acres

Hydrologic Soil Group = C

Runoff Curve Number = 91 (C soil disturbed for construction)

Slope of Swale = 3%

Rainfall (P) = 2.5 inches (from NRCC) (This represents NY state's average 1-year, 24-hour storm)

Runoff (Q) = 1.6 inches (from TR55 RCN tables)

Time of Concentration for Runoff (T_c) = 6 minute (assumed 0.1 hour, the shortest allowed with TR-55)

From HydroCAD routing:

$Q_p = 12.2$ cfs

For Ditch A, the design cross-section shows a bottom width of 4 feet., design depth of 1 foot, and 2:1 side slopes.

Therefore, ditch area = 6 ft^2 for design depth

Compute velocity, $V = \frac{1.486}{n} \left(\frac{A}{W_p} \right)^{2/3} S^{1/2}$

Where:

$n = 0.040$ for vegetated channels

$A = 6$ sq. ft.

$W_p = 8.2$ ft. (wetted perimeter)

$S = .03$ ft/ft (slope)

$$\text{Therefore, } V = \frac{1.486}{.04} \left(\frac{6}{8.2} \right)^{2/3} (.03)^{1/2}$$

$$= 5 \text{ feet per second}$$

Select the appropriate stabilization lining.

Since $Q = AV$, the ditch capacity is

$$Q = (6 \text{ ft}^2)(5 \text{ ft/sec}) = 30 \text{ cfs or more than twice required}$$

Case 2—Construction Ditch B

Given:

Drainage Area = 10 acres

Hydrologic Soil Group = C

Runoff Curve Number = 91

Slope of Swale = 3%

Rainfall (P) = 2.5 inches

Runoff (Q) = 1.6 inches

Time of Concentration for Runoff (T_c) = 0.1

From HydroCAD routing:

$$Q_p = 25 \text{ cfs}$$

For Ditch B, the design cross-section has a 6-foot bottom width, 1-foot depth, and 2:1 side slopes.

$$\text{Therefore, the area} = 8 \text{ ft}^2$$

Computing velocity for a ditch slope of 3%,

$$V = \frac{1.486}{.04} \left(\frac{8}{10.47} \right)^{2/3} (.03)^{1/2}$$

$$V = (37.15)(.836)(.173) = 5.37 \text{ ft/sec}$$

Since:

$Q = AV$, the ditch capacity is

$$Q = (8 \text{ ft}^2)(5.37 \text{ ft/sec}) = 43 \text{ cfs}$$

Case 3 - This site is adjacent to a significant water body in Westchester County. We want to protect the site for the 2-year, 24-hour storm.

Given:

Drainage Area = 10 acres

Hydrologic Soil Group = D soils

Runoff Curve Number = 94, ("D" under construction)

Slope of Swale = 3%

Rainfall (P) = 3.5 inches (NRCC)

Runoff (Q) = 2.8 inches (TR55 RCN)

Assume Time of Concentration for Runoff (T_c) = 0.1 hour (most conservative value)

From HydroCAD routing:

$$Q_p = 28.7 \text{ cfs}$$

From Case 2, Ditch B, we know that the maximum capacity is 43 cfs with a velocity of 5.37 feet per second.

Our conclusions would indicate that Ditch B is adequate for capacity. The velocity is higher and thus a lining should be used to protect the ditch from erosion.

Sediment Storage Volume Design Procedure

Practices such as silt fence, straw bale dikes, earthen berms, and other slope interrupters, are often used on slopes or near the toes of fill slopes to capture sediment laden runoff. These have failed many times in the field due to poor siting, improper installation, lack of maintenance, and little consideration of the proper use of the practice.

The following design example shows how careful we need to be in using these practices. We will look at the use of silt fence in the following typical situations.

Case 1 - At the toe of a 3:1 earthfill

Given:

Earthfill slope 30 feet high, slope length 95 feet

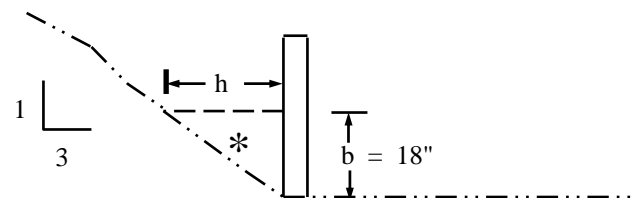
Hydrologic Soil Group—C

The Runoff Curve Number = 91 (bare soil)

Typically, the installed height of the silt fence is 30-36". The maximum design sediment depth behind the silt fence is 50% of its height, or 18" maximum.

For this case, the design sediment area is equal to:

$$A = 1/2bh$$



* Design sediment storage volume

$$A = 1/2 (1.5')(4-5') = 3.375 \text{ sq. ft. per linear foot}$$

This equals 337.5 cubic feet per 100 feet of fence.

The actual slope surface is approximately 95 feet. For a rainfall of 1 inch on this site, the runoff equals 0.4 inches (TR55). The total volume of runoff would equal

$$\frac{0.4 \text{ inches}}{12 \text{ inches/ft}} \times 9500 \text{ sq. ft.} = 317 \text{ cu. ft.}$$

This example shows that the volume required for a 1-inch storm is barely provided, but the location of the fence provides no buffer for material that rolls down the slope nor room for maintenance. The fence should be located at least 10 feet from the toe of the slope.

Case 2- Determine level of protection for CASE 1 when fence is moved 10 feet from the toe of slope.

When the silt fence is moved 10' away from the 3:1 slope, the design area of storage equals,

$$337.5 \text{ sq. ft.} + 1,500 \text{ sq. ft.} = 1,837.5 \text{ cu.ft. per 100 feet of fence}$$

Since this is the maximum runoff volume that can be controlled, the runoff depth equates to:

$$\frac{1,837.5 \text{ ft}^3}{9,500 \text{ ft}^2} = 0.193 \text{ feet} = 2.3 \text{ inches}$$

From TR55 for a runoff $Q = 2.3$ inches, with a Curve Number at 91, P , rainfall is found to be 3.2 inches.

Thus, this design configuration can manage to store the runoff from a 3.2 inch rainfall event.

This method can be used to evaluate the positioning of these sediment control practices on the contour to hold sediment close to its source. It allows a designer to evaluate an existing condition, or to select a specific level of protection higher than that which may be provided by the standard details.

Rock Outlet Protection Design Examples

(Refer to Rock Outlet Protection Standard on Page 3.40)

Example 1: Pipe Flow (full) with discharge to unconfined section.

Given: A circular conduit flowing full.

$Q = 280$ cfs, diam. = 66 in., tailwater (surface) is 2 ft. above pipe invert (minimum tailwater condition).

Find: Read $d_{50} = 1.2$ and apron length (L_a) = 38 ft.
Apron width = diam. + $L_a = 5.5 + 38 = 43.5$ ft.

Use: $d_{50} = 15''$, $d_{\max} = 22''$, blanket thickness = 32''

Example 2: Box Flow (partial) with high tailwater

Given: A box conduit discharging under partial flow conditions. A concrete box 5.5 ft. x 10 ft. flowing 5.0 ft. deep,

$Q = 600$ cfs and tailwater surface is 5 ft. above invert (max. tailwater condition).

Since this is not full pipe and does not directly fit the nomograph assumptions of Figure 7B.13 substitute depth as the diameter, to find a discharge equal to full pipe flow for that diameter, in this case 60 inches.

$$\text{Since, } Q = AV \text{ and } A = \frac{\pi D^2}{4}$$

First, compute the actual box culvert velocity for the given flow conditions:

$$V = (Q/A) = (600/(5) (10)) = 12 \text{ fps}$$

Then determine the equivalent flow through a 5 foot diameter pipe using the same velocity as the box culvert as computed above:

$$Q = \frac{\pi D^2}{4} \times V = \frac{3.14 (5 \text{ ft})^2}{4} \times 12 \text{ fps} = 236 \text{ cfs}$$

At the intersection of the curve $d = 60$ in. and $Q = 236$ cfs, read $d_{50} = 0.4$ ft.

Then reading the $d = 60$ in. curve, read apron length (L_a) = 40 ft.

Apron width, $W = \text{conduit width} + (0.4)(L_a) = 10 + (0.4)(40) = 26$ ft.

Example 3: Open Channel Flow with Discharge to Unconfined Section

Given: A trapezoidal concrete channel 5 ft. wide with 2:1 side slopes is flowing 2 ft. deep, $Q = 180$ cfs (velocity = 10 fps) and the tailwater surface downstream is 0.8 ft. (minimum tailwater condition).

Find: Using similar principles as Example 2, compute equivalent discharge for a 2 foot, using depth as a diameter, circular pipe flowing full at 10 feet per second.

Velocity:

$$Q = \frac{\pi (2 \text{ ft})^2}{4} \times 10 \text{ fps} = 31.4 \text{ cfs}$$

At intersection of the curve, $d = 24$ in. and $Q = 32$ cfs, read $d_{50} = 0.6$ ft.

Then reading the $d = 24$ in. curve, read apron length (L_a) = 20 ft.

Apron width, $W =$ bottom width of channel + $L_a = 5 + 20 = 25$ ft.

Example 4: Pipe flow (partial) with discharge to a confined section

Given: A 48 in. pipe is discharging with a depth of 3 ft. $Q = 100$ cfs, and discharge velocity of 10 fps (established from partial flow analysis) to a confined trapezoidal channel with a 2 ft. bottom, 2:1 side slopes, $n = .04$, and grade of 0.6%.

Calculation of the downstream channel (by Manning's Equation) indicates a normal depth of 3.1 ft. and normal velocity of 3.9 fps.

Since the receiving channel is confined, the maximum tailwater condition controls.

Find: discharge using previous principles:

$$Q = \frac{\pi (3\text{ft})^2}{4} \times 10 \text{ fps} = 71 \text{ cfs}$$

At the intersection of $d = 36$ in. and $Q = 71$ cfs, read $d_{50} = 0.3$ ft.

Reading the $d = 36$ " curve, read apron length (L_a) = 30 ft.

Since the maximum flow depth in this reach is 3.1 ft., that is the minimum depth of riprap to be maintained for the entire length.

Flow Diffuser Design Examples

(Refer to Flow Diffuser on Page 3.16)

The stormwater runoff from a 3.5 acre drainage area is to be discharged offsite through a flow diffuser. The drainage area is upland meadow, pasture and access road. The 10 year, 24 hour rainfall is 3.5 inches. A peak rate of runoff of 8.8 cubic feet per second results from a curve number of 80 and a time of concentration of 6 minutes (0.10 hour), using the HydroCAD computer model. This flow is being diffused off the right of way to prevent excessive flows further down the access road corridor.

A. Determine the diffuser length:

Since the maximum flow rate from the diffuser onto the vegetated buffer area is 0.25 cfs, per linear foot of weir

length, the diffuser length is:

$$W = \frac{Q_{10}}{Q_D} = \frac{8.8 \text{ cfs}}{0.25 \text{ cfs/ft}} = 35.2 \text{ ft}$$

B. Using the standard minimum diffuser cross-section dimensions, solve for the d_{50} rock size:

Assume: 1:1 side slopes, 2 ft top width, $h = 1.0$ ft, $W = 36$ ft for:

$$Q = \frac{(h^{2/3})(W)}{[L/D + 2.5 L^2]^{0.5}}$$

Where:

h = ponding depth behind the diffuser

W = linear length of diffuser along centerline

L = average horizontal flow length through the diffuser perpendicular to the centerline

D = average stone diameter (ft.) in the structure

Try a $D (d_{50}) = 0.50$ ft (6 inches), from typical cross section, $L = 3$ ft, then,

$$Q = \frac{1^{2/3} \times 36}{[3/0.5 + 2.5 + (3)^2]^{0.5}} = \frac{36}{(17)^{0.5}} = \frac{36}{4.18}$$

Therefore, $Q = 8.6$ cfs, this approximates the 10 year discharge and the design is balanced.

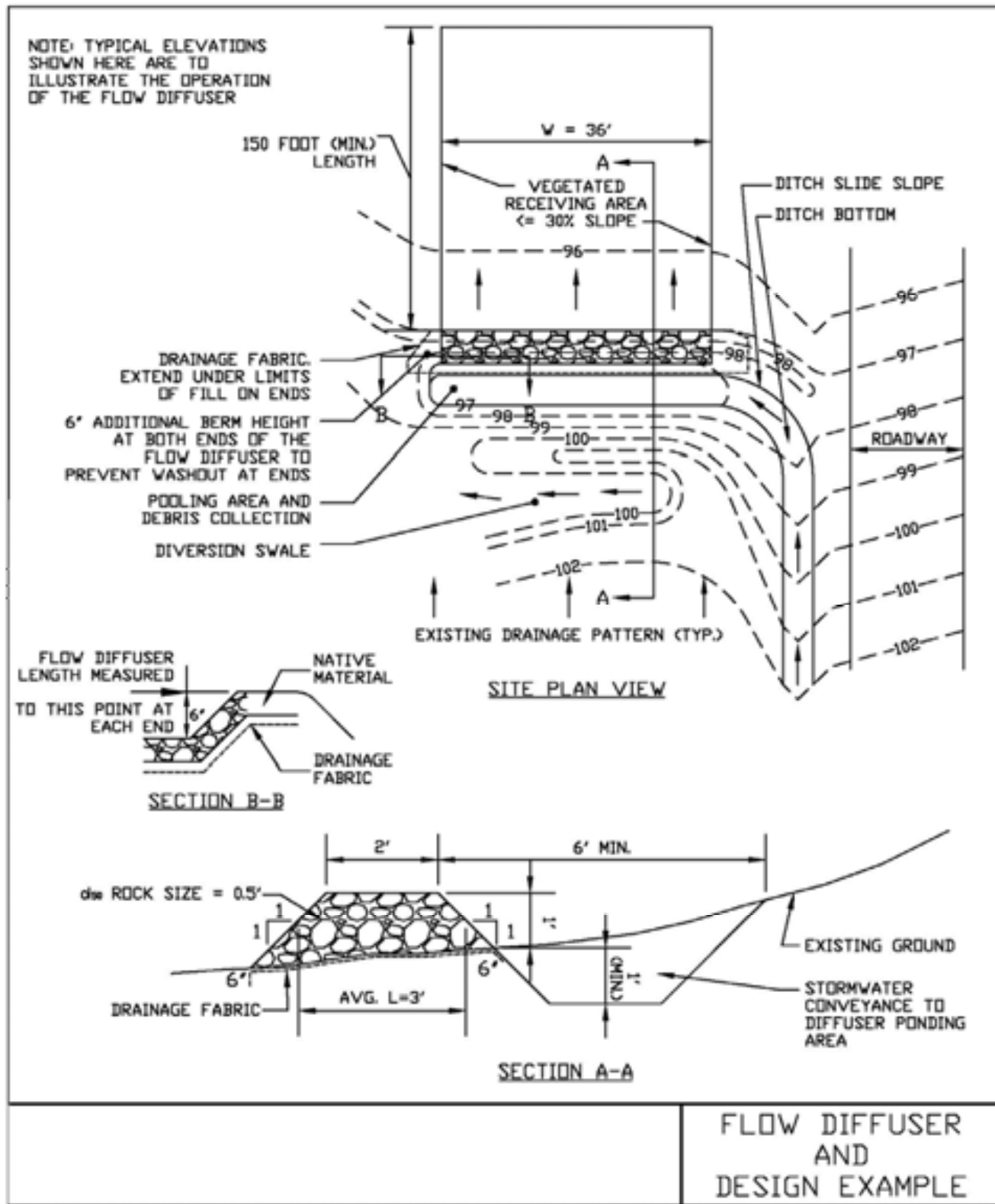
What if d_{50} is 0.75 ft. or 9 in.?, then:

$$Q = \frac{36}{[3/0.75 + 2.5 + (3)^2]^{0.5}} = \frac{36}{3.94} = 9.1 \text{ cfs}$$

And this flow exceeds the maximum allowable. Figure B.1 on page B.5 shows the dimensions and details for the final diffuser configuration.

Design Note: Changing the variables of height, side slope, rock size, and weir length, will result in a change of the diffuser discharge. All dimensions need to be balanced so the diffused flow does not exceed the maximum allowable of 0.25 cfs per linear foot of the diffuser. This practice can be modeled for storage requirements as a pond with a constant overflow rate.

Figure B.1
Flow Diffuser Design Example



CEDAR POINT SECTION 3

SEDIMENT BASIN DESIGN EXAMPLE

Cedar Point is a residential construction project in Cicero, Onondaga County, New York. Section 3 contains quarter acre lots with residential streets on approximately 20.4 acres. A sediment basin will be utilized as a component of the erosion and sediment control plan for this project. It will be located at the storm drainage outlet of the project (See Figure B.5). The drainage area to the basin is 14.9 acres.

The runoff curve number (RCN) used to calculate the stormwater runoff for design storms from this drainage area is based on the maximum disturbed construction condition. In this case it means bare soil for all the lot areas and impervious surface for the street area. This drainage area has 1.6 acres of paved roads and gutters; 6.4 acres of exposed soil in Hydrologic Soil Group (HSG) B; and 6.9 acres of exposed soil in HSG C. This results in a composite RCN of 90. Based on hydrologic data obtained from the Northeast Regional Climate Center (NRCC) and using the HydroCAD computer model, the peak discharge for the 10 year frequency storm is 39.2 cubic feet per second. See Figures B.2 to B.7 that show the development of the hydrology data. The steps to obtain this data are listed below:

1. Go to the NRCC website, <http://precip.eas.cornell.edu/>.
2. Select the tab Data and Products.
3. Use the Google Map to zoom into the project and double click.
4. From the Products list, select Extreme Precipitation Tables- Text/CSV.
5. At the bottom of the page, set smoothing to No, then click Submit.
6. Select Save when asked.
7. Set Save In to your HydroCAD IDF file or your HydroCAD projects folder.
8. Set the name for this file as NY-Cicero.hci.
9. Set the file format as "plain text".
10. Click save and close the NRCC site.

If you are using a different computer program, import the text files into that program in accordance with the programs protocols. These text files will be converted into rainfall distribution curves for each specific rainfall frequency.

11. Open HydroCAD and click on the calculator icon.
12. Click "Rainfall"
13. Click "Import Events from IDF"
14. Click "Create Mass Curves", then OK.
15. Click "Yes" on popup screen to replace the storm events, and accept.

This process imports rainfall values from the 1 year to the 500 year storm. This will be shown on the main screen

when you toggle down the storm event window. Make sure when calculating T_c with HydroCAD that the NRCC 2 year storm value is used for the sheet flow calculation and not the older value. For our example, the 2 year rainfall is 2.37 inches and the 10 year rainfall is 3.39 inches.

The design results are shown on the following Temporary Sediment Basin Design Data Sheet. The instructions for the use of this form are shown on page 5.25.

The outlet for this sediment basin is a skimmer device. It is critical to size the orifice so that the appropriate detention time for dewatering is applied to maximize the basin efficiency. The Dewatering Device standard on page 5.10 sets the criteria for orifice sizing.

The Cedar Point Section 3 soils contain approximately 45 % fines (less than the #200 sieve size); therefore the storage volume drawdown time should be a minimum of 48 hours. The dewatering volume is calculated to be approximately 54,000 cubic feet. Therefore, from Figure 5.3 on page 5.11 of the Dewatering Device standard, enter the bottom of the chart at 54,000 cubic feet. Travel vertically to the 2 day dewatering time line. Then read across to find the orifice diameter at approximately 4.5 inches.

The arm length for the skimmer is equal to the hypotenuse of a 45 degree right triangle using the full storage depth as the leg of the triangle (see Figure 5.4 on page 5-12). Our full storage depth is 8 feet. Therefore, the length of the skimmer arm is $8 \text{ feet} \times 1.414 = 11.3 \text{ feet}$. Use 12.0 feet for ease of field construction with a four foot flexible coupling to the bottom of the riser (see Figure B.13 on page B.18).

The design results are shown on the Temporary Sediment Basin Design Data Sheet, Figure B.9 on page B.14.

Figure B.2
NRCC Project Locator Map

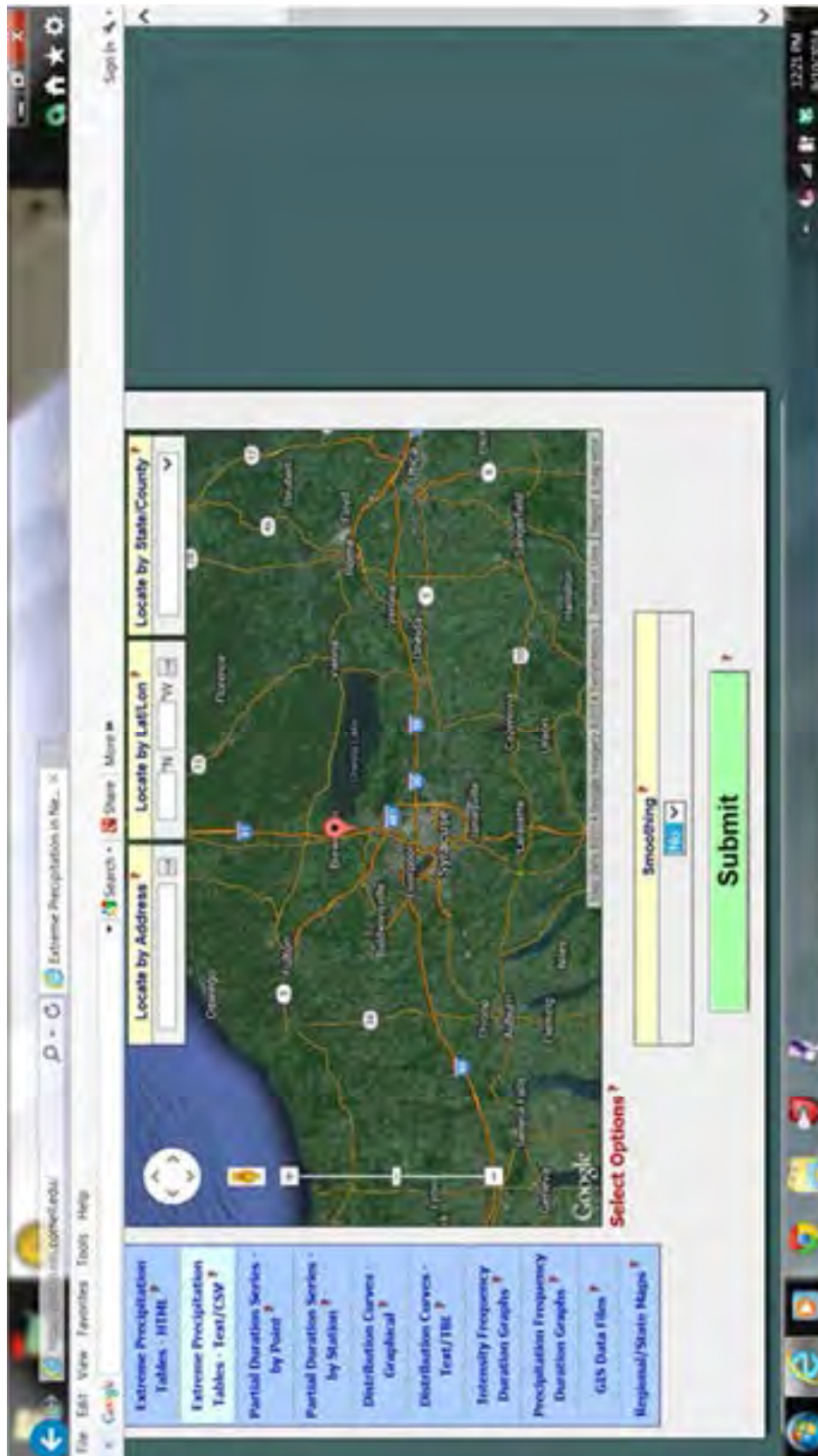


Figure B.3
NRCC Sediment Basin Location

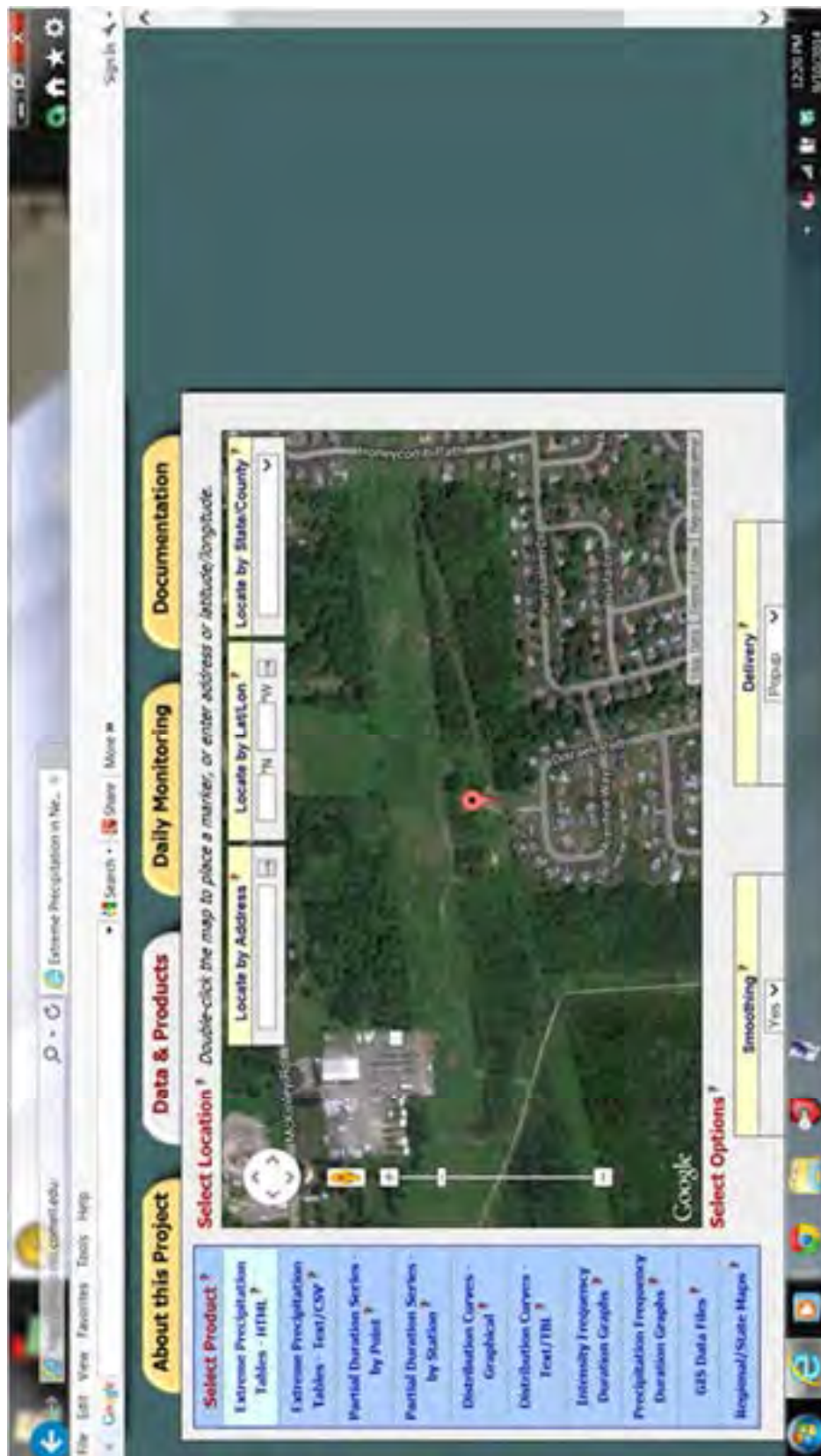


Figure B.4
Cedar Point Google Map Pre-Construction

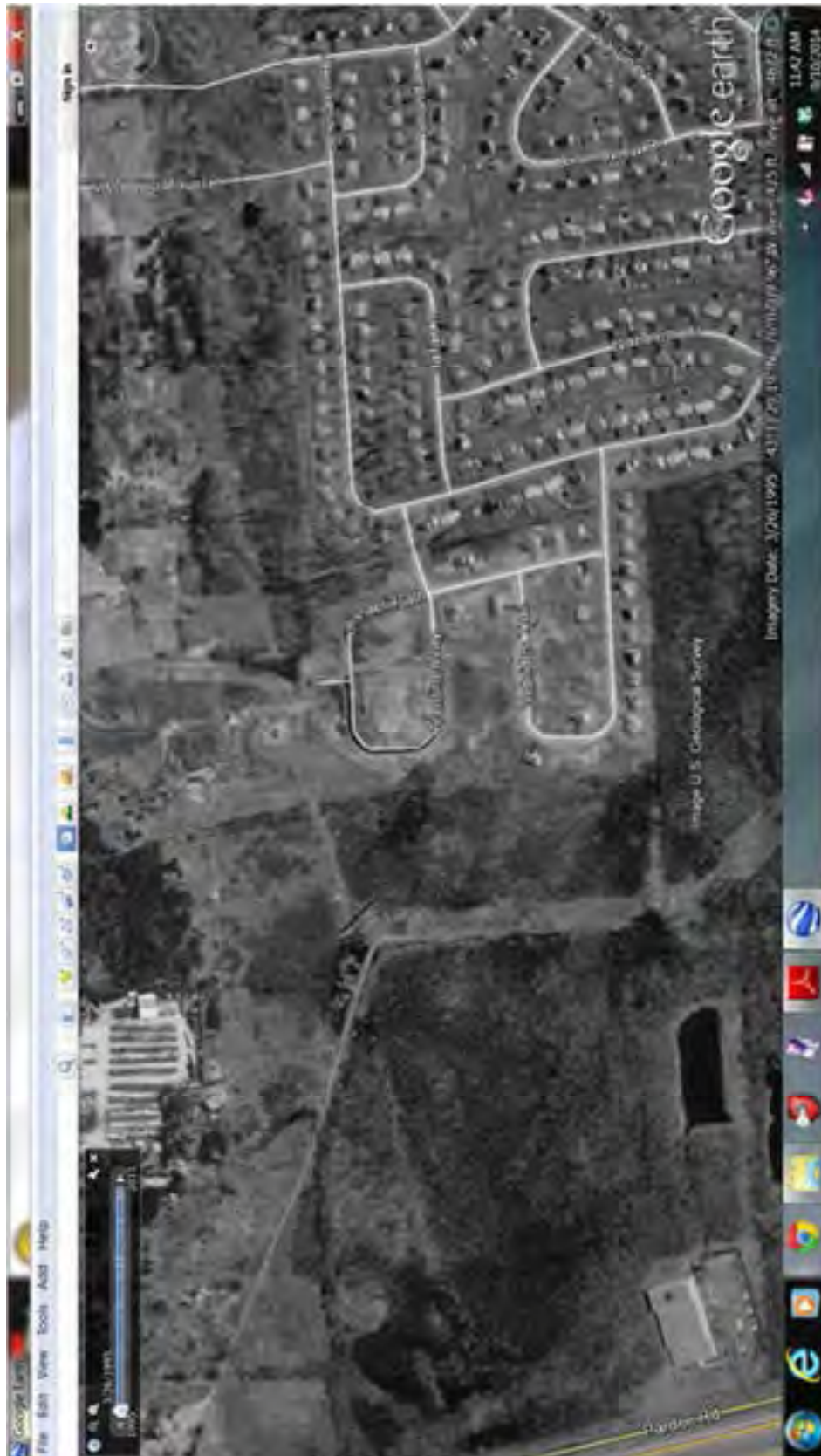


Figure B.5
Cedar Point Site Sediment Basin Photograph

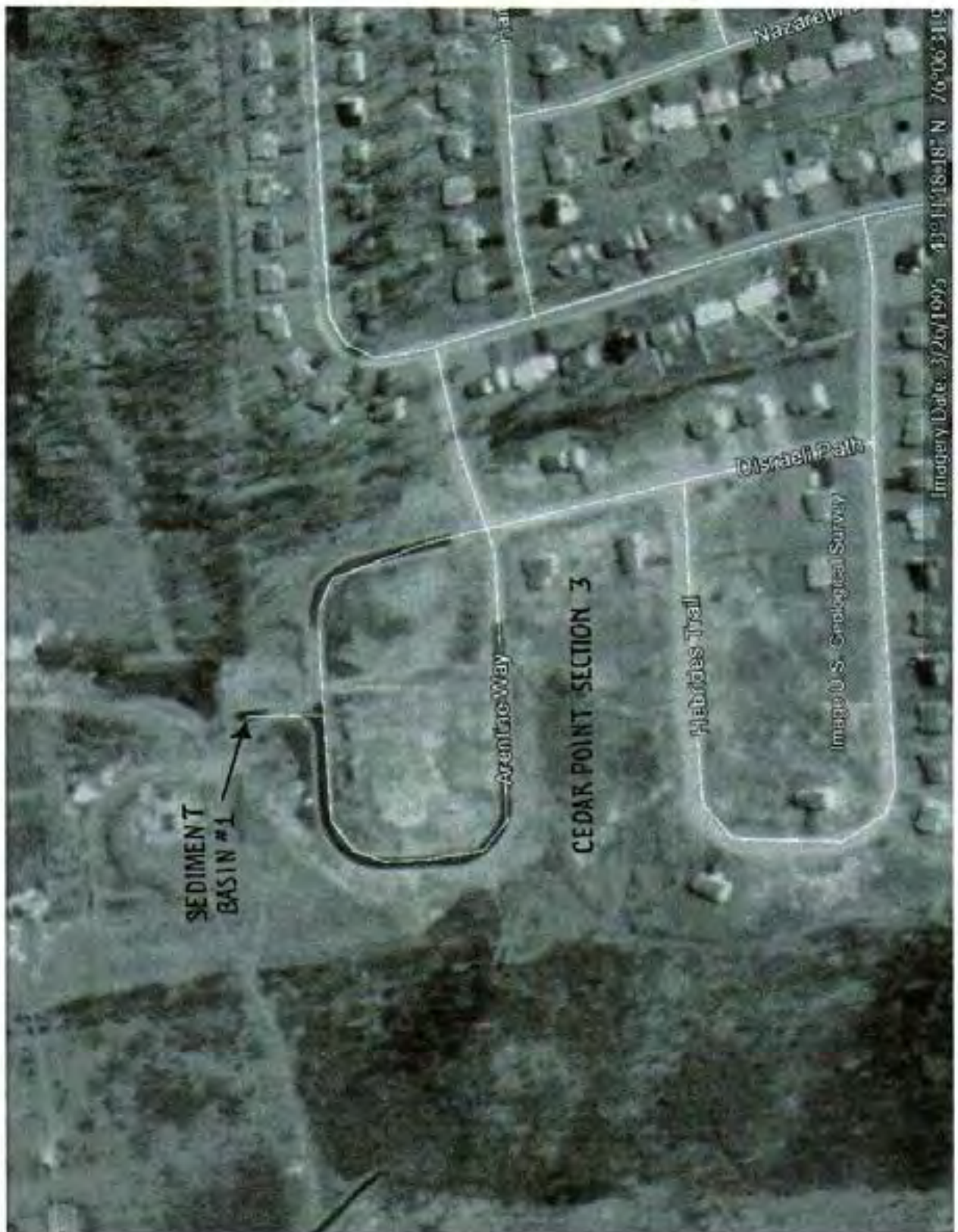


Figure B.6
NRCC Rainfall Text Table

File Edit Format View Help
Northeast Regional Climate Center Extreme Precipitation Estimates (inches)
Point Estimates, unsmoothed
Data Series: Partial duration series
State: New York
Location: -76.108
Lat: 42.100
Elev (feet): unknown

MEAN PRECIPITATION FREQUENCY ESTIMATES
Freq (yr) 5-min, 10-min, 15-min, 30-min, 60-min, 120-min, 3-hr, 6-hr, 12-hr, 24-hr, 3-day, 4-day, 7-day, 10-day
2 0.18 0.43 0.53 0.71 0.88 1.00 1.11 1.19 1.68 2.03 2.29 2.65 3.22 3.78
3 0.13 0.30 0.42 0.64 0.84 1.04 1.19 1.30 1.96 2.37 2.67 3.03 3.66 4.23
5 0.19 0.60 0.74 1.02 1.30 1.46 1.63 2.00 2.42 2.90 3.29 3.69 4.34 5.00
10 0.45 0.69 0.85 1.29 1.54 1.71 1.92 2.33 2.84 3.38 3.86 4.28 5.03 5.67
25 0.54 0.81 1.03 1.47 1.84 2.12 2.39 2.89 3.52 4.15 4.73 5.27 6.01 6.70
50 0.63 0.96 1.29 1.73 2.13 2.49 2.82 3.48 4.23 4.84 5.39 5.96 6.84 7.60
100 0.71 1.11 1.39 2.00 2.44 2.92 3.39 4.06 4.86 5.62 6.31 7.03 7.93 8.62
200 0.83 1.28 1.62 2.35 2.73 3.27 3.84 4.65 5.50 6.39 7.11 8.09 9.06 9.78
500 1.04 1.53 2.00 2.80 3.33 4.04 4.93 5.78 7.09 8.09 9.55 10.91 12.86 13.56

UPPER LIMIT PRECIPITATION FREQUENCY ESTIMATES
Freq (yr) 5-min, 10-min, 15-min, 30-min, 60-min, 120-min, 3-hr, 6-hr, 12-hr, 24-hr, 3-day, 4-day, 7-day, 10-day
2 0.14 0.47 0.56 0.78 0.96 1.08 1.22 1.36 1.83 2.21 2.57 2.84 3.44 4.01
3 0.15 0.51 0.66 0.89 1.10 1.24 1.36 1.50 2.08 2.48 2.84 3.13 3.63 4.36
5 0.42 0.64 0.80 1.09 1.38 1.60 1.75 1.90 2.50 3.03 3.37 3.53 3.96 4.66 5.32
10 0.49 0.73 0.93 1.36 1.68 1.88 2.14 2.30 3.03 3.63 3.97 4.26 4.72 4.88 5.18
25 0.63 0.91 1.16 1.66 2.18 2.63 2.76 3.19 4.27 4.78 5.33 5.66 6.06 6.85 7.56
50 0.72 1.10 1.35 1.97 2.63 3.21 3.40 4.00 5.24 5.74 6.30 6.70 7.10 8.01 8.80
100 0.84 1.10 1.63 2.36 3.14 3.93 4.15 4.84 6.21 6.82 7.41 7.80 8.40 9.46 10.26
200 1.03 1.54 2.09 2.82 3.93 4.84 5.06 6.04 7.99 8.31 9.30 10.02 11.18 13.97
500 1.33 1.98 2.33 3.70 5.26 6.37 6.54 8.84 10.19 10.69 12.91 13.67 15.94 14.69

LOWER LIMIT PRECIPITATION FREQUENCY ESTIMATES
Freq (yr) 5-min, 10-min, 15-min, 30-min, 60-min, 120-min, 3-hr, 6-hr, 12-hr, 24-hr, 3-day, 4-day, 7-day, 10-day
2 0.34 0.38 0.46 0.62 0.76 0.87 0.93 1.10 1.27 1.31 2.07 2.43 2.95 3.45
3 0.12 0.49 0.61 0.87 1.01 1.13 1.26 1.39 1.83 2.31 2.59 2.94 3.36 4.15
5 0.16 0.53 0.69 0.94 1.20 1.35 1.49 1.81 2.21 2.69 3.05 3.43 4.10 4.72
10 0.39 0.60 0.74 1.04 1.34 1.51 1.64 2.08 2.51 3.01 3.42 3.83 4.51 5.20
25 0.44 0.67 0.83 1.19 1.54 1.78 1.99 2.43 2.89 3.47 3.97 4.42 5.09 5.93
50 0.47 0.72 0.89 1.28 1.71 2.03 2.24 2.70 3.17 3.85 4.41 4.92 5.57 6.49
100 0.52 0.78 0.98 1.42 1.94 2.31 2.54 3.02 3.48 4.23 4.90 5.47 6.03 7.14
200 0.54 0.83 1.07 1.56 2.17 2.65 2.87 3.35 3.82 4.70 5.42 6.08 6.39 7.86
500 0.66 0.98 1.26 1.83 2.61 3.14 3.45 3.87 4.32 5.34 6.16 6.92 7.34 8.89

Date/Time: Wed Sep 10 12:13:00 EDT 2014

Figure B.7
HydroCAD Summary Sheet

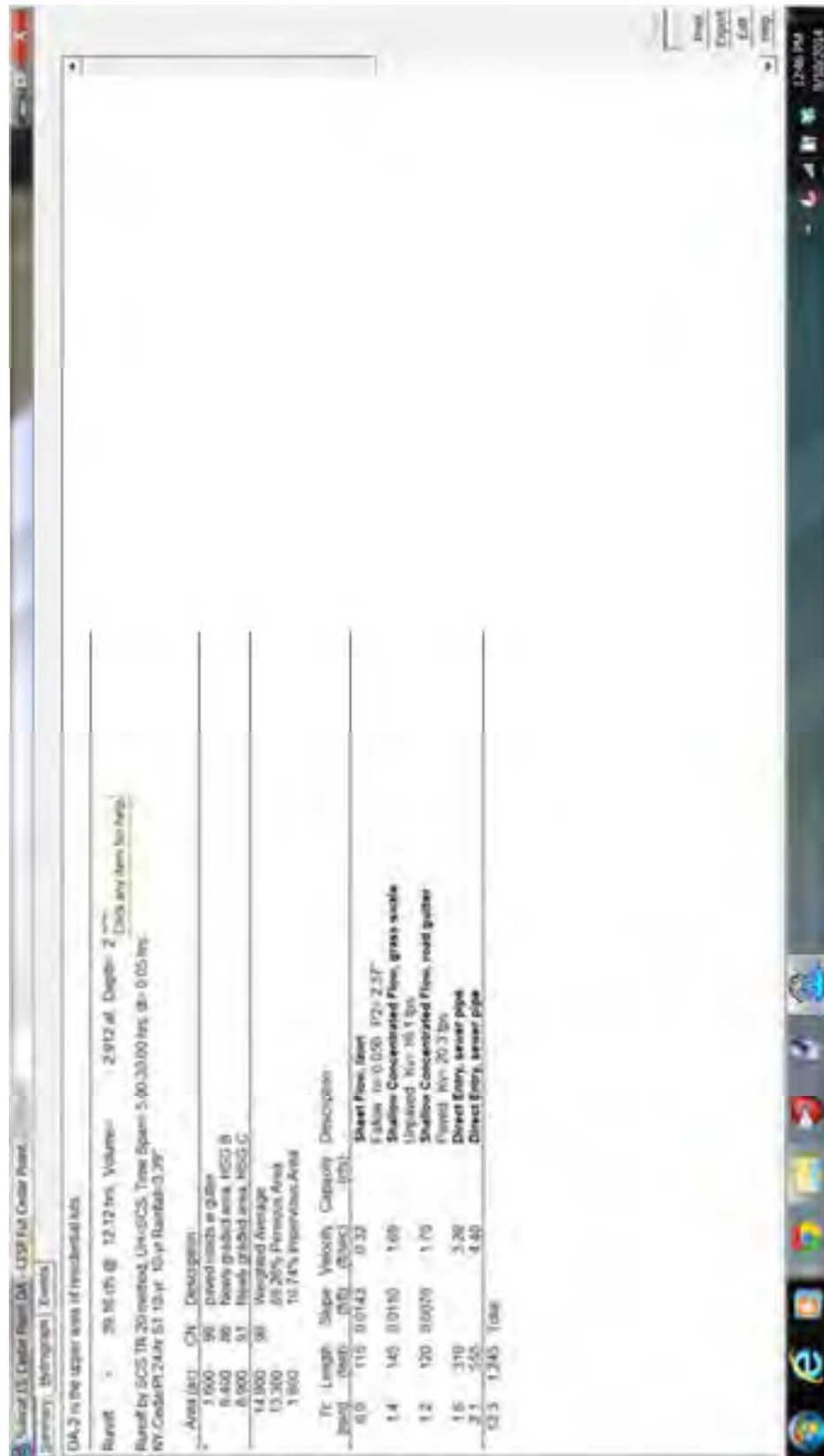


Figure B.8
Cedar Point Sediment Basin Stage - Storage Curve

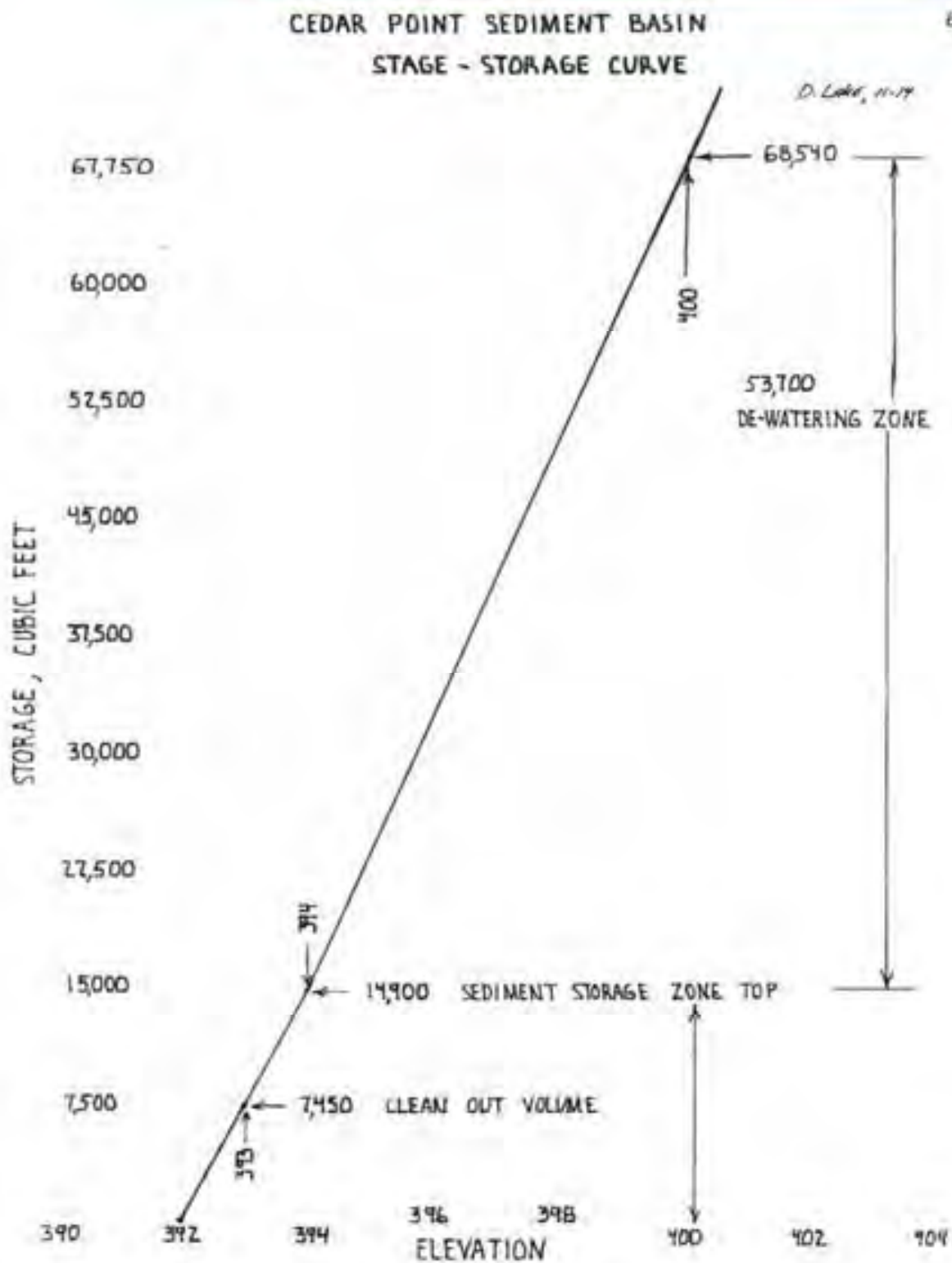


Figure B.9

Temporary Sediment Basin Design Data Sheet

TEMPORARY SEDIMENT BASIN DESIGN DATA SHEET

Computed by D. Lake Date _____ Checked by _____ Date _____
 Project Cedar Point Section 3 Basin # 1
 Location Cicero, NY Total Area draining to basin (≤ 50 Ac.) 14.9 Acres

BASIN SIZE DESIGN

1. Sediment storage zone volume = 1,000 cu. ft. x number of disturbed acres = 14900 cu. ft., Top of Zone Elev. 394.0
2. Dewatering zone volume = 3,600 cu. ft. x number of drainage area acres = 53640 cu. ft., Top of Zone Elev. 400.0
3. Length to width ratio = 3.4:1
4. A. Cleanout at 50% of sediment storage zone volume, Elev. 393.0
 B. Distance below top of riser 7.0 feet
5. Minimum surface area is larger of $0.01 Q_{(10)}$ 0.39 or, $0.015 DA$ = 0.22 use 0.4 acres

DESIGN OF SPILLWAYS & ELEVATIONS

Runoff

6. $Q_{(10)}$ = 39.2 cfs (Attach runoff computation sheets)

Pipe Spillway (Q_{ps})

7. Min. pipe spillway cap., $Q_{ps} = 0.2 \times$ 14.9 Drainage Area, acres = 3 cfs
 Note: If there is no emergency spillway, then required $Q_{ps} = Q_{(10)}$ = — cfs.
8. H, head = 8 ft. Barrel length = 60 ft
9. Barrel: Diam. 12 inches; $Q_{ps} = (Q)$ 9.1 x (cor.fac.) 1.04 = 9.5 cfs.
10. Riser: Diam. 21 inches; Length 7.5 ft.; h = 1.0 ft. Crest Elev. 400.0
11. Trash Rack: Diameter = 30 inches; H, height = 11 inches

Emergency Spillway Design

12. Emergency Spillway Flow, $Q_{es} = Q_p - Q_{ps} =$ 39.2 - 9.5 = 29.7 cfs.
13. Width 12 ft.; H_p 1.0 ft. Crest elevation 401.0; Design High Water Elev. 402.0
 Entrance channel slope 2 %; Top of Dam Elev. 403.0
 Exit channel slope 3 %

ANTI-SEEP COLLAR/SEEPAGE DIAPHRAGM DESIGN

Collars:

14. y = 7.5 ft.; z = 2.5 ft.; pipe slope = 1 %, L_s = 51 ft.
 Use 2 collars, 4' - 9 inches square; projection = 1.8 ft.

Diaphragms:

_____ width _____ ft. height _____ ft.

DEWATERING ORIFICE SIZING

(Determined from the Dewatering Device Standard)

15. Dewatering orifice diameter = 4.5 inches. Skimmer ☒ or Riser _____ (check one)
16. Design dewatering time 2 days (Min. 2 days required)

Figure B.10
Temporary Sediment Basin Profile Detail

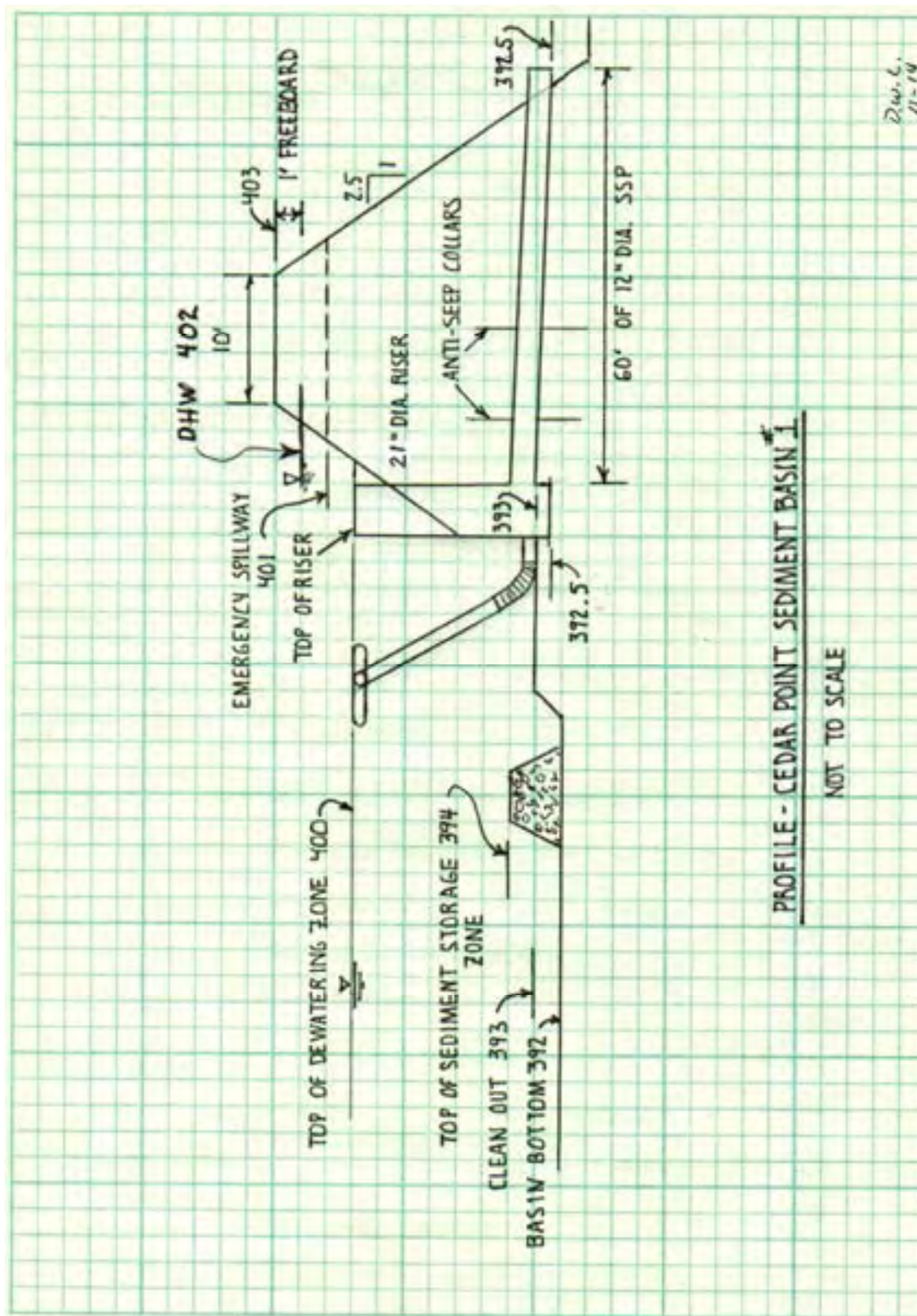


Figure B.11
Temporary Sediment Basin Spillway Detail

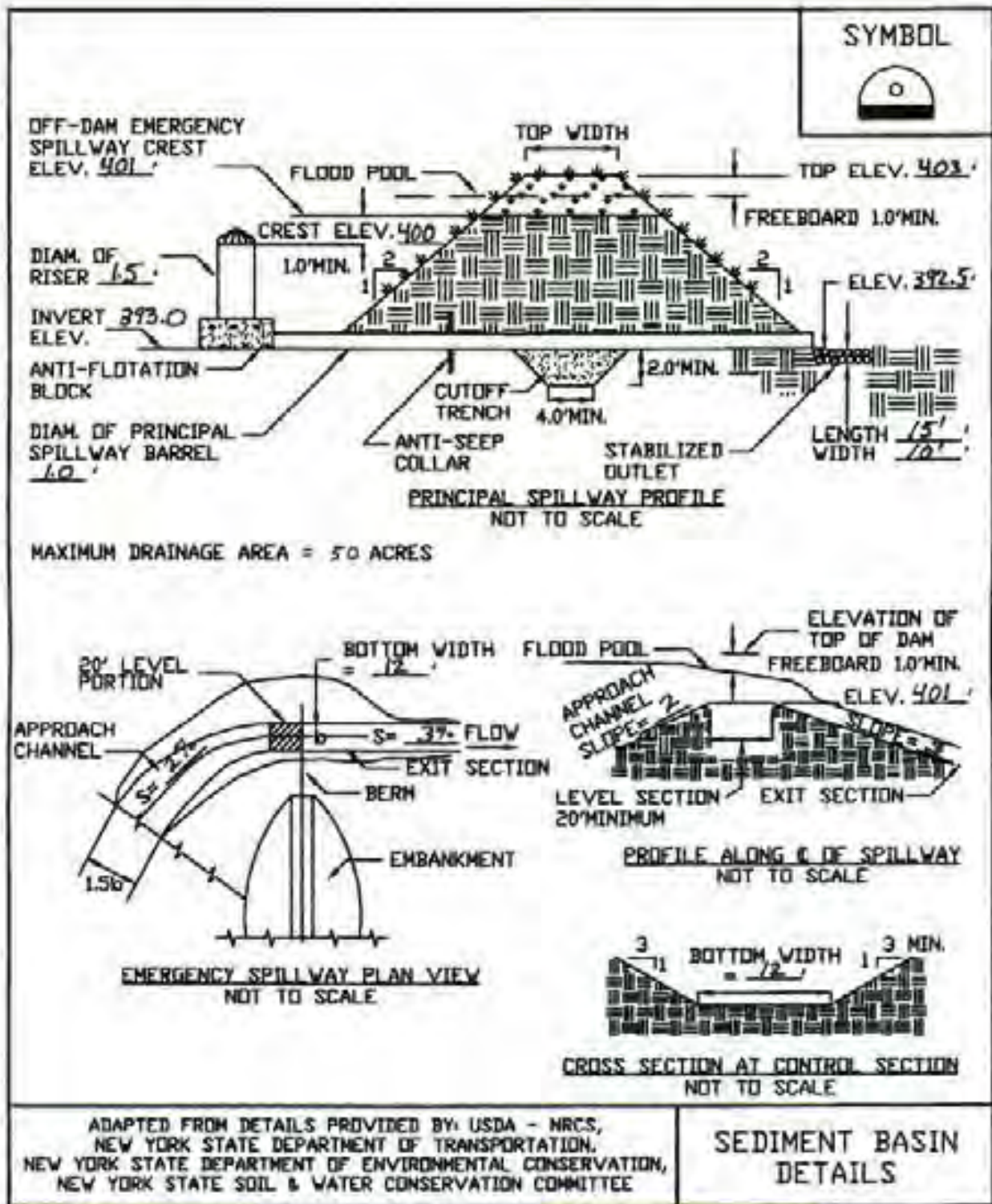


Figure B.12
Skimmer Orifice Design Chart

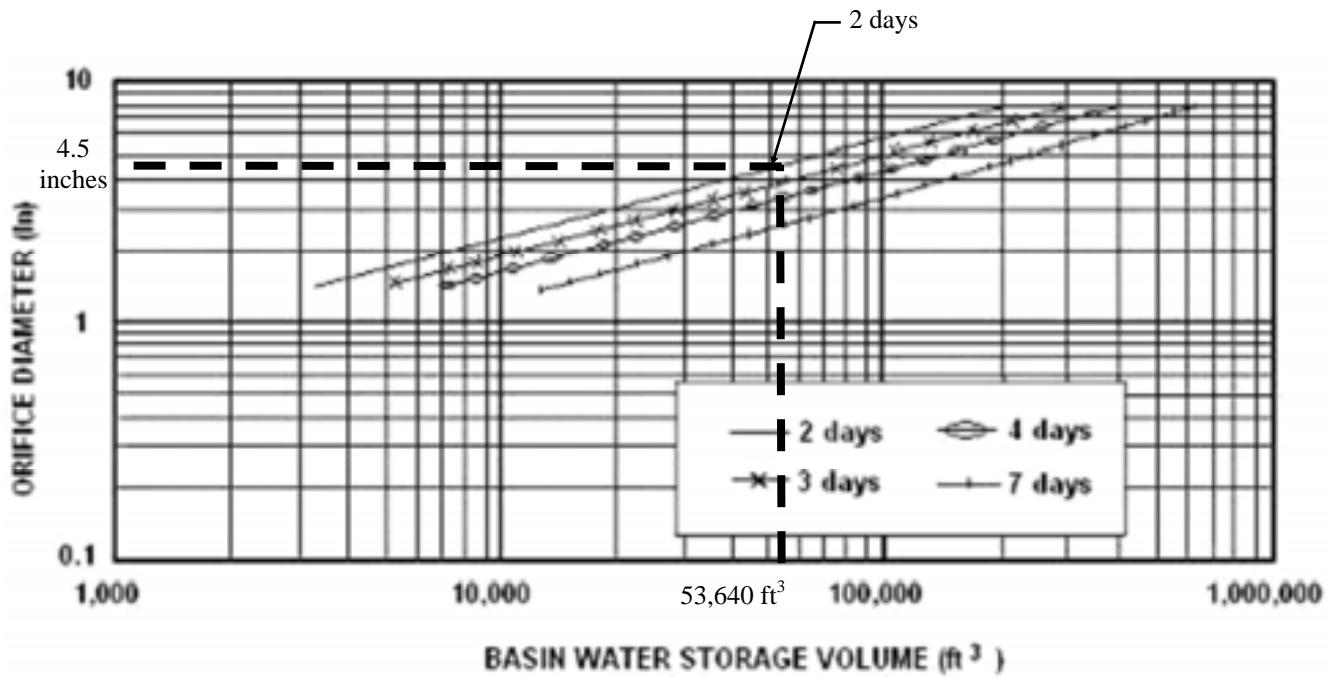
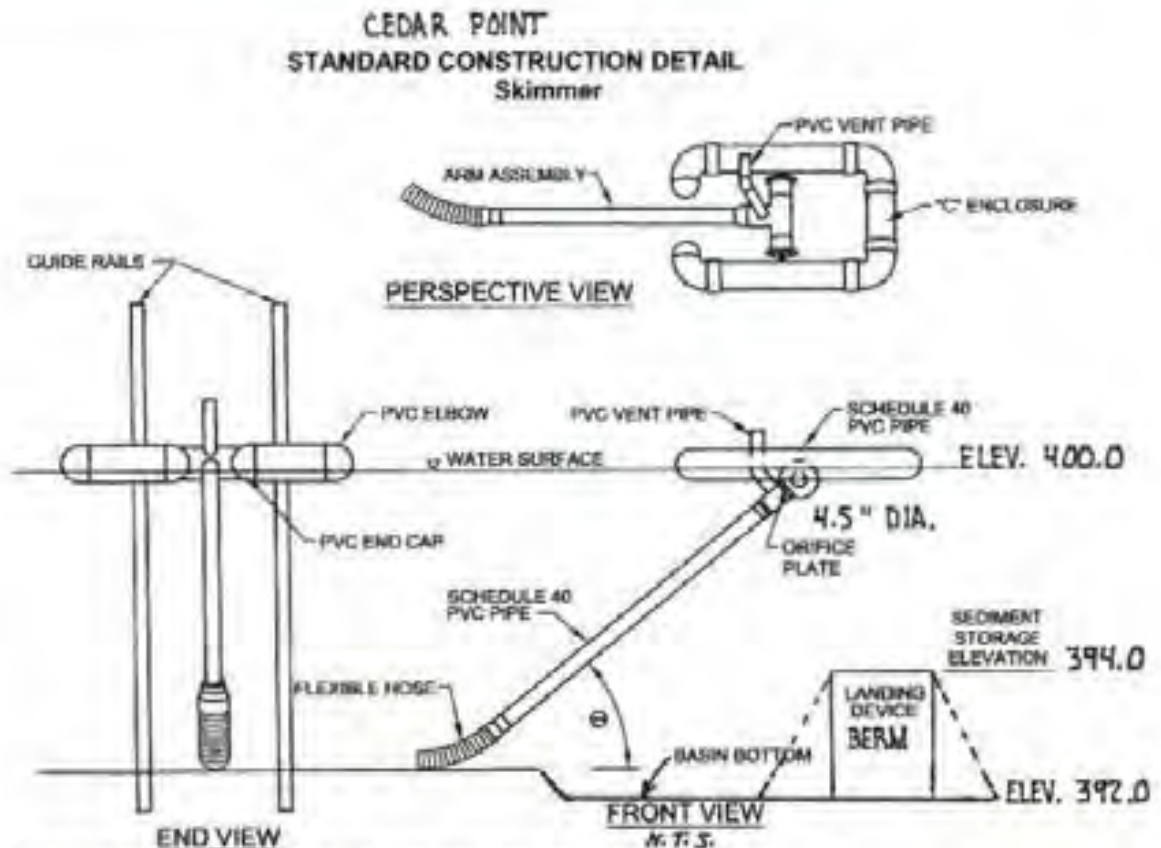


Figure B.13
Skimmer Dewatering Device Detail



Adapted from Penn State Agricultural and Biological fact Sheet F-253

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

Basin No.	Water Surface Elevation (ft)	Arm Length (ft)	Arm Dia. (in)	Orifice Size* (in)	Top of Landing Device Elevation (ft)	Flexible Hose Length (in)	Flexible Hose Attachment Elevation (ft)
CP-1	400.0	12	6	4.5	394.0	48	393.0

* Must be equal to or less than arm diameter

A rope shall be attached to the skimmer arm to facilitate access to the skimmer once installed.

Skimmer shall be inspected weekly and after each runoff event.

Any malfunctioning skimmer shall be repaired or replaced within 24 hours of inspection.

Ice or sediment buildup around the principal spillway shall be removed so as to allow the skimmer to respond to fluctuating water elevations.

Sediment shall be removed from the basin when it reaches the level marked on the sediment clean-out stake or the top of the landing device.

A semi-circular landing zone may be substituted for the guide rails

APPENDIX C
COST ANALYSIS OF
EROSION AND SEDIMENT CONTROL PRACTICES

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COST ANALYSIS OF EROSION AND SEDIMENT CONTROL PRACTICES

Analyzing Benefits and Costs

Benefit-Cost analysis is a technique used to determine whether a measure will result in more benefits than it will cost.

For the purposes of making a benefit-cost analysis for erosion and sediment control, the time period associated with erosion and sedimentation is considered to extend from the first disturbance of the land to the time of establishing effective erosion control.

Ascribing Effects to Treatment Measures

The generally accepted basis for attributing effects of treatment measures on a comparable basis is the “with” and “without” approach. This approach compares the expected difference in damages between what is expected if no control is used and what is expected if a measure is installed. The total difference in expected damage is the estimated benefit of the measure.

Sediment damages may be related to (1) deposition of eroded materials on flood plains, in channels, reservoirs, residences, utilities, and other properties that require the removal and disposition of materials, and the repairing of damaged facilities and (2) swamping damage which adversely affects existing features or limits potential improvement of land caused by a rise in the ground water table or by impairing surface drainage.

Sediment resulting from construction sites can be deposited along a stream and cause individual landowners to pay for its removal. Sediment can also destroy aesthetic values of a stream (clean water vs. turbid water) and adversely impact stream fisheries and micro-organisms.

In municipal and industrial uses where water is pumped directly from a river or reservoir, slugs of sediment associated with excessive rainfall may pose severe water quality problems. Turbidity may be increased, necessitating increased treatment, which raises the cost of operations. Sediment may also be deposited in storm drains, reducing their ability to control flooding. This increases flood damage and requires the cleanout of sediment from the storm drain systems.

Pricing Treatment Measures and Benefits

Prices applied should reflect values expected to prevail at the time of occurrence. Current prices are used for installation costs of treatment measures. Projected

normalized prices (based on past prices and trends) should be used for estimating future values (benefits, operations and maintenance costs and replacement costs) for permanent type measures only.

Period of Analysis and Evaluation

The period of analysis in years should equal the economic life (need for a measure) or the physical life of treatment measures, whichever is less. The benefits considered over the evaluation period include those accruing over the period.

The annual costs of permanent measures chargeable to the evaluation period include the amortized installation cost and the future annual operation, maintenance, and replacement cost necessary to provide the benefits over the evaluation period. The amortization rate should be based on prevailing local interest rates at the time of installation.

Appraisal of Damages and Treatment Costs

Many people are affected by the damages resulting from erosion and sedimentation. Also, communities and individuals benefit from its prevention, reduction, or mitigation.

Costs will be incurred to: (1) install remedial treatment measures; or (2) correct damages; or (3) a combination of the two.

Treatment Measures

Treatment measures on developing sites are frequently temporary—generally lasting up to one or two construction seasons. Benefits and cost for temporary measures can be compared directly using current prices.

Permanent measures are planned to trap sediment and control erosion and runoff during and beyond the construction period. The prevention of sediment damages can be accomplished by either, or both of, two methods:

1. Stabilizing sediment source areas by applying conservation erosion control measures.
2. Trapping sediment before it leaves the construction area (sediment control)

Erosion control is almost always more effective than sediment control at preventing sediment damage. Some of the potential benefits from preventing downstream sediment transport and deposition include:

1. Prevention or reduction in cost of removal and disposition of sediment from properties.
2. Prevention or reduction in damage to property.
3. Prevention of water quality impairment.

Some permanent measures may be retained to provide long-term benefits.

For example, a sediment basin may be cleaned out after construction is finished and utilized for aesthetics, recreation, fish, or stormwater management.

Benefits and costs for permanent measures need to be converted by discounting and amortizing to average annual figures for comparison.

Benefit-Cost Analysis

A simple equation for determining the benefits of controlling sediment is:

$$B = (S \times Y) - [C + (S \times Y)(1.00 - P)]$$

Where: B = Benefits in dollars.

S = Cubic yards of sediment expected to move off the site if no control measures are applied. (See Section 3).

Y = Cost in dollars per yard to recover and dispose of sediment that has moved off the site.

C = Estimated cost of temporary measures to be installed. (See Cost Tables).

P = Estimated effectiveness of proposed measures expressed as a decimal.

Example

This example illustrates the methodology of a benefit-cost analysis:

Given: A construction site of 78 acres, which without erosion or sediment control measures will yield about 5 acre feet or 8,000 cubic yards of sediment (S) to the lower end of the site. There is a channel with several culverts located below the site and it is assumed all the sediment would be deposited in it. It would be necessary to remove all the additional sediment in order to maintain the capacity of the channel and avoid increased hazard to flooding. The cost of removing and disposing the sediment is estimated at \$2.00 per cubic yard (Y).

With temporary erosion and sediment control measures, including a sediment basin, in place during the one year construction period, sediment delivered to the channel will

be reduced 90 percent (P). The cost of the measures would be as follows, (no amortization is required since costs and benefits are incurred in a similar one year period):

1. Land grading measures.....\$2,000
2. Temporary sediment basin.....\$3,000
 - a. Construction.....\$1,500
 - b. Maintenance.....\$1,000
 - c. Restoration.....\$500

Total Cost (C).....\$5,000

The “without treatment” condition reveals damages in the form of costs to remove sediment. Benefit (costs saved) are derived by subtracting the sediment removal costs under the “with treatment” condition.

1. Without treatment condition

8,000 cu.yd. (S) x \$2.00/cu.yd. (Y) = \$16,000 (SxY)
2. With treatment condition
 - a. Costs (C) described above =\$5,000
 - b. Removal costs for the 10% of sediment that passes through the control measure (measure is 90% effective)

$(S \times Y)(1.00 - P) = (16,000)(1.00 - .90) \dots \$1,600$
 - c. Total Cost = \$5,000 + \$1,600 = \$6,600
3. Benefits

$\$16,000 - \$6,600 = \dots \$9,400$ (B)
(\$9,400 is money saved by installing sediment treatment)

Using the formula directly, the computations show the same results:

$$B = (S \times Y) - [C + (S \times Y)(1.00 - P)]$$

$$B = (\$8,000 \times 2.00) - [(\$5,000 + (8,000 \times 2.00)(1.00 - 0.90)]$$

$$B = (\$16,000) - (\$5,000 + 1,600)$$

$$B = (\$16,000) - (\$6,600)$$

$$B = \$9,400$$

In this example, the more economical approach would be to install treatment measures rather than correct damages at a later date. A third alternative would be “do nothing” which would result in a higher flood damage hazard that would need evaluation under a more sophisticated analytical model. **Also, in this simple example, water quality issues (such as habitat loss) were not included even though society, in general, does place a value on such issues.**

Table C.1—Cost Table of Selected Practices

The cost of implementing erosion and sediment control practices is highly variable and dependent upon many factors including availability and proximity of materials, time of year, prevailing wage rates, and regional cost trends to name a few. It is therefore difficult to develop cost estimates that are applicable statewide and year-round. The cost data contained in this chapter is based on actual bid prices from county and state highway construction projects, and suppliers for the year 2013. The following cost figures for selected practices, are provided to aid project planners in estimating erosion and sediment cost for feasibility studies. Values have been rounded to nearest dollar. **The actual dollar amounts are not recommended for use in estimating and bidding construction contracts.** It is advisable to check with local suppliers and contractors for this purpose.

Erosion and Sediment Control Measures	\$ Low	\$ High	\$ Median
VEGETATIVE MEASURES			
Temporary Seeding	750/ac.	1,950/ac.	1,050/ac.
Permanent Seeding	2,850/ac.	5,000/ac.	3,800/ac.
Straw Mulch	1,250/ac.	1,900ac.	1,400/ac.
Wood Mulch	-	32,000/ac.	32,000/ac.
Topsoil Stripping	-	-	3/cu.yd.
Topsoil Spreading	-	-	38/cu.yd.
Sodding	-	-	23/sq.yd.
RECP Netting	8/sq.yd.	10/sq.yd.	9/ sq.yd.
Tree Protection	-	-	10/ln.ft.
BIOTECHNICAL MEASURES			
Willow Wattles	-	-	19/ln.ft.
Live Stakes	5.85	9.00	7/ea.
Brush Layering	-	-	15/ln.ft.
RUNOFF CONTROL MEASURES			
Temporary Swale	4/ln.ft.	6/ln.ft.	5/ln.ft.
Rock Check Dam	248/ea.	860/ea.	500/ea.
Diversion or Grass Channel	12/ln.ft.	23/ln.ft.	19/ln.ft.
Riprap Channel	70/cu.yd.	105/cu.yd.	86/cu.yd.
Flow Spreader/Diffuser	-	-	48/ln.ft.
Rock Outlet Structure	-	-	1,900/ea.
Turf Reinforcement Mats			25/ sq.yd

Table C.1 (cont'd)
Cost Table for Selected Practices

Erosion and Sediment Control Measures	\$ Low	\$ High	\$ Median
SEDIMENT CONTROL MEASURES			
Silt Fence	4ln.ft.	10/ln.ft.	6/ln.ft.
Straw Bale Dike	6/ln.ft.	10/ln.ft.	8/ln.ft.
Stabilized Construction Access	-	-	57/cu.yd.
Temporary Sediment Basin	-	-	96/cu.yd.
Temporary Sediment Trap	1,100/ea.	3,800/ea.	2,900/ea.
Temporary Sediment Dike	-	-	23/ln.ft.
Turbidity Curtain	8/sq.yd.	105/sq.yd.	60/sq.yd.
Filter Fabric Inlet Protection	-	-	190/ea.
Excavated Drop Inlet Protection	-	-	950/ea.
Temporary Sediment Tank	-	-	5,000/ea.
Block & Gravel Inlet Protection	-	-	1,000/ea.
Compost Filter Sock			50/ln.ft.
Geotextile Filter Bag			700/ea.
Sediment Basin Skimmer			1,200/ea.
Concrete Truck Washout Facility			1,500/ea.

Table C.2
Maintenance Cost As Percentage of Installation Cost

<u>Item</u>	<u>Percentage (%)</u>
Seeding	20
Mulch	2
Silt Fence	100
Sediment Trap	30
Sediment Basin	25
Inlet Protection	60
Stabilized Construction Entrance	100
Rock Riprap	10
Grass Channel	10
Temporary Swale	50
Flow Spreader	50
Tree Protection	30
Rock Outlet Structure	20

References

1. Soil Conservation Service, USDA. Oct. 1977. National Handbook for Conservation Practices, U.S. Government Printing Office, Washington, D.C.
2. Soil Conservation Service, USDA. July 1984. Engineering Field Manual of Conservation Practices, 4th Printing, U.S. Government Printing Office, Washington, D.C.
3. Soil Conservation Service, USDA. Sept. 1987. Drainage Guide for New York State, Syracuse, N.Y.

APPENDIX D
EROSION & SEDIMENT CONTROL PLAN
FOR SMALL HOMESITE CONSTRUCTION

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EROSION AND SEDIMENT CONTROL PLAN FOR SMALL HOMESITE CONSTRUCTION

Definition

Small homesite erosion and sediment control plans are a group of minimum erosion and sediment control practices and management techniques that apply to small homesite construction activity on a single residential lot, in order to prevent polluted discharge.

Purpose

This appendix lays out a series of minimum requirements for erosion and sediment control, and management practices that may be used to meet these requirements. Use of these templates will help show compliance with the general requirements for construction activities that require basic stormwater pollution prevention plans (SWPPP). This applies to the construction of small homesites. The owner/developer must complete the relevant conditions (1-4), or small parcel erosion and sediment control plan included in this section, and submit the NOI in order to meet compliance with the SPDES General Permit for Stormwater Discharges From Construction Activities.

Criteria

Generally, several types of practices are required on any one site for effective erosion and sediment control. There are three broad categories of construction-related practices for controlling erosion and sediment on small homesite developments:

1. **Cover practices** prevent erosion by protecting the soil surface from rainfall and runoff. Prevention of erosion is the most preferable and cost-effective approach. These practices include: protection of existing vegetation; temporary covering of exposed soil by mulching, matting, or covering; and permanent site stabilization by topsoiling, seeding, and/or sodding.
2. **Structural Practices** are structural controls that either reduce erosion, control runoff, or keep sediment on the construction site. Examples of these practices include stabilized construction entrances, silt fences, sediment traps, berms, and check dams.
3. **Management Measures** are construction management methods that prevent or reduce erosion potential and ensure the proper functioning of erosion and sediment control practices. Careful construction management can dramatically reduce the costs associated with erosion and sediment problems. Examples of these management measures include:
 - Preserving existing trees and grass where possible

to prevent erosion;

- Decompacting and re-vegetating the site as soon as possible;
- Locating soil piles away from roads or waterways;
- Limiting tracking of mud onto streets by requiring all vehicles to use designated access drives;
- Removing sediment carried off-site by vehicles or storms;
- Installing downspout extenders to prevent erosion from roof runoff; and
- Maintaining erosion and sediment practices through sediment removal, structure replacement, etc.

Specifications

Each construction site is different. The owner/developer of a small construction site may choose and follow one of the four variations of ESC plans included in this section to develop a SWPPP in compliance with the SPDES Construction Permit For Stormwater Discharges From Construction Activities. However, because of the general nature of the following conditions, **the plans included in this section may not cover all of the resource protection needs on a particular site, and this form does not exempt an owner from the responsibility of filing an NOI, if required.**

Small Homesite Minimum Requirements:

1. Stabilized Construction Entrance:

To prevent vehicles and equipment from tracking sediment and mud off-site, apply gravel or crushed rock to the driveway area and restrict traffic to this one route. This practice will help keep soil from sticking to tires and stop soil from washing off into the street. Carry out periodic inspections and maintenance including washing, top-dressing with additional stone, reworking, and compaction. Plan for periodic street cleaning to remove any sediment that may have been tracked off-site. Remove sediment by shoveling or sweeping and transport to a suitable disposal area where it can be stabilized.

2. Stabilization of Denuded Areas:

In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the current soil disturbance activity ceased. For construction sites that directly discharge to one of the 303 (d) segments listed in the Construction General Permit or is

located in one of the watersheds listed in Appendix C, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased.

Stabilize disturbed areas by implementing soil covering practices (e.g. mulching, matting, sodding). Exposed soils are the most prone to erosion from rainfall and runoff. Vegetation helps protect the soil from these forces and provides natural erosion control. Plan construction to limit the amount of exposed area, and avoid grading activities during the rainy season (November through March) as much as possible. Clearing limits should be clearly marked and kept as small as possible. Once construction is completed, the site must be permanently stabilized with topsoiling, seeding and plantings, or sodding if needed.

3. Protection of Adjacent Properties:

Keep sediment on-site by using structural and source control practices (e.g. vegetative buffer strips, sediment barriers, soil berms or dikes, etc). See Sections 3, 4, or 5 as appropriate. Wherever possible, preserve a buffer of existing vegetation around the site boundary. This will help to decrease runoff velocities and trap sediment suspended in the runoff. Other structural controls such as filter fence or straw bale barriers should also be used to filter runoff and trap sediment on-site.

When excavating basement soils, move the soil to a location that is, or will be, vegetated, such as in the backyard or side yard area. This will increase the distance eroded soil must travel, through vegetation, to reach the storm sewer system. Piles should be situated so that sediment does not run into the street or adjoining yards. Soil piles should be temporarily seeded and circled with silt fence until the soil is either replaced or removed. Backfill basement walls as soon as possible and rough grade the lot. This will eliminate the large soil mounds, which are highly erodible, and prepare the lot for temporary cover. After backfilling, grade or remove excess soil from the site quickly, to eliminate any sediment loss from surplus fill.

4. Concentrated Flow:

For constructed drainage ways, or other areas of concentrated flow, install check dams according to the specifications on page E.12 to reduce erosion in the channel. As with other erosion controls, check dams must be inspected regularly. Remove sediment accumulated behind the dam as needed to allow channel to drain through the stone check dam and prevent large flows from carrying sediment over the dam. Replace stones as needed to maintain the design cross section of the structures. Sediment removal is crucial to the effectiveness of the

dam—if not maintained, high flows could cause erosion around the sides of the structures, adding significant sediment loads downstream.

5. Maintenance:

Maintain erosion and sediment control practices through regular inspection. Regular maintenance is extremely important for the proper operation of structural practices. After initial groundbreaking, the responsible contractor shall conduct daily maintenance inspections within the active work area to ensure practices are being maintained in effective operating conditions at all times.

6. Soil Restoration:

Soils that have been disturbed and compacted due to construction activities should be de-compacted to restore their previous hydrologic condition. This normally involves aeration of small areas for home sites. Large areas should be restored in accordance with the Soil Restoration standard in Section 4 of this book of standards.

7. Other Practices:

Use additional practices as required by the local plan approval authority to mitigate effects of increased runoff. This may include providing additional controls to a locally protected stream or resource area, protecting riparian corridors (vegetative stream buffers), etc. Individual homeowners and/or developers are responsible for researching additional requirements related to erosion and sediment runoff control established by their local jurisdictions.

Figure D.1
Erosion Control Plan Condition 1

<p>EROSION CONTROL PLAN LEGEND</p> <p>— — — — — PROPERTY LINE</p> <p>— — — — — EXISTING DRAINAGE</p> <p>— — — — — FINISHED DRAINAGE</p> <p>— — — — — LIMITS OF GRADING</p> <p>● — — — — — STRAW BALES</p> <p>■ — — — — — SILT FENCE</p> <p>① — — — — — VEGETATION SPECIFICATION</p> <p>⊗ — — — — — TREE PRESERVATION</p> <p>▨ — — — — — STOCKPILED SOIL</p> <p>▩ — — — — — GRAVEL</p>	<p>NOTES:</p> <p>1. On moderate slopes, up to 8 percent, silt fence and straw bales may be used interchangeably.</p> <p>2. Slopes exceeding 25 percent shall have silt fence backed by straw bales for support.</p> <p>3. Use additional practices as required by the local plan approval authority to mitigate effects of post construction runoff.</p>	<p>EROSION CONTROL PLAN CONDITION 1</p>
<p>The diagram shows a property layout with a 'HOUSE' and a 'GARAGE'. A 'STABILIZED CONSTRUCTION ENTRANCE' is indicated. Erosion control measures are shown: a silt fence (dashed line with squares) and straw bales (dashed line with circles) are placed on the contour of a slope. Vegetation (circles with a dot) and tree preservation (circles with a cross) are also marked. A note 'Placed on the Contour' points to the silt fence. A note '3. Use additional practices as required by local code enforcement or as needed to mitigate water quality impacts.' is present. The property is adjacent to a 'STREET' and an 'EXISTING CURB AND GUTTER'.</p>		
<p>NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE</p>		

PROJECT LOCATION:	PROPERTY OWNER:	SLOPE:
ANTICIPATED STARTING DATE:	CONTRACTOR:	SOIL TYPE:
ANTICIPATED COMPLETION DATE:		

Condition 1—Vegetative Requirements & Compliance Form

Vegetation Requirements:

1) Site Preparation

- A. Install needed water and erosion control measures and bring area to be seeded to desired grades using a minimum of 4 in. topsoil.
- B. Prepare seedbed by loosening soil to a depth of 4-6 inches.
- C. Lime to a pH of 6.5
- D. Fertilize as per soil test or, if fertilizer must be applied before soil test results are received, apply 850 pounds of 5-10-10 or equivalent per acre (20 lbs/1,000 sq. ft.)
- E. Incorporate lime and fertilizer in top 2-4 inches of topsoil.
- F. Smooth. Remove all stones over 1 inch in diameter, sticks, and foreign matter from the surface. Firm the seedbed.

2) Planting—Sunny Location.

Upon completing soil de-compaction, use a cultipacker type seeder if possible. Seed to a depth of 1/8 to 1/4 inch. If seed is to be broadcast, cultipack or roll after seeding. If hydroseeded, lime and fertilizer may be applied through the seeder and rolling is not practical. Seed using the following mix and rates:

Species (% by weight)	lbs/1,000sq. ft	lbs./acre
65% Kentucky bluegrass blend.....	2.0-2.6.....	85-114
20% perennial ryegrass.....	0.6-0.8.....	26-35
15% fine fescue.....	0.4-0.6.....	19-26
Total.....	3.0-4.0.....	130-175
or,		
100% Tall fescue, Turf-type, fine leaf.....	3.4-4.6.....	150-200

- 3) When using the cultipacker or broadcast seed method, mulch using small grain straw, applied at a rate of 2 tons per acre; and anchor with a netting or tackifier. Hydroseed applications should include mulch, fertilizer and seed.

Common white clover can be added to mixtures at the rate of 1-2 lbs/acre to help maintain green color during the dry summer period, however, they will not withstand heavy traffic. Fertilizing—First year, (spring seedlings) three to four weeks after germination apply 1 pound nitrogen/1,000 square feet using a complete fertilizer with a 2-1-1 or 4-1-3 ratio or as recommended by soil test results. For summer and early fall seedings, apply as above unless air temperatures are above 85°F for extended period. Wait until heat wave is over to fertilize. For late fall/ winter seedings, fertilize in spring. Restrict use—new seedlings should be protected from use for one full year to allow development of a dense sod with good root structure.

Certification Statement

Please complete and sign this 2-sided document (with Typical Erosion Control Plan) and attach to BLUEPRINTS and SITE PLAN prior to any earth disturbance. These documents must be kept on site and be available for review as requested by any agent of the NYSDEC. **This 2-sided form can be used as a basic stormwater pollution prevention plan, but will not exempt a landowner from filing a Notice of Intent.**

"I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the qualified inspectors during a site inspection. I also understand that the owner or operator must comply with the term and conditions of the most current version of the New York State Pollutant Discharge Elimination System (SPDES) general permit for stormwater discharges from construction activities and that is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for know violations."

Builder/Contractor (print)

Signature

Address

Figure D.2
Erosion Control Plan Condition 2

<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>EROSION CONTROL PLAN LEGEND</p> <p>PROPERTY LINE</p> <p>EXISTING DRAINAGE</p> <p>FINISHED DRAINAGE</p> <p>LIMITS OF GRADING</p> <p>STRAW BALES</p> <p>SILT FENCE</p> <p>VEGETATION SPECIFICATION</p> <p>TREE PRESERVATION</p> <p>STOCKPILED SOIL</p> <p>GRAVEL</p> </div> <div style="width: 50%;"> <p>NOTES:</p> <p>1. On moderate slopes, up to 8 percent, silt fence and straw bales may be used interchangeably.</p> <p>2. Slopes exceeding 25 percent shall have silt fence backed by straw bales for support.</p> <p>3. Use additional practices as required by the local plan approved by the local plan approval authority to mitigate effects of post construction runoff.</p> </div> </div> <div style="margin-top: 20px;"> <p>The diagram shows a property layout with a 'HOUSE' and a 'GARAGE'. A 'STABILIZED CONSTRUCTION ENTRANCE' is shown with a gravel area. Erosion control measures are indicated by symbols: silt fences (dashed lines with flags), straw bales (rows of circles), and vegetation (circles with dots). A 'Placed on the Contour' label points to a silt fence. The plan also shows property lines, existing and finished drainage, and limits of grading. A 'STREET' is shown at the bottom with an 'EXISTING CURB AND GUTTER'.</p> </div>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">PROJECT LOCATION:</td> <td style="width: 50%;">PROPERTY OWNER:</td> </tr> <tr> <td>ANTICIPATED STARTING DATE:</td> <td>CONTRACTOR:</td> </tr> <tr> <td>ANTICIPATED COMPLETION DATE:</td> <td>SOIL TYPE:</td> </tr> <tr> <td colspan="2">SLOPE:</td> </tr> </table>	PROJECT LOCATION:	PROPERTY OWNER:	ANTICIPATED STARTING DATE:	CONTRACTOR:	ANTICIPATED COMPLETION DATE:	SOIL TYPE:	SLOPE:	
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ANTICIPATED STARTING DATE:	CONTRACTOR:								
ANTICIPATED COMPLETION DATE:	SOIL TYPE:								
SLOPE:									
<p align="center">NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE</p>									
<p align="center">EROSION CONTROL PLAN CONDITION 2</p>									

Condition 2—Vegetative Requirements & Compliance Form

Vegetation Requirements:

1) Site Preparation

- A. Install needed water and erosion control measures and bring area to be seeded to desired grades using a minimum of 4 in. topsoil.
- B. Prepare seedbed by loosening soil to a depth of 4-6 inches.
- C. Lime to a pH of 6.5
- D. Fertilize as per soil test or, if fertilizer must be applied before soil test results are received, apply 850 pounds of 5-10-10 or equivalent per acre (20 lbs/1,000 sq. ft.)
- E. Incorporate lime and fertilizer in top 2-4 inches of topsoil.
- F. Smooth. Remove all stones over 1 inch in diameter, sticks, and foreign matter from the surface. Firm the seedbed.

2) Planting—Sunny Location.

Upon completing soil de-compaction, use a cultipacker type seeder if possible. Seed to a depth of 1/8 to 1/4 inch. If seed is to be broadcast, cultipack or roll after seeding. If hydroseeded, lime and fertilizer may be applied through the seeder and rolling is not practical. Seed using the following mix and rates:

<u>Species (% by weight)</u>	<u>lbs/1,000sq. ft</u>	<u>lbs./acre</u>
65% Kentucky bluegrass blend.....	2.0-2.6.....	85-114
20% perennial ryegrass.....	0.6-0.8.....	26-35
15% fine fescue.....	0.4-0.6.....	19-26
Total.....	3.0-4.0.....	130-175
or,		
100% Tall fescue, Turf-type, fine leaf.....	3.4-4.6.....	150-200

- 3) When using the cultipacker or broadcast seed method, mulch using small grain straw, applied at a rate of 2 tons per acre; and anchor with a netting or tackifier. Hydroseed applications should include mulch, fertilizer and seed.

Common white clover can be added to mixtures at the rate of 1-2 lbs/acre to help maintain green color during the dry summer period, however, they will not withstand heavy traffic. Fertilizing—First year, (spring seedlings) three to four weeks after germination apply 1 pound nitrogen/1,000 square feet using a complete fertilizer with a 2-1-1 or 4-1-3 ratio or as recommended by soil test results. For summer and early fall seedings, apply as above unless air temperatures are above 85°F for extended period. Wait until heat wave is over to fertilize. For late fall/ winter seedings, fertilize in spring. Restrict use—new seedlings should be protected from use for one full year to allow development of a dense sod with good root structure.

Certification Statement

Please complete and sign this 2-sided document (with Typical Erosion Control Plan) and attach to BLUEPRINTS and SITE PLAN prior to any earth disturbance. These documents must be kept on site and be available for review as requested by any agent of the NYSDEC. **This 2-sided form can be used as a basic stormwater pollution prevention plan, but will not exempt a landowner from filing a Notice of Intent.**

"I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the qualified inspectors during a site inspection. I also understand that the owner or operator must comply with the term and conditions of the most current version of the New York State Pollutant Discharge Elimination System (SPDES) general permit for stormwater discharges from construction activities and that is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for know violations."

Builder/Contractor (print)

Signature

Address

Figure D.3
Erosion Control Plan Condition 3

<p>EROSION CONTROL PLAN LEGEND</p> <p>— — — — — PROPERTY LINE</p> <p>— — — — — EXISTING DRAINAGE</p> <p>— — — — — FINISHED DRAINAGE</p> <p>— — — — — LIMITS OF GRADING</p> <p>● — — — — — STRAW BALES</p> <p>■ — — — — — SILT FENCE</p> <p>① — — — — — VEGETATION SPECIFICATION</p> <p>⊙ — — — — — TREE PRESERVATION</p> <p>▨ — — — — — STOCKPILED SOIL</p> <p>▩ — — — — — GRAVEL</p>	<p>NOTES:</p> <p>1. On moderate slopes, up to 8 percent, silt fence and straw bales may be used interchangeably.</p> <p>2. Slopes exceeding 25 percent shall have silt fence backed by straw bales for support.</p> <p>3. Use additional practices as required by the local plan approval authority to mitigate effects of post construction runoff.</p>												
<p style="text-align: center;">Placed on the Contour</p>													
<p align="center">STREET</p> <p align="center">EXISTING CURB AND GUTTER</p>													
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<p>NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE</p>													
<p align="center">EROSION CONTROL PLAN CONDITION 3</p>													

Condition 3—Vegetative Requirements & Compliance Form

Vegetation Requirements:

1) Site Preparation

- A. Install needed water and erosion control measures and bring area to be seeded to desired grades using a minimum of 4 in. topsoil.
- B. Prepare seedbed by loosening soil to a depth of 4-6 inches.
- C. Lime to a pH of 6.5
- D. Fertilize as per soil test or, if fertilizer must be applied before soil test results are received, apply 850 pounds of 5-10-10 or equivalent per acre (20 lbs/1,000 sq. ft.)
- E. Incorporate lime and fertilizer in top 2-4 inches of topsoil.
- F. Smooth. Remove all stones over 1 inch in diameter, sticks, and foreign matter from the surface. Firm the seedbed.

2) Planting—Sunny Location.

Upon completing soil de-compaction, use a cultipacker type seeder if possible. Seed to a depth of 1/8 to 1/4 inch. If seed is to be broadcast, cultipack or roll after seeding. If hydroseeded, lime and fertilizer may be applied through the seeder and rolling is not practical. Seed using the following mix and rates:

Species (% by weight)	lbs/1,000sq. ft	lbs./acre
65% Kentucky bluegrass blend.....	2.0-2.6.....	85-114
20% perennial ryegrass.....	0.6-0.8.....	26-35
15% fine fescue.....	0.4-0.6.....	19-26
Total.....	3.0-4.0.....	130-175
or,		
100% Tall fescue, Turf-type, fine leaf.....	3.4-4.6.....	150-200

- 3) When using the cultipacker or broadcast seed method, mulch using small grain straw, applied at a rate of 2 tons per acre; and anchor with a netting or tackifier. Hydroseed applications should include mulch, fertilizer and seed.

Common white clover can be added to mixtures at the rate of 1-2 lbs/acre to help maintain green color during the dry summer period, however, they will not withstand heavy traffic. Fertilizing—First year, (spring seedlings) three to four weeks after germination apply 1 pound nitrogen/1,000 square feet using a complete fertilizer with a 2-1-1 or 4-1-3 ratio or as recommended by soil test results. For summer and early fall seedings, apply as above unless air temperatures are above 85°F for extended period. Wait until heat wave is over to fertilize. For late fall/ winter seedings, fertilize in spring. Restrict use—new seedlings should be protected from use for one full year to allow development of a dense sod with good root structure.

Certification Statement

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Builder/Contractor (print)

Signature

Address

Figure D.4
Erosion Control Plan Condition 4

<p>EROSION CONTROL PLAN LEGEND</p> <p>— PROPERTY LINE</p> <p>— EXISTING DRAINAGE</p> <p>— FINISHED DRAINAGE</p> <p>--- LIMITS OF GRADING</p> <p>● STRAW BALES</p> <p>■ SILT FENCE</p> <p>① VEGETATION SPECIFICATION</p> <p>⊙ TREE PRESERVATION</p> <p>▨ STOCKPILED SOIL</p> <p>▩ GRAVEL</p>	<p>NOTES:</p> <p>1. On moderate slopes, up to 8 percent, silt fence and straw bales may be used interchangeably.</p> <p>2. Slopes exceeding 25 percent shall have silt fence backed by straw bales for support.</p> <p>3. Use additional practices as required by the local plan approval authority to mitigate effects of post construction runoff.</p>	<p>EXISTING CURB AND GUTTER</p> <p>STREET</p> <p>PROPERTY OWNER:</p> <p>CONTRACTOR:</p> <p>SOIL TYPE:</p> <p>SLOPE:</p>
<p>The diagram illustrates a property layout for an erosion control plan. It shows a 'HOUSE' and a 'GARAGE' situated next to a 'STABILIZED CONSTRUCTION ENTRANCE'. A '25' BUFFER' is indicated along the property line. The plan includes a legend for various erosion control measures: Property Line, Existing/Finished Drainage, Limits of Grading, Straw Bales, Silt Fence, Vegetation Specification (marked with ①), Tree Preservation (marked with ⊙), Stockpiled Soil (hatched), and Gravel (cross-hatched). Notes specify that on moderate slopes (up to 8%), silt fences and straw bales can be used interchangeably, and that slopes exceeding 25% must have silt fences backed by straw bales. It also states that additional practices may be required by local plan approval authorities to mitigate post-construction runoff.</p>		
<p>NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE</p>		
<p>EROSION CONTROL PLAN CONDITION 4</p>		

Condition 4—Vegetative Requirements & Compliance Form

Vegetation Requirements:

1) Site Preparation

- A. Install needed water and erosion control measures and bring area to be seeded to desired grades using a minimum of 4 in. topsoil.
- B. Prepare seedbed by loosening soil to a depth of 4-6 inches.
- C. Lime to a pH of 6.5
- D. Fertilize as per soil test or, if fertilizer must be applied before soil test results are received, apply 850 pounds of 5-10-10 or equivalent per acre (20 lbs/1,000 sq. ft.)
- E. Incorporate lime and fertilizer in top 2-4 inches of topsoil.
- F. Smooth. Remove all stones over 1 inch in diameter, sticks, and foreign matter from the surface. Firm the seedbed.

2) Planting—Sunny Location.

Upon completing soil de-compaction, use a cultipacker type seeder if possible. Seed to a depth of 1/8 to 1/4 inch. If seed is to be broadcast, cultipack or roll after seeding. If hydroseeded, lime and fertilizer may be applied through the seeder and rolling is not practical. Seed using the following mix and rates:

Species (% by weight)	lbs/1,000sq. ft	lbs./acre
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15% fine fescue.....	0.4-0.6.....	19-26
Total.....	3.0-4.0.....	130-175
or,		
100% Tall fescue, Turf-type, fine leaf.....	3.4-4.6.....	150-200

- 3) When using the cultipacker or broadcast seed method, mulch using small grain straw, applied at a rate of 2 tons per acre; and anchor with a netting or tackifier. Hydroseed applications should include mulch, fertilizer and seed.

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Builder/Contractor (print)

Signature

Address

Construction Details for Stabilized Construction Entrance and Silt

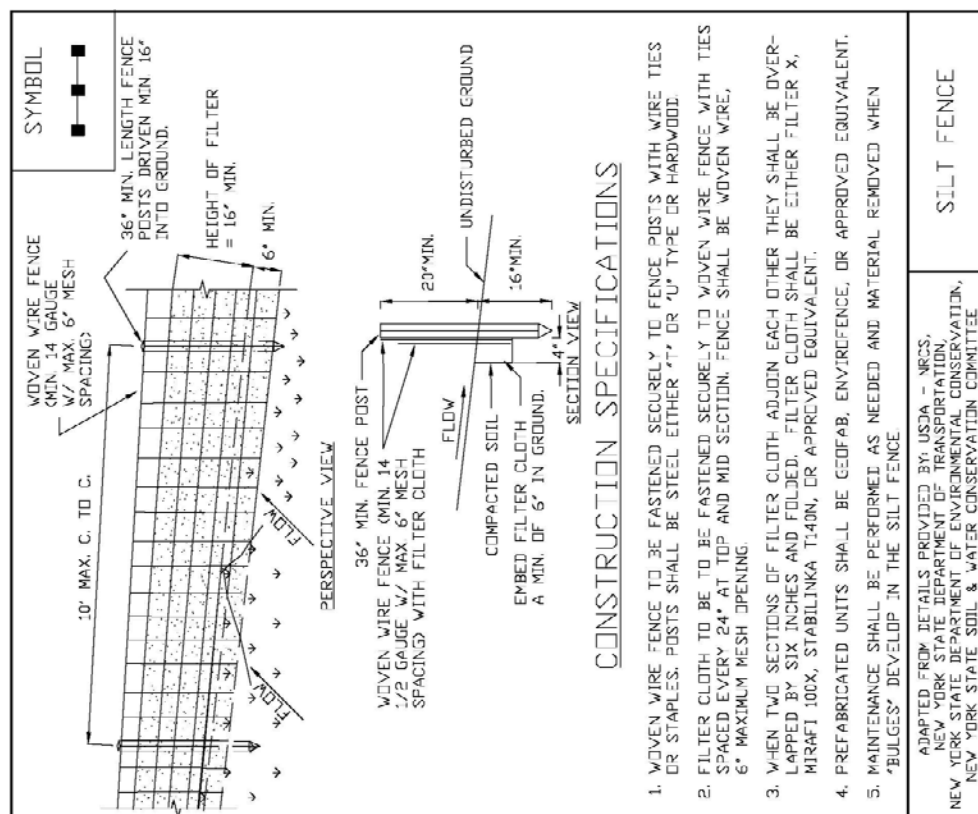
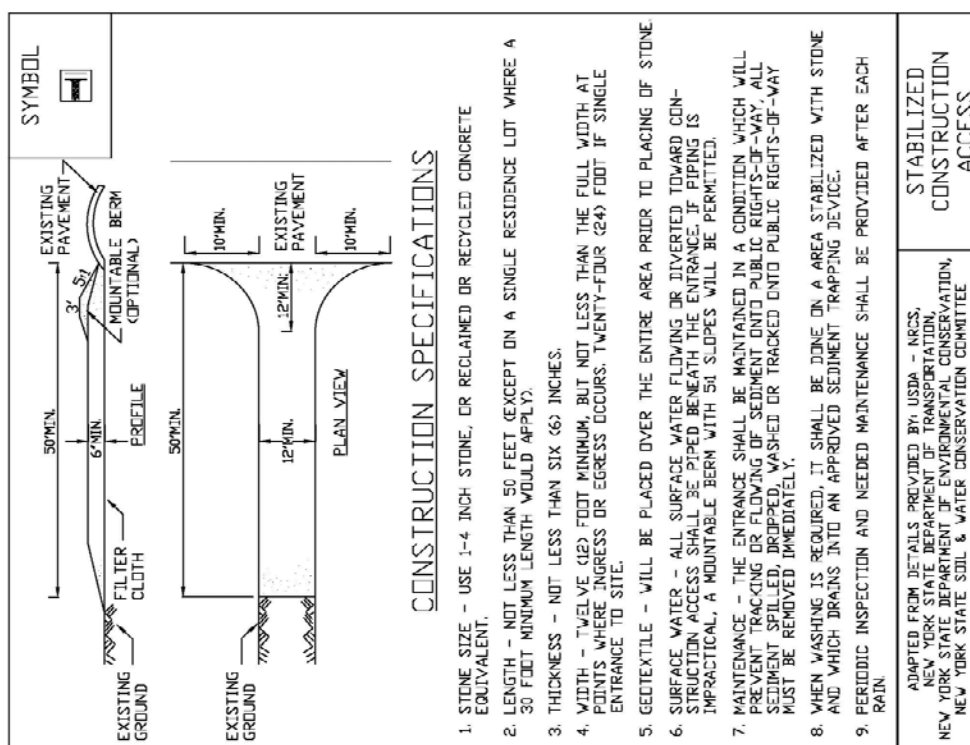
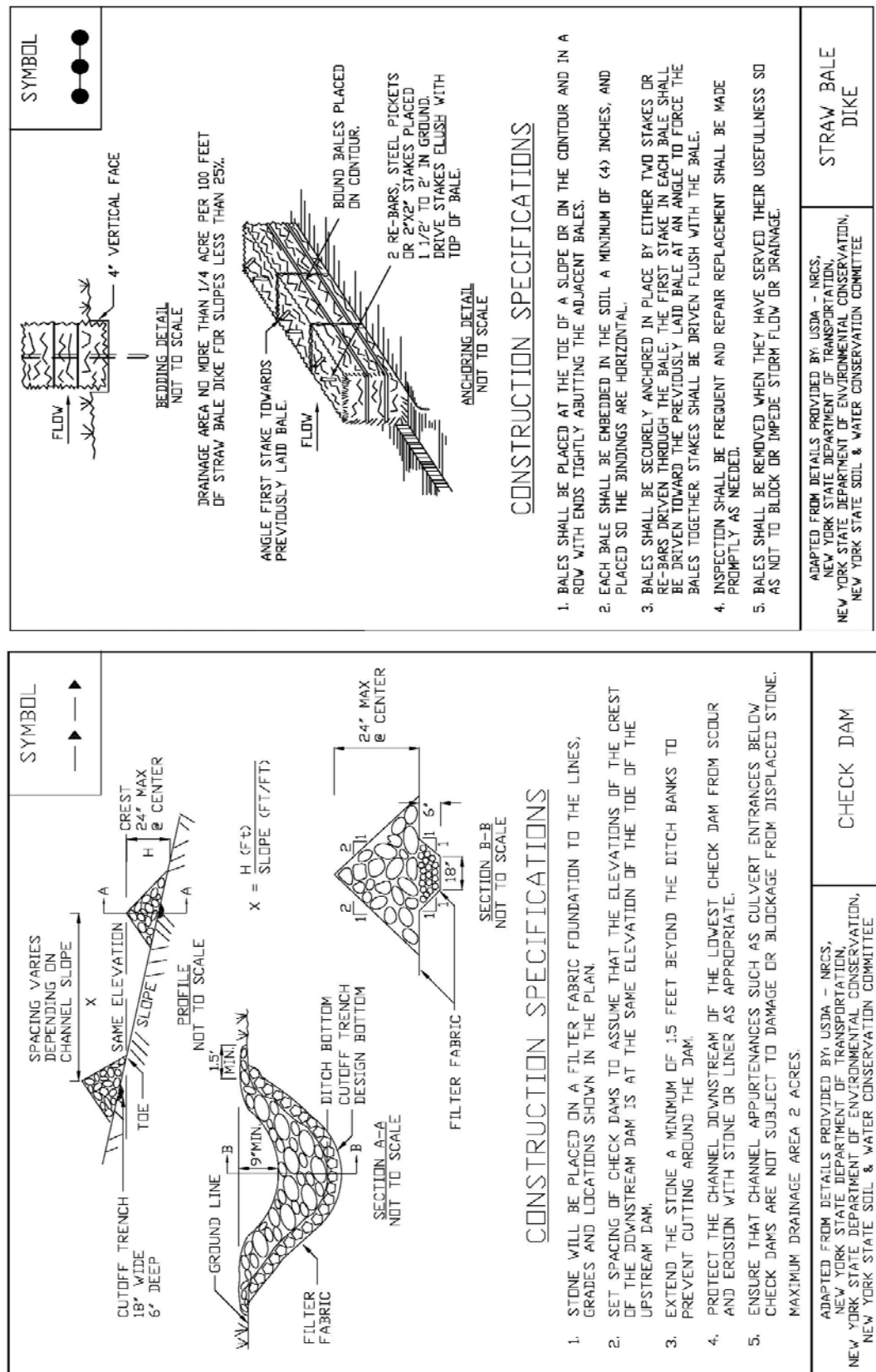


Figure D.6
Construction Details for Straw Bale Dike and Check Dam



APPENDIX E

EROSION AND SEDIMENT CONTROL

PLAN REVIEW CHECKLIST

Project Name _____ Site Location _____

Applicant's Name & Address _____

General

A narrative statement shall be provided that describes the proposed project nature and purpose; the existing site conditions including topography, vegetation and drainage; adjacent and off-site areas affected by the project; description of the soils on the site and key properties; notations of critical areas such as steep slopes, channels or wetlands; the overall phasing, sequencing and stabilization plan; total disturbed area and, areas not to be disturbed, and soil restoration plan.

I. Construction Drawings

Are the following items shown on the construction drawings:	<u>Yes</u>	<u>No</u>
1. Vicinity Map with scale and north arrow	_____	_____
2. Legend, scales, N arrow on plan view	_____	_____
3. Existing and proposed topography shown with contours labeled with spots elevations in critical areas	_____	_____
4. Scope of the plan noted in the Title Block	_____	_____
5. Limits of clearing and grading shown , and methods of spoil disposal	_____	_____
6. Existing vegetation delineated	_____	_____
7. Soil boundaries shown on the existing and proposed plan views	_____	_____
8. Existing drainage patterns, 100 year floodplain and sub-areas shown, runoff outfall locations identified	_____	_____
9. Existing and proposed development facilities/ improvements shown	_____	_____
10. Location of Erosion and Sediment control practices as phased with construction, with dimensions and material specifications	_____	_____
11. Phasing plan with 5 acre threshold limits shown	_____	_____
12. Stockpile locations, staging areas, access points, and concrete trunk washout locations clearly defined	_____	_____
13. Street profiles, utility locations, property boundaries and, easement delineations shown	_____	_____
14. Soil Restoration Plan detailed on the site plan	_____	_____

II. <u>Construction Notes & Details</u>		<u>Yes</u>	<u>No</u>
1. Specific sequence of operation given for each phase	_____	_____	
2. Inspection and maintenance schedule shown for the specific practices	_____	_____	
3. Design details show all dimensions and installation details necessary for construction	_____	_____	
4. Implementation schedule for E&S practices is provided with removal criteria stated	_____	_____	
5. Site pollution and construction waste management plan incorporated in the notes	_____	_____	
6. Site Inspections during construction are noted on the drawings and are in accordance with the General Permit for Stormwater Discharges from Construction Activities	_____	_____	
III. <u>Erosion & Sediment Control Practices</u>			
A. General	<u>Yes</u>	<u>No</u>	
1. Practice meets purpose and design criteria	_____	_____	
2. Standard details and construction notes are provided	_____	_____	
3. Special timing of practice noted if applicable	_____	_____	
4. Provisions for traffic crossings shown on the drawings where necessary	_____	_____	
B. Practices Controlling Runoff	<u>Yes</u>	<u>No</u>	
1. Positive drainage is maintained with contributing drainage area shown	_____	_____	
2. Flow grades properly stabilized	_____	_____	
3. Adequate outlet or discharge condition stabilized	_____	_____	
4. Necessary dimensions, gradations, calculations, and materials shown	_____	_____	
C. Practices Stabilizing Soil	<u>Yes</u>	<u>No</u>	
1. Seeding rates and areas properly shown on the drawings	_____	_____	
2. Mulch materials and rates specified on the drawings	_____	_____	
3. Sequencing and timing provisions limit soil exposure to 7 to 14 days as appropriate	_____	_____	

C.	Practices Stabilizing Soil (cont'd)	<u>Yes</u>	<u>No</u>
	4. Rolled Erosion Control Products (RECP's) used are specified to location and appropriate weight/tie down	_____	_____
	5. All soil seed bed preparation and amendments are specified on the drawings or in the specifications	_____	_____
	6. The seeding dates are specified to cover the entire year for both temporary and permanent seedings	_____	_____
	7. Maximum created slopes are no steeper than 2 foot horizontal to 1 foot vertical with Cut and Fill slopes shown	_____	_____
D.	Practices Controlling Sediment	<u>Yes</u>	<u>No</u>
	1. Sediment traps/basins are sized in accordance with criteria	_____	_____
	2. The contributing drainage area is shown on the grading plan	_____	_____
	3. All scaled dimensions and volumes are shown on the plan	_____	_____
	4. Maintenance requirements and clean out elevations established for all sediment control practices (50% capacity)	_____	_____
	5. All access points of the project are shown to be stabilized	_____	_____
	6. Storm drain inlets adequately protected	_____	_____
	7. Buffer filter strips are appropriately sited and installed	_____	_____
	7. Silt fences are shown on the contour lines with no more than one quarter acre per 100 foot drainage to it	_____	_____
	8. Temporary sediment traps are not being used at locations of future stormwater infiltration facilities	_____	_____
	9. Dewatering devices for traps and basins are adequately designed with details shown on the plans	_____	_____
	10. Geotextile filter bags are properly sited, sized, and have their maintenance requirements detailed on the drawings	_____	_____
	11. Turbidity curtains are properly located with installation, anchoring, and maintenance details shown on the plans	_____	_____

Additional Comments and Notes

Plan Reviewed By: _____ Date: _____

APPENDIX F
CONSTRUCTION SITE INSPECTION
AND MAINTENANCE LOG BOOK

**STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM FOR CONSTRUCTION
ACTIVITIES**

SAMPLE CONSTRUCTION SITE LOG BOOK

Table of Contents

- I. Pre-Construction Meeting Documents
 - a. Preamble to Site Assessment and Inspections
 - b. Pre-Construction Site Assessment Checklist

- II. Construction Duration Inspections
 - a. Directions
 - b. Modification to the SWPPP

I. PRE-CONSTRUCTION MEETING DOCUMENTS

Project Name _____
Permit No. _____ **Date of Authorization** _____
Name of Operator _____
Prime Contractor _____

a. Preamble to Site Assessment and Inspections

The Following Information To Be Read By All Person's Involved in The Construction of Stormwater Related Activities:

The Operator agrees to have a qualified inspector¹ conduct an assessment of the site prior to the commencement of construction² and certify in this inspection report that the appropriate erosion and sediment controls described in the SWPPP have been adequately installed or implemented to ensure overall preparedness of the site for the commencement of construction.

Prior to the commencement of construction, the Operator shall certify in this site logbook that the SWPPP has been prepared in accordance with the State's standards and meets all Federal, State and local erosion and sediment control requirements. A preconstruction meeting should be held to review all of the SWPPP requirements with construction personnel.

When construction starts, site inspections shall be conducted by the qualified inspector at least every 7 calendar days. The Operator shall maintain a record of all inspection reports in this site logbook. The site logbook shall be maintained on site and be made available to the permitting authorities upon request.

Prior to filing the Notice of Termination or the end of permit term, the Operator shall have a qualified inspector perform a final site inspection. The qualified inspector shall certify that the site has undergone final stabilization³ using either vegetative or structural stabilization methods and that all temporary erosion and sediment controls (such as silt fencing) not needed for long-term erosion control have been removed. In addition, the Operator must identify and certify that all permanent structures described in the SWPPP have been constructed and provide the owner(s) with an operation and maintenance plan that ensures the structure(s) continuously functions as designed.

1 Refer to "Qualified Inspector" inspection requirements in the current SPDES General Permit for Stormwater Discharges from Construction Activity for complete list of inspection requirements.

2 "Commencement of construction" means the initial removal of vegetation and disturbance of soils associated with clearing, grading or excavating activities or other construction activities.

3 "Final stabilization" means that all soil-disturbing activities at the site have been completed and a uniform, perennial vegetative cover with a density of eighty (80) percent has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

b. Pre-construction Site Assessment Checklist

(NOTE: Provide comments below as necessary)

1. Notice of Intent, SWPPP, and Contractors Certification:

Yes No NA

- ☐ ☐ ☐ Has a Notice of Intent been filed with the NYS Department of Conservation?
- ☐ ☐ ☐ Is the SWPPP on-site? Where? _____
- ☐ ☐ ☐ Is the Plan current? What is the latest revision date? _____
- ☐ ☐ ☐ Is a copy of the NOI (with brief description) onsite? Where? _____
- ☐ ☐ ☐ Have all contractors involved with stormwater related activities signed a contractor's certification?

2. Resource Protection

Yes No NA

- ☐ ☐ ☐ Are construction limits clearly flagged or fenced?
- ☐ ☐ ☐ Important trees and associated rooting zones, on-site septic system absorption fields, existing vegetated areas suitable for filter strips, especially in perimeter areas, have been flagged for protection.
- ☐ ☐ ☐ Creek crossings installed prior to land-disturbing activity, including clearing and blasting.

3. Surface Water Protection

Yes No NA

- ☐ ☐ ☐ Clean stormwater runoff has been diverted from areas to be disturbed.
- ☐ ☐ ☐ Bodies of water located either on site or in the vicinity of the site have been identified and protected.
- ☐ ☐ ☐ Appropriate practices to protect on-site or downstream surface water are installed.
- ☐ ☐ ☐ Are clearing and grading operations divided into areas <5 acres?

4. Stabilized Construction Access

Yes No NA

- ☐ ☐ ☐ A temporary construction entrance to capture mud and debris from construction vehicles before they enter the public highway has been installed.
- ☐ ☐ ☐ Other access areas (entrances, construction routes, equipment parking areas) are stabilized immediately as work takes place with gravel or other cover.
- ☐ ☐ ☐ Sediment tracked onto public streets is removed or cleaned on a regular basis.

5. Sediment Controls

Yes No NA

- ☐ ☐ ☐ Silt fence material and installation comply with the standard drawing and specifications.
- ☐ ☐ ☐ Silt fences are installed at appropriate spacing intervals
- ☐ ☐ ☐ Sediment/detention basin was installed as first land disturbing activity.
- ☐ ☐ ☐ Sediment traps and barriers are installed.

6. Pollution Prevention for Waste and Hazardous Materials

Yes No NA

- ☐ ☐ ☐ The Operator or designated representative has been assigned to implement the spill prevention avoidance and response plan.
- ☐ ☐ ☐ The plan is contained in the SWPPP on page _____
- ☐ ☐ ☐ Appropriate materials to control spills are onsite. Where? _____

II. CONSTRUCTION DURATION INSPECTIONS

a. Directions:

Inspection Forms will be filled out during the entire construction phase of the project.

Required Elements:

- 1) On a site map, indicate the extent of all disturbed site areas and drainage pathways. Indicate site areas that are expected to undergo initial disturbance or significant site work within the next 14-day period;
- 2) Indicate on a site map all areas of the site that have undergone temporary or permanent stabilization;
- 3) Indicate all disturbed site areas that have not undergone active site work during the previous 14-day period;
- 4) Inspect all sediment control practices and record the approximate degree of sediment accumulation as a percentage of sediment storage volume (for example, 10 percent, 20 percent, 50 percent);
- 5) Inspect all erosion and sediment control practices and record all maintenance requirements such as verifying the integrity of barrier or diversion systems (earthen berms or silt fencing) and containment systems (sediment basins and sediment traps). Identify any evidence of rill or gully erosion occurring on slopes and any loss of stabilizing vegetation or seeding/mulching. Document any excessive deposition of sediment or ponding water along barrier or diversion systems. Record the depth of sediment within containment structures, any erosion near outlet and overflow structures, and verify the ability of rock filters around perforated riser pipes to pass water; and
- 6) Immediately report to the Operator any deficiencies that are identified with the implementation of the SWPPP.

SITE PLAN/SKETCH

Inspector (print name)

Date of Inspection

Qualified Inspector (print name)

Qualified Inspector Signature

The above signed acknowledges that, to the best of his/her knowledge, all information provided on the forms is accurate and complete.

Maintaining Water Quality**Yes No NA**

- ☐ ☐ ☐ Is there an increase in turbidity causing a substantial visible contrast to natural conditions at the outfalls?
- ☐ ☐ ☐ Is there residue from oil and floating substances, visible oil film, or globules or grease at the outfalls?
- ☐ ☐ ☐ All disturbance is within the limits of the approved plans.
- ☐ ☐ ☐ Have receiving lake/bay, stream, and/or wetland been impacted by silt from project?

Housekeeping

1. General Site Conditions

Yes No NA

- ☐ ☐ ☐ Is construction site litter, debris and spoils appropriately managed?
- ☐ ☐ ☐ Are facilities and equipment necessary for implementation of erosion and sediment control in working order and/or properly maintained?
- ☐ ☐ ☐ Is construction impacting the adjacent property?
- ☐ ☐ ☐ Is dust adequately controlled?

2. Temporary Stream Crossing

Yes No NA

- ☐ ☐ ☐ Maximum diameter pipes necessary to span creek without dredging are installed.
- ☐ ☐ ☐ Installed non-woven geotextile fabric beneath approaches.
- ☐ ☐ ☐ Is fill composed of aggregate (no earth or soil)?
- ☐ ☐ ☐ Rock on approaches is clean enough to remove mud from vehicles & prevent sediment from entering stream during high flow.

3. Stabilized Construction Access

Yes No NA

- ☐ ☐ ☐ Stone is clean enough to effectively remove mud from vehicles.
- ☐ ☐ ☐ Installed per standards and specifications?
- ☐ ☐ ☐ Does all traffic use the stabilized entrance to enter and leave site?
- ☐ ☐ ☐ Is adequate drainage provided to prevent ponding at entrance?

Runoff Control Practices

1. Excavation Dewatering

Yes No NA

- ☐ ☐ ☐ Upstream and downstream berms (sandbags, inflatable dams, etc.) are installed per plan.
- ☐ ☐ ☐ Clean water from upstream pool is being pumped to the downstream pool.
- ☐ ☐ ☐ Sediment laden water from work area is being discharged to a silt-trapping device.
- ☐ ☐ ☐ Constructed upstream berm with one-foot minimum freeboard.

Runoff Control Practices (continued)

2. Flow Spreader

Yes No NA

- ☐ ☐ ☐ Installed per plan.
- ☐ ☐ ☐ Constructed on undisturbed soil, not on fill, receiving only clear, non-sediment laden flow.
- ☐ ☐ ☐ Flow sheets out of level spreader without erosion on downstream edge.

3. Interceptor Dikes and Swales

Yes No NA

- ☐ ☐ ☐ Installed per plan with minimum side slopes 2H:1V or flatter.
- ☐ ☐ ☐ Stabilized by geotextile fabric, seed, or mulch with no erosion occurring.
- ☐ ☐ ☐ Sediment-laden runoff directed to sediment trapping structure

4. Stone Check Dam

Yes No NA

- ☐ ☐ ☐ Is channel stable? (flow is not eroding soil underneath or around the structure).
- ☐ ☐ ☐ Check is in good condition (rocks in place and no permanent pools behind the structure).
- ☐ ☐ ☐ Has accumulated sediment been removed?.

5. Rock Outlet Protection

Yes No NA

- ☐ ☐ ☐ Installed per plan.
- ☐ ☐ ☐ Installed concurrently with pipe installation.

Soil Stabilization

1. Topsoil and Spoil Stockpiles

Yes No NA

- ☐ ☐ ☐ Stockpiles are stabilized with vegetation and/or mulch.
- ☐ ☐ ☐ Sediment control is installed at the toe of the slope.

2. Revegetation

Yes No NA

- ☐ ☐ ☐ Temporary seedings and mulch have been applied to idle areas.
- ☐ ☐ ☐ 4 inches minimum of topsoil has been applied under permanent seedings

Sediment Control Practices

1. Silt Fence and Linear Barriers

Yes No NA

- ☐ ☐ ☐ Installed on Contour, 10 feet from toe of slope (not across conveyance channels).
- ☐ ☐ ☐ Joints constructed by wrapping the two ends together for continuous support.
- ☐ ☐ ☐ Fabric buried 6 inches minimum.
- ☐ ☐ ☐ Posts are stable, fabric is tight and without rips or frayed areas.
- Sediment accumulation is ____% of design capacity.

Sediment Control Practices (continued)

2. Storm Drain Inlet Protection (Use for Stone & Block; Filter Fabric; Curb; or, Excavated; Filter Sock or Manufactured practices)

Yes No NA

- ☐ ☐ ☐ Installed concrete blocks lengthwise so open ends face outward, not upward.
- ☐ ☐ ☐ Placed wire screen between No. 3 crushed stone and concrete blocks.
- ☐ ☐ ☐ Drainage area is 1 acre or less.
- ☐ ☐ ☐ Excavated area is 900 cubic feet.
- ☐ ☐ ☐ Excavated side slopes should be 2:1.
- ☐ ☐ ☐ 2" x 4" frame is constructed and structurally sound.
- ☐ ☐ ☐ Posts 3-foot maximum spacing between posts.
- ☐ ☐ ☐ Fabric is embedded 1 to 1.5 feet below ground and secured to frame/posts with staples at max 8-inch spacing.
- ☐ ☐ ☐ Posts are stable, fabric is tight and without rips or frayed areas.
- ☐ ☐ ☐ Manufactured insert fabric is free of tears and punctures.
- ☐ ☐ ☐ Filter Sock is not torn or flattened and fill material is contained within the mesh sock.

Sediment accumulation ____% of design capacity.

3. Temporary Sediment Trap

Yes No NA

- ☐ ☐ ☐ Outlet structure is constructed per the approved plan or drawing.
- ☐ ☐ ☐ Geotextile fabric has been placed beneath rock fill.
- ☐ ☐ ☐ Sediment trap slopes and disturbed areas are stabilized.

Sediment accumulation is ____% of design capacity.

4. Temporary Sediment Basin

Yes No NA

- ☐ ☐ ☐ Basin and outlet structure constructed per the approved plan.
- ☐ ☐ ☐ Basin side slopes are stabilized with seed/mulch.
- ☐ ☐ ☐ Drainage structure flushed and basin surface restored upon removal of sediment basin facility.
- ☐ ☐ ☐ Sediment basin dewatering pool is dewatering at appropriate rate.

Sediment accumulation is ____% of design capacity.

Note: Not all erosion and sediment control practices are included in this listing. Add additional pages to this list as required by site specific design. All practices shall be maintained in accordance with their respective standards.

Construction inspection checklists for post-development stormwater management practices can be found in Appendix F of the New York Stormwater Management Design Manual.

CONSTRUCTION DURATION INSPECTIONS

b. Modifications to the SWPPP (To be completed as described below)

The Operator shall amend the SWPPP whenever:

1. There is a significant change in design, construction, operation, or maintenance which may have a significant effect on the potential for the discharge of pollutants to the waters of the United States and which has not otherwise been addressed in the SWPPP; or
2. The SWPPP proves to be ineffective in:
 - a. Eliminating or significantly minimizing pollutants from sources identified in the SWPPP and as required by this permit; or
 - b. Achieving the general objectives of controlling pollutants in stormwater discharges from permitted construction activity; and
3. Additionally, the SWPPP shall be amended to identify any new contractor or subcontractor that will implement any measure of the SWPPP.

Modification & Reason:This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general note-taking. There are no margins, text, or other markings on the page.

APPENDIX G
TREE SPECIES FOR NEW YORK STATE

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Table G.1

Trees Suitable for Landscape and Conservation Plantings in New York

TREE SIZE:

Large Sized Trees (75'+) - Trees that exceed this height at maturity.

Medium Sized Trees (35' - 75') - Trees in this height range at maturity.

Small Sized Trees (15' - 35') - Trees relatively low at maturity.

VAR: (x) = varieties of the species are available for various uses.

FOLIAGE:

E = evergreen

c = colorful in fall

l = lustrous; shiny

D = deciduous

d = dense

u = unusual leaves

f = fine textured

SITE TOLERANCE:

cold = hardy in zones 2 and 3 (northeastern mountains)

wet = tolerant of moderately well to somewhat poorly drained soils.

dry = tolerant of sandy, gravelly, excessively drained soils.

shade = will tolerate some shady sites.

sea = trees which may tolerate seaside conditions.

city = trees that withstand usual city conditions.

PEST:

F = usually free S = susceptible

FEATURES:

Habit = general shape of open grown plants.

Bo - broad open (wide)

Co - columnar

FEATURES: (cont'd)

Ho - horizontal branching

Na - narrow

Op - open

Ov - ovoid/oblong

Pe - pendulous

Py - pyramidal

Ro - round

S - spreading

Up - upright

Wo - wide/open

BRK; (x) = bark has interesting characteristics of color, texture or form.

FLR; (x) = flowers are colorful and interesting.

f = fragrant;

s = showy;

u = unusual shape.

FRU; (x) = fruits are interesting and/or edible.

LVS; (x) = leaves have attractive color and/or unusual shape.

USES:

WIND; (x) = suitable for windbreaks and screening.

SHD; (x) = suitable as lawn shade trees.

STRT; (x) = trees often selected for street planting.

WILD; F/c = trees offering food and cover to wild-life.

F = trees providing food from fruits.

W/c = trees offering winter cover.

BARR; (x) = trees which can be used as a barrier to some traffic.

ORN; (x) = trees whose main value is ornamental.

Table G.1 (cont'd)

Trees Suitable for Landscape and Conservation Plantings in New York

A. LARGE SIZED TREES (75 ft.+)	1.DECIDUOUS SPECIES	HEIGHT	VAR	FOLIAGE	SITE TOLERANCE					FEATURES				USES									
					COLD	WET	DRY	SHADE	SEA	CITY	PEST	HABIT	BRK	FLR	FRU	LVS	WIND	SHOE	STRT	WILD	BARR	ORN	
	BEECH, EUROPEAN <i>Fagus sylvatica</i>	90'	X	D,c,d,j									Py	X								X	
	BIRCH, PAPER <i>Betula papyrifera</i>	90'		D,c	X								Py	X									X
	BIRCH, RIVER <i>Betula nigra</i>	90'		D,c		X							Py	X									
	CHERRY, BLACK <i>Prunus serotina</i>	90'	X	D,d,j	X			X				S	X	X	X						F		X
	GINKGO <i>Ginkgo biloba</i>	120'		D,c,u				X		F		Wo								X		X	
	GUM, BLACK TUPELO <i>Nyssa sylvatica</i>	90'		D,c,d,j		X			X			Py											X
	HICKORY, PIGNUT <i>Carya glabra</i>	120'		D,c			X					Ro									F		X
	HICKORY, SHAGBARK <i>Carya ovata</i>	120'	X	D,c								Na/Up	X								F		X
	HONEYLOCUST 1 <i>Gleditsia</i> spp.	135'	X	D,c,u			X			X	F	Bo								X		X	
	JAPANESE ZELKOVA <i>Zelkova serrata</i>	90'		D,c								Ro								X			
	KATSURA TREE <i>Cercidiphyllum japonicum</i>	60-100'		D,c,u							F	Ro								X			
	LINDEN, LITTLE-LEAF <i>Tilia cordata</i>	90'	X	D,d	X					X		Py		X	X					X		X	
	LONDON PLANE TREE X <i>Platanus acerifolia</i>	100'		D								S	X							X			
	MAPLE, NORWAY <i>Acer platanoides</i>	120'	X	D,c	X	X						Ro	X	X						X		X	
	MAPLE, RED <i>Acer rubrum</i>	120'	X	D,c		X						Ov								X		X	
	MAPLE, SUGAR <i>Acer saccharum</i>	90'		D,c								Ro/S								X		F	
	OAK, WHITE <i>Quercus alba</i>	90'	X	D								varies								X			
	POPLAR, HYBRID 2 X <i>Populus</i>	90'	X	D,c,u	X							S											X
	POPLAR, WHITE <i>Populus alba</i>	125'	X	D,c,u		X						F	Py							X		X	
	SWEET-GUM <i>Liquidambar styraciflua</i>																						X

Table G.1 (cont'd)
Trees Suitable for Landscape and Conservation Plantings in New York

A. LARGE SIZED TREES (75 ft.+)										
2. EVERGREEN SPECIES	SITE TOLERANCE					FEATURES			USES	
	HEIGHT	VAR FOLIAGE	COLD WET	DRY SHADE	SEA CITY PEST	HABIT BRK	FLR FRU LVS	WIND SHDE STRT	WILD BARR ORN	
CEDAR, EASTERN RED <i>Juniperus virginiana</i>	90'	X E,d	X	X	F	Py X	X	X	WC	
FIR, DOUGLAS <i>Pseudotsuga menziesii</i>	300'	X E,d				Py	X	X	WC X	
FIR, WHITE <i>Abies concolor</i>	120'	X E,c				Py	X	X	WC	
HEMLOCK, CANADA <i>Tsuga canadensis</i>	90'	X E,d	X			Py		X	WC X	
LARCH, EUROPEAN <i>Larix decidua</i>	100'	X D,c	X			Py	X		X	
PINE, AUSTRIAN <i>Pinus nigra</i>	90'	X E		X		Py		X	WC X	
PINE, EASTERN WHITE <i>Pinus strobus</i>	100-150'	X E	X			Ro/Py		X	WC X	
PINE, JAPANESE BLACK <i>Pinus thunbergii</i>	90'	E		X		S			WC X	
SPRUCE, COLORADO <i>Picea pungens</i>	100'	X E,c,d	X	X	S	Py	X	X	WC X	
SPRUCE, NORWAY <i>Picea abies</i>	150'	X E,d	X			Py	X	X	WC	
SPRUCE, SERBIAN <i>Picea omorika</i>	90'	E,c,d				Py	X	X	WC X	
SPRUCE, WHITE <i>Picea glauca</i>	90'	X E	X			Py	X	X	WC X	

¹ Thornless, seedless cultivars recommended

² Select male, non-root suckering, disease resistant cultivars

Note: It is not recommended to combine Colorado Blue Spruce or any other spruce with Douglas Fir in the same landscape design. Douglas Fir is an alternate host for the Cooley Spruce Gall Aphid.

Table G.1 (cont'd)

Trees Suitable for Landscape and Conservation Plantings in New York

B. MEDIUM SIZED TREES (35'-75')															
1. DECIDUOUS SPECIES	HEIGHT	VAR FOLIAGE	SITE TOLERANCE					FEATURES				USES			
			COLD	WET	DRY	SHADE	SEA CITY	PEST	HABIT	BRK	FLR	FRU	LVS	WIND SHDE	STRT WILD BARR ORN
ALDER, EUROPEAN <i>Alnus glutinosa</i>	75'	D	X	X						Ov				X	
ALDERS <i>Alnus spp.</i>	60'-75'	X D,d	X	X				S	Ro		X			X	
BIRCH, SWEET <i>Betula lenta</i>	75'	D,c	X							Py	X		X		X
CHERRY, EUROPEAN BIRD <i>Prunus padus</i>	45'	X D,u	X							Op		X,f	X		F
CHERRY, PIN 1 <i>Prunus pennsylvanica</i>	36'	D,c,f	X		X	X				Op	X	X	X		F
CHERRY, SARGENT <i>Prunus sargentii</i>	75'	X D,c,d								Up	X	X		X	F
CHESTNUT, CHINESE <i>Castanea mollissima</i>	60'	D,c,d,l								Ro			X		F
CHOKECHERRY, AMUR <i>Prunus maackii</i>	45'	D,d	X							Ro	X	X			F
CRAB APPLE, SIBERIAN <i>Malus baccata</i>	50'	X D,d	X					S		Na		X,f	X		F
CRIMEAN LINDEN X <i>Tilia euchlora</i>	60'	X D,d,l								Pe		X,f		X	X
DOGWOOD, FLOWERING <i>Cornus florida</i>	40'	X D,c,d,l						F		Ho	X	X,u	X	X	X
ELM, SIBERIAN <i>Ulmus pumila</i>	75'	X D,f			X					Ro/OpF				X	
HAWTHORN, COCKSPUR <i>Crataegus crus-galli</i>	36'	X D,d,l			X			S		Ro/S		X	X	X	F
HOLLY, AMERICAN <i>Ilex opaca</i>	45'	X E,d,u						X		F	Py		X	X	WC
HORNBEAM, AMERICAN <i>Carpinus caroliniana</i>	36'	X D,c,d		X				F		Ro	X		X	X	F
HORNBEAM, EUROPEAN <i>Carpinus betulus</i>	60'	X D,d								Py			X		X
HORNBEAM, HOP <i>Ostrya virginiana</i>	60'	D,d						F		Py		X	X		F

Table G.1 (cont'd)
Trees Suitable for Landscape and Conservation Plantings in New York

B. MEDIUM SIZED TREES (35'-75')		SITE TOLERANCE										FEATURES				USES					
1. DECIDUOUS SPECIES	HEIGHT	VAR	FOLIAGE	COLD	WET	DRY	SHADE	SEA	CITY	PEST	HABIT	BRK	FLR	FRU	LVS	WIND	SHDE	STRT	WILD	BARR	ORN
JAPANESE PAGODA TREE <i>Sophora japonica</i>	75'	X	D			X				F	Ro	X	X				X	X		X	
MAPLE, STRIPED <i>Acer pensylvanicum</i>	36'	X	D,u	X			X				Op	X			X						X
MOUNTAIN-ASH, EUROPEAN <i>Sorbus aucuparia</i>	45'	X	D							S	S		X	X	X				F		X
MOUNTAIN-ASH, KOREAN <i>Sorbus alnifolia</i>	60'	X	D,d								Py/Ro	X	X	X	X						X
MULBERRY, WHITE <i>Morus alba</i>	45'	X	D,d,u			X					Ro		X	X	X				F		
OAK, RED <i>Quercus borealis</i>	75'		D,d,l	X					X		Ro		X	X	X		X	X	F		
OAK, SWAMP WHITE <i>Quercus bicolor</i>	60'		D,d	X	X						Na/Ro				X		X		F		
OAK, WILLOW <i>Quercus phellos</i>	50'		D,f								Ro							X			X
POPLAR, SIMON <i>Populus simonii</i>	50'	X	D,d	X							Na						X				X
REDBUD, EASTERN <i>Cercis canadensis</i>	36'	X	D,c,u								Wo		X		X						X
SASSAFRAS <i>Sassafras albidum</i>	60'		D,u								So	X		X	X						X
SERVICEBERRY <i>Amelanchier</i> spp.	25'-60'		D,c							X	S		X	X	X				F		X
SORREL TREE <i>Oxycodendrum arboreum</i>	75'		D,c,d,l								Py		X	X	X						X
WILLOW, THURLOW WEEPING <i>X Salix elegantissima</i>	40'		D,f		X						Pe										X
WILLOW, WHITE <i>Salix alba</i>	75'	X	D	X	X						Up				Colored winter twigs						X
YELLOW-WOOD, AMERICAN <i>Cladrastis lutea</i>	50'	X	D,c,d	X							Ro	X	X		X						X

¹ Spreads rapidly by root suckers

² Spreads rapidly by root suckers, do not plant near Pine Barrens ecosystems

Table G.1 (cont'd)

Trees Suitable for Landscape and Conservation Plantings in New York

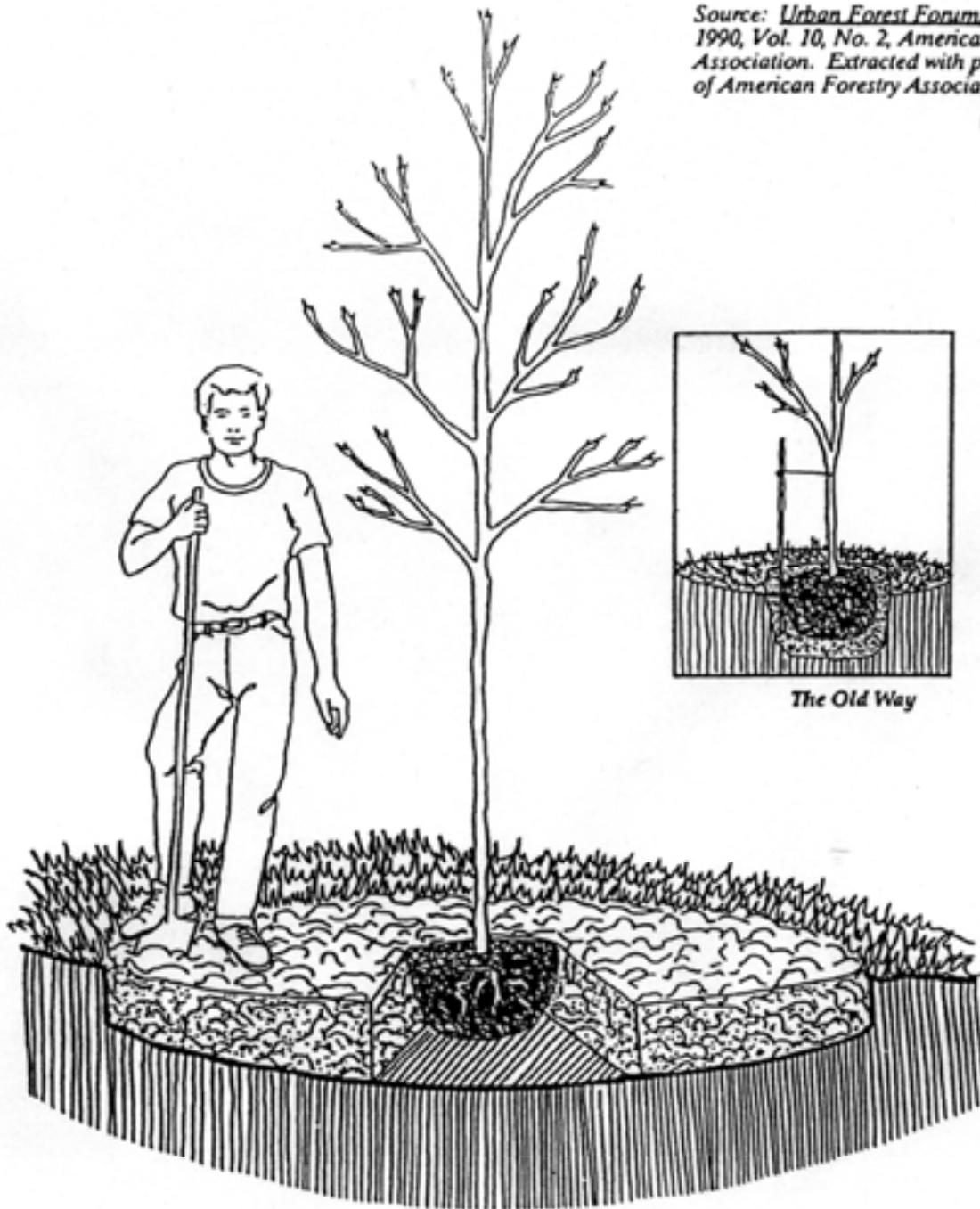
B. MEDIUM SIZED TREES (35'-75')	2. EVERGREEN SPECIES	HEIGHT	VAR	FOLIAGE	SITE TOLERANCE					FEATURES				USES							
					COLD	WET	DRY	SHADE	SEA	CITY	PEST	HABIT	BRK	FLR	FRU	LVS	WIND	SHOE	STRT	WILD	BARR
	ARBORVITAE, AMERICAN <i>Thuja occidentalis</i>	60'	X	E,u	X	X	X	X	X			Co					X		WC		X
	FIR, KOREAN <i>Abies koreana</i>	50'		E,d								Py				X	X		WC		X
	FIR, VEITCH <i>Abies veitchii</i>	75'		E,c	X							Py				X	X		WC		
	HEMLOCK, CAROLINA <i>Tsuga caroliniana</i>	75'		E,d						X		Py/Pe					X	X	WC		X
	PINE, JACK <i>Pinus banksiana</i>	75'		E	X		X					Bo							WC		
	PINE, PITCH <i>Pinus rigida</i>	75'		E			X					Op							WC		
	PINE, RED <i>Pinus resinosa</i>	75'		E	X		X		X			Py					X		WC		
	PINE, SCOTCH <i>Pinus sylvestris</i>	75'	X	E	X				X			Op/Py	X				X		WC		
	PINE, SWISS STONE <i>Pinus cembra</i>	75'		E,d	X							PyS							WC		X
	SPRUCE, BLACK	50'		E,d	X	X		X				Co					X		WC		
	SPRUCE, BLACK HILLS	75'		E,d	X		X				F	Co					X		WC		

Table G.1 (cont'd)
Trees Suitable for Landscape and Conservation Plantings in New York

C. SMALL SIZED TREES (15'-35')	SITE TOLERANCE													FEATURES				USES			
	HEIGHT	VAR	FOLIAGE	COLD	WET	DRY	SHADE	SEA	CITY	PEST	HABIT	BRK	FLR	FRU	LVS	WIND	SHOE	STRT	WILD	BARR	ORN
BIRCH, GRAY <i>Betula populifolia</i>	30'		D	X		X				S	several stems				X						X
BLACKHAW <i>Viburnum prunifolium</i>	30'		D,c,1	X									X	X	X		X		F		X
CHERRY, CORNELIAN <i>Cornus mas</i>	24'	X	D,1							F	Ro		X	X	X				F		
CHERRY, SOUR <i>Prunus cerasus</i>	30'	X	D	X							Ro		X	X					F		X
CORK TREE, AMUR <i>Phellodendron amurense</i>	30'		D	X							Wo	X		X	X						
CRABAPPLES <i>Malus spp</i>	15'-30'		D	X						S	Ro		X,s	X				X	F		X
DOGWOOD, JAPANESE <i>Cornus kousa</i>	20'	X	D,d,1								Ho		X,s	X	X						X
HAWTHORNS <i>Crataegus spp</i>	15'-30	X	D,d	X		X				S	Rothomy		X	X	X		X		F		X
LABURNUM SCOTCH <i>Laburnum alpinum</i>	30'	X	D								U		X,u				X				
LILAC, JAPANESE TREE <i>Syringa amurensis japonica</i>	30'		D,coarse									X	X,u				X				X
MAPLE, AMUR <i>Acer ginnala</i>	20'	X	D,c,d	X		X			X		Up/Ro		X,f	X	X		X				X
MAPLE, MOUNTAIN <i>Acer spicatum</i>	25'		D,coarse	X		X			X		Ov			X	X						X
MOUNTAIN-ASH, SHOWY <i>Sorbus decora</i>	30'	X	D	X						S	shrubby		X	X							X
NANNYBERRY <i>Viburnum lentago</i>	30'		D,c,1	X					X		dense/shrubby		X	X	X		X		F		X
RHODODENDRON, ROSEBAY <i>Rhododendron maximum</i>	12'-36'	X	E	X		X			X		Ro			X							X
RUSSIAN OLIVE <i>Elaeagnus angustifolia</i>																					
SEA-BUCKTHORN, COMMON <i>Hippophae rhamnoides</i>	30'			X					X		Ro/o		X	X	X						X

Figure G.1 New Tree Planting Procedure

Source: *Urban Forest Forum*, April/May 1990, Vol. 10, No. 2, American Forestry Association. Extracted with permission of American Forestry Association.



The new method of tree planting will result in better survival and growth than the old method. Grass competition and soil compaction are two of the most common factors in poor performance. The New Method: Prepare a planting area five times the diameter of the root ball or container. Use a rototiller and/or spades to loosen and mix the soil to a depth of about 12 inches. Organic matter (well decomposed) can be added. Dig a hole in the center to set the tree, so that the root ball will rest on solid ground. Backfill around the root area, pressing the soil but not packing it. Mulch the entire prepared area with 2 to 4 inches of bark, wood chips, decomposed sawdust, or leaves. Reference the article for a full explanation.

Table G.2

Susceptibility of Tree Species to Compaction¹

Resistant:

Box elder.....	<i>Acer negundo</i>	Willows.....	<i>Salix spp.</i>
Green ash.....	<i>Fraxinus pennsylvanica</i>	Honey locust.....	<i>Gleditsia triacanthos</i>
Red elm.....	<i>Ulmus rubra</i>	Eastern cottonwood.....	<i>Populus deltoides</i>
Hawthornes.....	<i>Crataegus spp.</i>	Swamp white oak.....	<i>Quercus bicolor</i>
Bur oak.....	<i>Quercus macrocarpa</i>	Hophornbeam.....	<i>Ostrya virginiana</i>
Northern white cedar....	<i>Thuja occidentalis</i>		

Intermediate:

Red maple.....	<i>Acer rubrum</i>	Sweetgum.....	<i>Liquidambar styraciflua</i>
Silver maple.....	<i>Acer saccharinum</i>	Norway maple.....	<i>Acer platanoides</i>
Hackberry.....	<i>Celtis occidentalis</i>	Shagbark hickory.....	<i>Carya ovata</i>
Black gum.....	<i>Nyssa sylvatica</i>	London plane.....	<i>Platanus x hybrida</i>
Red oak.....	<i>Quercus rubra</i>	Pin oak.....	<i>Quercus palustris</i>
Basswood.....	<i>Tilia americana</i>		

Susceptible:

Sugar maple.....	<i>Acer saccharum</i>	Austrian Pine.....	<i>Pinus nigra</i>
White pine.....	<i>Pinus strobus</i>	White ash.....	<i>Fraxinus americana</i>
Blue spruce.....	<i>Picea pungens</i>	Paper birch.....	<i>Betula papyrifera</i>
White oak.....	<i>Quercus alba</i>	Mountain ash.....	<i>Sorbus aucuparia</i>
Red pine.....	<i>Pinus resinosa</i>	Japanese maple.....	<i>Acer palmatum</i>

¹ If a tree species does not appear on the list, insufficient information is available to rate it for this purpose.

Table G.3

Size and Weight of Earth Ball Required to Transplant Wild Stock

Caliper ¹ (Inches)	Shade Trees (Maple, Ash, Oak, Birch, etc.)		Small Trees & Shrubs (Crabapple, Thornapple, Viburnum, Dogwood, etc.)		
	Minimum Diameter Ball (Inches)	Weight of Ball (lbs.)	Up to 6 ft. Height — 6 ft. and Caliper ¹	Minimum Diameter Ball (Inches)	Weight of Ball (lbs.)
1/2	14	88	2	12	55
3/4	16	130	3	14	88
1	18	186	4	16	130
1-1/4	20	227	5	18	186
1-1/2	22	302	3/4	18	186
1-3/4	24	390	1	20	227
2	28	621	1-1/2	22	302
3	32	836	1-3/4	24	390
3-1/2	38	1,400	2	28	621
4	42	1,887	2-1/2	32	836
			3	38	1,400

¹Caliper is a diameter measurement of trees at a height of 6 inches above the ground.
(American Standards for Nursery Stock)

APPENDIX H

GLOSSARY

The list of terms that follows is representative of those used by soil conservationists, soil scientists, engineers, developers, contractors, planners, etc. The terms are in common use in conservation matters.

ACCESS ROAD - A road or vehicular travel way constructed to provide needed access to a site.

ACRE-FOOT - The volume of a substance, such as water, that will cover 1 acre to a depth of 1 foot.

AESTHETIC VALUE - The increase in value of a property derived from such intangible factors as its inherent attractiveness, its access to attractive views, or its general appeal to the sense of beauty of the owner or purchaser.

AMORTIZATION - To repay a debt in a sequence of equal payments. Part of each payment is used to pay the interest due at the time it is made, and the balance is applied to the reduction of the principal.

ANGLE OF REPOSE - Angle between the horizontal and the maximum slope that a soil assumes through natural processes.

ANTECEDENT MOISTURE CONDITION (AMC) - The degree of wetness of a watershed at the beginning of a storm.

APRON - A floor or lining to protect a surface from erosion; for example, the pavement below chutes, spillways, or at the toes of dams.

ASSESSED VALUE - The value placed on property for taxation purposes.

ASSOCIATED COSTS - A term commonly used in water resource development projects. These costs include the value of goods and services needed over and above project costs to make the immediate products or services of a project available for use or sale.

BASE FLOW - The stream discharge from groundwater runoff.

BEDDING - The process of laying a drain or other conduit in its trench and tamping earth around the conduit to form its bed. The manner of bedding may be specified to conform to the earth load and conduit strength.

BEDLOAD - The sediment that moves by sliding, rolling, or bounding on or very near the streambed; sediment moved mainly by tractive or gravitational forces or both, but at

velocities less than the surrounding flow.

BENCH MARK -

(economics) - Data for a specific time period that is used as a base for comparative purposes with comparable data.

(engineering) - A point of reference in elevation surveys.

BERM - A shelf that breaks the continuity of a slope.

BLIND - Placement of loose soil around a tile or conduit to prevent damage or misalignment when the trench is backfilled. Allows water to flow more freely to the tile.

BLIND DRAIN - A type of drain consisting of an excavated trench refilled with pervious materials, such as coarse sand, gravel or crushed stone, where water percolates through the voids and flows toward an outlet. Often referred to as a French drain because of its initial development and widespread use in France.

BLIND INLET - Inlet to a drain in which entrance of water is by percolation rather than open flow channels.

BRUSH LAYERING - The embedment of green branches of shrub or tree species, perpendicular to the slope, on successive horizontal rows or contours.

BRUSH-MATTING - A blanket, or covering, of hardwood brush fastened down with stakes and wire.

cfs. - abbreviation for cubic feet per second. A unit of water flow.

CAPITAL RECOVERY PERIOD - The period of time required for the net returns from an outlay of capital to equal the investment.

CAPITALIZED COST - The first cost of an asset plus the present value of all renewals expected within the planning horizon.

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.

COMPACTION - To unite firmly; the act or process of becoming compact, usually applied in geology to the changing of loose sediments into hard, firm rock. With respect to construction work with soils, engineering compaction is any process by which the soil grains are rearranged to decrease void space and bring them into closer contact with one another, thereby increasing the weight of solid material per cubic foot.

CONDUIT - Any channel intended for the conveyance of water, whether open or closed.

CONIFER - A tree belonging to the order of Coniferea, usually evergreen, with cones and needle-shaped or scale-like leaves and producing wood known commercially as "soft wood".

CONSERVATION - The protection and improvement of natural resources.

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 INTERVAL - The vertical distance between contour lines.

CONTOUR MAP - A map that shows the shape of the surface features of the ground by the use of contours.

CONTOUR WATTLING - The packing of lengths of bundles of twigs or tree whips into a continuous length, partially buried across a slope at regular contour intervals and supported on the downhill side by stakes.

CREST -

1. The top of a dam, dike, spillway, or weir, or other water barrier or control.

2. The summit of a wave or peak of a flood.

CRITICAL SITE - A sediment producing, highly erodible, or severely eroded area or site.

CRITICAL VELOCITY - Velocity at which a given discharge changes from tranquil to rapid flow; that velocity in open channels for which the specific energy (sum of the depth and velocity head) is a minimum for a given discharge.

CROSS-SECTION - A drawing that shows the features that would be exposed by a vertical cut through a man-made or natural structure or area.

CROWN (forestry) - The upper part of a tree, including the branches and foliage.

CUBIC FOOT PER SECOND - Rate of fluid flow at which 1 cubic foot of fluid passes a measuring point in 1 second. (Abbr. cfs.) (Syn. Second-foot; CUSEC.) See **cfs**.

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 embankment or fill areas.

CUTOFF -

1. Wall, collar, or other structure, such as a trench, filled with relatively impervious material intended to reduce seepage of water through porous strata.
2. In river hydraulics, the new and shorter channel formed either naturally or artificially when a stream cuts through the neck of a band.

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, drain, or pump structure for the purpose of preventing debris from entering.

DECIDUOUS PLANT - A plant that sheds all of its leaves every year at a certain season.

DEGRADATION - To wear down by erosion, especially through stream action.

DEPOSIT - Material left in a new position by a natural transporting agent, such as water, wind, ice, or gravity, or by the activity of man.

DESIGN STANDARDS - Standards of construction

governing the size, shape, and relationship of spaces in any structure, which will control soil erosion and sedimentation.

DESIGN STORM - A given rainfall amount, areal distribution, and time distribution, used to estimate runoff. The rainfall amount is for a given frequency (25-year, 50-year, etc.).

DE-SILTING AREA - An area of grass, shrubs, or other vegetation used for inducing deposition of silt and other debris from flowing water, located about a stream, pond, field, or other area needing protection from sediment accumulation. See Filter Strip.

DETENTION DAM - A dam constructed for the purpose of temporary storage of stream flow or surface runoff and for releasing the stored water at controlled rates.

DIKE - An embankment to confine or control water, especially one built along the banks of a river to prevent overflow of lowlands; a levee.

DISCHARGE - Rate of flow, specifically fluid flow; a volume of fluid passing a point unit time, commonly expressed as cubic feet per second, million gallons per day, gallons per minutes, or cubic meters per second.

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: Q = cubic feet per second, A = square feet, and V = feet per second, respectively. To calculate the mean velocity, V , for uniform flow in pipes or open channels, see Manning's formula.

DIVERSION - Channel constructed across the slope for the purpose of intercepting surface runoff; changing the accustomed course of all or part of the surface water drainage path. See Terrace.

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 un-terraced area. They may also divert water out of active gullies, protect farm buildings from runoff, reduce the number of waterways, and are sometimes used in connection with strip cropping to shorten the length of slope so that the strips can effectively control erosion. See Terrace.

DRAINAGE - The removal of excess surface water or groundwater from land by means of surface or subsurface drains.

DRAINAGE AREA - The area draining into a stream at a

given point. The area may be of different sizes for surface runoff, subsurface flow and base flow, but generally the surface runoff area is used as the drainage area. See watershed.

DRAINAGE DISTRICT - A cooperative, self-governing public corporation created under state law to finance, construct, operate, and maintain a drainage system involving a group or land holding.

DROP-INLET SPILLWAY - Overfall structure in which the water drops through a vertical riser connected to a discharge conduit.

DROP SPILLWAY - Overfall 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 surplus energy; a fall. A drop may be vertical or inclined.

EFFLUENT-

1. The discharge or outflow of water from ground or subsurface storage.
2. The fluids discharged from domestic, industrial, and municipal waste collection systems or treatment facilities.

ERODIBILITY (OF SOIL) - The 'K' value in RUSLE expresses the average long-term soil and soil profile response to the erosive powers of rain storms.

EROSION - The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

- a. **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.
- b. **RILL EROSION**- An erosion process in which numerous small channels only a few inches deep are formed; occurs mainly on recently cultivated soils. See Rill.
- c. **SHEET EROSION**- The removal of a fairly thin, uniform layer of soil from the land surface by runoff water.

EROSIVITY (OF SOIL) - The 'R' value in RUSLE expresses the interrelationships of the raindrop energy times

the 30-minute rainfall intensity.

EUTROPHICATION - A means of aging lakes whereby aquatic plants are abundant and waters are deficient in oxygen. The process is usually accelerated by enrichment of waters with surface runoff containing nitrogen and phosphorus.

EVAPOTRANSPIRATION (ET) - Plant transpiration plus evaporation from the soil. Difficult to determine separately, therefore used together as a unit for study.

FALLOW - Cropland plowed, but not seeded during one or more growing seasons; cropland left idle may be a normal part of the cropping system for weed control, water conservation, soil conditioning, etc.

FILTER STRIP - Strip of permanent vegetation designed to retard flow of runoff water, causing deposition of transported material, thereby reducing sediment flow. See **Desilting Area**.

FINISHED GRADE - The final grade or elevation of the ground surface conforming to the approved grading plan.

FLOOD FRINGE - That portion of the floodplain subject only to shallow inundation and low velocity flow of flooding water.

FLOODPLAIN - Normally dry land areas subject to periodic, temporary inundation by stream flow or tidal overflow. Land formed by deposition of sediment by water; alluvial land.

FLOODPLAIN MANAGEMENT - The wise use of floodplains so as to reduce human suffering, property damage, and habitat loss resulting from floods and to lessen the need for expensive flood control structures, such as dams and reservoirs.

FLOODWAY - That portion of the floodplain required to store and discharge floodwaters without causing significant damaging, or potentially damaging, increases in flood heights and velocities.

FREEBOARD (hydraulics) - Vertical distance between the maximum water surface elevation anticipated in design and the top of restraining banks or structures provided to prevent overtopping because of unforeseen conditions.

FREQUENCY - An expression or measure of how often a hydrologic event of given size or magnitude should, on the average, be equaled or exceeded. For example, a 50-year frequency flood should be equaled or exceeded in size, on the average, only once in 50 years. In drought or deficiency studies, it usually defines how many years will, on the

average, be equal to or less than a given size or magnitude.

FUNCTIONAL PLAN - A plan for one element, or closely related elements of a comprehensive plan, for example, transportation, recreation, and open spaces. Such plans, of necessity, should be closely related to the land use plan. Plans that fall short of considering all elements of a comprehensive plan may be considered as functional plans. Thus, resource conservation and development plans and watershed project plans should be considered as functional plans.

GABION - A galvanized wire basket filled with stone used for structural purposes. When fastened together, gabions are used as retaining walls, revetments, slope protection and similar structures.

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.

GRASSED WATERWAY - A natural or constructed waterway, usually broad and shallow, covered with erosion resistant grasses, used to conduct surface water; can reduce velocity and filter water.

GRAVEL ENVELOPE - Selected aggregate placed around the screened pipe section of well casing or a subsurface drain to facilitate the entry of water into the well or drain.

GRAVEL FILTER - Graded sand and gravel aggregate placed around a drain or well screen to prevent the movement of fine materials from the aquifer into the drain or well.

GRUBBING - The removal of stumps and root material from the soil mantle.

GULLY - A channel or miniature valley cut by concentrated runoff but through which water commonly flows only during and immediately after heavy rains or during the melting of 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 smothered by ordinary tillage or low impact grading.

HARDPAN - A hardened soil layer in the lower A or in the B horizon caused by cementation of soil particles with organic matter, or with materials such as silica, sesquioxides, or calcium carbonate. The hardness does not

change appreciably with changes in moisture content, and pieces of the hard layer do not slake in water.

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.

HOOD INLET - Entrance to a closed conduit that has been shaped to induce full flow at minimum water surface elevation.

HORIZONS, MINERAL SOIL -

A horizons are surface layers

B horizons are subsoil horizons ¹. They are designated as follows:

- B alone indicates some residual transformation or change in place, such as color.
- Bt indicates accumulations of translocated clay. Bx indicates a B horizon with fragipan characteristics such as firmness, brittleness and high density.

C horizons are substrata layer ¹; they consist of mineral material like or unlike the material from which the A & B horizons have formed and have been little affected by soil forming process. They are designated as follows:

- C alone indicates material like the material from which the A & B horizons have formed.
- Cx indicates a C horizon of material like that of the A & B horizons but has the firm, brittle and dense characteristics of a fragipan.

¹ Roman numerals are prefixed to the appropriate horizon designations such as IIB, IIBt, IIBx, and IIC or IICx when it is necessary to number a series of layers of unlike or contrasting material from the surface downward. Claverack is an example in which the A & B horizons have formed in sand and the underlying material is contrasting silty clay that is indicated as a IIC horizon.

HYDRAULIC GRADE LINE - In a closed conduit, a line joining the elevations to which water could stand in risers of vertical pipes connected to the conduit at their lower end and open at their upper end. In open channel flow, the hydraulic grade line is the free water surface.

HYDROGRAPH - A graph showing stage, flow, velocity, or other property of water with respect to time.

HYDROLOGIC SOIL COVER COMPLEX - A combination of a hydrologic soil group and a type of cover.

HYDROLOGIC SOIL GROUP - A group of soils having the same runoff potential under similar storm and cover conditions.

HYDROLOGY - The science that deals with the occurrence and movement of water in the atmosphere, upon the surface, and beneath the land areas of the earth. Rainfall intensities, rainfall interception by trees, effects of crop rotation on runoff, floods, droughts and the flow of springs and wells, are some of the topics studied by a hydrologist.

HYDROSEEDING - The dissemination of seed hydraulically in a liquid medium; mulch, lime, and fertilizer can be incorporated into the sprayed mixture.

IMPERVIOUS SOIL - A soil through which water, air or roots cannot penetrate. No soil is impervious to water and air without significant impact or compaction.

IMPOUNDMENT - Generally, an artificial collection or storage of water, as a reservoir, pit, dugout, sump, etc.

INDUSTRIAL PARK - A tract of land, the control and administration of which are vested in a single body, suitable for industrial use because of location, topography, proper zoning, availability of utilities, and accessibility to transportation.

INFILTRATION - Rainfall minus interception, evaporation, and surface runoff. The part of rainfall that enters the soil.

INFILTRATION RATE - A soil characteristic determining or describing the maximum rate at which water can enter the soil under specified conditions, including the presence of an excess of water.

INITIAL ABSTRACTION (I_a) - When considering surface runoff, I_a is all the rainfall before runoff begins. When considering direct runoff, I_a consists of interception, evaporation and the soil-water storage that must be exhausted before direct runoff may begin.

INOCULATION (OF SEEDS) - The addition of nitrogen fixing bacteria (inoculant) to legume seeds or to the soil in which the seeds are to be planted; the bacteria take free nitrogen from the air and make it available to the seeds.

INTERCEPTION - Precipitation retained on plant or plant residue surfaces and finally absorbed, evaporated, or sublimated. That which flows down the plant to the ground is called "stem flow" and not counted as true interception.

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 term

continued supply from melting snow or other sources. The stream, or channel, is dry for some part of the year, usually during the dry months.

ISO-ERODENT VALUE - A term used to correlate areas of equally erosive average annual rainfall.

LANDSCAPE - All the natural features, such as fields, hills, forests, water, etc., that distinguish one part of the earth's surface from another part, usually that portion of land or territory which the eye can comprehend in a single view, including all of its natural characteristics.

LIME, AGRICULTURAL - A soil amendment consisting principally of calcium carbonate, but including 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.

LINING - A protective covering over all or part of the perimeter of a reservoir or a conduit to prevent seepage losses, withstand pressure, resist erosion, and reduce friction or otherwise improve conditions of flow.

LIVE STAKING - Utilizing vegetative cover for the control of erosion and shallow sliding by means of willow or poplar cuttings that root easily and grow rapidly under certain conditions.

MANNING'S FORMULA (hydraulics) - A formula used to predict the velocity of water flow in an open channel or pipeline:

$$V = [(1.486) (r^{2/3}) (s^{1/2})] / n$$

Where:

V = the mean velocity of flow in feet per second;

r = the hydraulic radius;

s = the slope of energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and

n = the roughness coefficient or retardance factor of the channel lining.

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, such as sand or paper, on the soil surface.

NETTING - Plastic, paper, cotton, or other material used to hold mulch on the soil surface.

OUTLET - Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

PARTICLE SIZE CLASSES FOR FAMILY GROUPINGS (as used in the Soil Classification System of the National Cooperative Soil Survey in the United States) - Various particle size classes are applied to arbitrary control sections that vary according to the depth of the soil, presence or absence of argillic horizons, depth to paralithic or lithic contacts, fragipans, horizons. No single set of particle size classes is appropriate as a family grouping for all kinds of soil. The classification tabulated below provides a choice of several particle size classes.

1. Sandy-Skeletal - More than 35 percent, by volume, coarser than 2 millimeters, with enough fines to fill interstices larger than 1 millimeter; fraction less than 2 millimeters is as defined for the sandy class.
2. Loamy-Skeletal - More than 35 percent, by volume, coarser than 2 millimeters, with enough fines to fill interstices larger than 1 millimeter; fraction less than 2 millimeters is as defined for loamy classes.
3. Sandy - Sands, except very fine sand, and loamy sands, except loamy very fine sand.
- 4a. Coarse Loamy- With less than 18 percent clay and more than 15 percent coarser than very fine sand (including coarse fragments up to 7.5 centimeters).
- 4b. Fine-Loamy- With more than 18 percent clay but less than 35 percent clay and more than 15 percent coarser than very fine sand (including coarse fragments up to 7.5 centimeters).
- 4c. Coarse-Silty- With less than 18 percent clay and less than 15 percent coarser than very fine sand (including coarse fragments up to 7.5 centimeters).
- 4d. Fine-Silty- With more than 18 percent clay and less than 35 percent clay and less than 15 percent coarser than very fine sand (including coarse fragments up to 7.5 centimeters).
- 5a. Fine- With more than 35 percent clay but less than 60 percent clay.
- 5b. Very-Fine- With more than 60 percent clay.

PEAK FLOW - The maximum instantaneous flow of water from a given storm condition at a specific location.

PEAT - Dark brown residual material produced by the partial decomposition and disintegration of plants that grow in wet places.

PERMEABILITY - The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

pH - A numerical measure of the acidity or alkalinity of a soil; neutral soil has a pH of 7; all pH values below 7 are acid, and all above 7 are alkaline.

PLANNED UNIT DEVELOPMENT - A zoning classification permitting flexibility of site design by combining building types and uses in ways that would be prohibited by traditional zoning standards.

PLAT OF SURVEY - A scaled drawing identifying a parcel of real estate, prepared by a registered surveyor, including a legal description of the property and the dimensions of the physical improvements.

RAINFALL INTENSITY - The rate at which rain is falling at any given instant, usually expressed in inches per hour.

RECP - Rolled erosion control products. These are manufactured rolls of material used to protect slopes and/or waterways by resisting flow and aiding vegetation.

RETARDANCE (vegetation) - The characteristic of the vegetative lining of a channel that tends to restrict and impede flow relative to a perfectly smooth channel.

RETURN FLOW - That portion of the water diverted from a stream which finds its way back to the stream channel either as surface or underground flow.

REVTMENT - Facing of stone or other material, either permanent or temporary, placed along the edge of a stream to stabilize the bank and to protect it from the erosive action of the stream.

RIPARIAN RIGHTS - The rights of an owner whose land abuts water. They differ from state to state and often depend on whether the water is a river, lake or ocean. See Water Rights.

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.

RUNOFF - That portion of the precipitation on a drainage

area that is discharged from the area in stream channels. Types include surface runoff, groundwater runoff, or seepage.

RUNOFF CURVE NUMBER (CN) - A parameter combining the effects of soils, watershed characteristics, and land use. This parameter represents the hydrologic soil cover complex of the watershed.

RUSLE - Abbreviation for Revised Universal Soil Loss Equation; used to estimate sheet and rill soil loss on potentially erosive sites.

SCALPING - Removal of sod or other vegetation in spots or strips.

SCARIFY - To abrade, scratch, or modify the surface; for example, to scratch the impervious seed coat of hard seed or to break the surface of the soil with a narrow-bladed implement.

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 basin or pond designed to store a calculated amount of sediment being transported on a site.

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.

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.

SETTLING BASIN - An enlargement in the channel of a stream to permit the settling of debris carried in suspension.

SHRINK-SWELL POTENTIAL - The susceptibility of soil to volume change due to loss or gain in moisture content.

SHRUB - A woody perennial plant differing from a perennial herb by its more woody stems and from a tree by its low stature and habit of branching from the base. There is no definite line between herbs and shrubs or between shrubs and trees; all possible intergradations occur.

SIDE SLOPES (engineering) - The slope of the sides of a canal, dam, or embankment. It is customary to name the horizontal distance first, as 1.5 to 1, or frequently, 1-1/2:1, meaning a horizontal distance of 1.5 feet to 1 foot vertical.

SITE ANALYSIS - Evaluation of the qualities and drawbacks of a site by comparison with those aspects of other comparable sites.

SOIL EROSION AND SEDIMENT CONTROL PLAN- A plan which fully indicates the necessary land protection and structural measures, including a schedule of the timing of their installation, which will effectively minimize soil erosion and sediment yields.

SOIL STRUCTURE - The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated soil particles. The principal forms of soil structure are: platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are: (1) single grain (each grain by itself, as in dune sand), or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

SOIL SURVEY - Survey showing soil type and composition.

SOIL TEXTURE - The relative proportions of the various soil separates in a soil as described by the classes of soil texture shown in Figure 1. The textural classes may be modified by the addition of suitable adjectives when coarse fragments are present in substantial amounts; for example, gravelly silt loam. (For other modifications, see coarse fragments). Sand, loamy sand, and sandy loam are further subdivided on the basis of the proportions of the various sand separates present.

SPILLWAY - An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.

SPOIL - Soil or rock material excavated from a canal, basin, or similar construction.

STAGE (hydraulics) - The variable water surface or the water surface elevation above any chosen datum.

STATE SOIL AND WATER CONSERVATION

COMMITTEE, COMMISSION, OR BOARD - The state agency established by state soil conservation districts, enabling legislation to assist with the administration of the provisions of the state soil conservation districts law. The official title may vary from the above as new, or amended, state laws are made.

STILLING BASIN - An open structure or excavation at the foot of an overfall, chute, drop, or spillway to reduce the energy of the descending stream.

STREAMBANKS - The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.

STRATA CAPACITY - The maximum amount of material a stream is able to transport.

STREAM LOAD - Quantity of solid and dissolved material carried by a stream. See Sediment Load.

STORMWATER MANAGEMENT - Runoff water safely conveyed or temporarily stored and released at an allowable rate to minimize erosion and flooding.

STRIPPING - Denuding vacant or untouched land of its present vegetative cover and topsoil.

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

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.

SUMP - Pit, tank, or reservoir in which water is collected for withdrawal or stored.

SUSPENDED LOAD - The fine sediment kept in suspension in a stream because the settling velocity is lower than the upward velocity of the current.

SWALE - A linear, but flattish depression in the ground surface which conveys drainage water but offers no impediment to traffic, as do ditches or gutters.

TERRACE - An embankment or combination of an embankment and channel constructed across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope. Terraces or terrace systems may be classified by their alignment, gradient, outlet, and cross-section. Alignment is parallel or non-parallel. Gradient may be

level, uniformly graded, or variably graded. Grade is often incorporated to permit paralleling the terraces. Outlets may be soil infiltration only, vegetated waterways, tile outlets, or combinations of these. Cross-sections may be narrow base, broad base, bench, steep backslope, flat channel, or channel.

TIME OF CONCENTRATION - Time required for water to flow from the most remote point of a watershed, in a hydraulic sense, to a specific point, usually the outlet.

TIMING SCHEDULE - A construction progress schedule showing the proposed dates of commencement and completion of each of the various subdivisions of work as shown and called for in the approved plans and specifications.

TOPOGRAPHIC MAP - A schematic drawing of prominent landforms indicated by conventional symbols such as hachures or contour lines.

TOPSOIL - The uppermost layers of soil containing organic material and suited for plant survival and growth.

TRAP EFFICIENCY - The capability of a reservoir to trap sediment.

TRAVEL TIME - The time for water to travel from one location to another in a watershed. Travel time is a component of time of concentration (T_c).

TRIBUTARY - Secondary, or branch of a stream, drain, or other channel that contributes flow to the primary or main channel.

TRM - Turf reinforcement mat. These are typically non-biodegradable mats with depth, which aid in stabilizing waterways by providing strength to vegetative root systems.

UNIFIED SOIL CLASSIFICATION SYSTEM (engineering) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index, and liquid unit.

UNIT HYDROGRAPH - A discharge hydrograph coming from one inch of direct runoff distributed uniformly over the watershed, with the direct runoff generated at a uniform rate during the given storm duration. A watershed may have 1-hour, 2-hour, etc. unit hydrographs.

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 RIGHTS - The legal rights to the use of water. They consist of riparian rights and those acquired by appropriation and prescription. Riparian rights are those rights to use and control water by virtue of ownership of the bank or banks. Appropriated rights are those acquired by an individual to the exclusive use of water, based strictly on priority of appropriation and application of the water to beneficial use and without limitation of the place of use to riparian land. Prescribed rights are those to which legal title is acquired by long possession and use without protest of other parties.

WATERSHED - The area contributing direct runoff to a stream. Usually it is assumed that base flow in the stream also comes from the same area. However, the ground water watershed may be larger or smaller.

WATERTABLE - The upper surface of groundwater or that level below which the soil is saturated with water; locus of points in soil water at which the hydraulic pressure is equal to atmospheric pressure.

WATERWAY - A natural course or constructed channel for the flow of water.

WATTLE - A group or bundle of twigs, whips, or witches.

WEEP-HOLES (engineering) - Openings, left in retaining walls, aprons, linings, or foundations to permit drainage and reduce pressure.

ZONING (rural) - A means by which governmental authority is used to promote the proper use of land under certain circumstances. This power traditionally resides in the state; and the power to regulate land uses by zoning is usually delegated to minor units of government, such as towns, municipalities, and counties, through an enabling act that specifies powers granted and the conditions under which these are to be exercised.

ZONING ORDINANCE - The exercise of police power for the purpose of carrying out the land use plan of an area. It may also include regulations to effect control of the size and height of buildings, population density, and use of buildings; for example, residential, commercial, industrial, etc.

APPENDIX I DIRECTORIES

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Note: These directories are current as of publication date and are subject to change.

Natural Resources Conservation Service Field Offices in NY

<u>COUNTY</u>	<u>OFFICE LOCATION</u>	<u>PHONE</u>
Albany	Troy Service Center, 61 State Street, Troy, NY 12180	518-271-1889
Allegany	Belmont Service Center, 5425 County Road 48, Belmont, NY 14813	585-268-5133
Broome	Binghamton Service Center, 1163 Upper Front Street, Binghamton, NY 13905	607-723-1384
Cattaraugus	Ellicottville Service Center, 8 Martha Street, Ellicottville, NY 14731	716-699-2326
Cayuga	Auburn Service Center, 7413 County House Road, Auburn, NY 13021	315-253-8471
Chautauqua	Jamestown Service Center, 3542 Turner Road, Jamestown, NY 14701	716-664-2351
Chemung/ Tioga	Waverly Service Center, 109A Chemung Street, Waverly, NY 14892	607-565-2106
Chenango	Norwich Service Center, 99 North Broad Street, Norwich, NY 13815	607-334-3231
Clinton/ Essex	Plattsburgh Service Center, 6064 State Route 22, Plattsburg, NY 12901	518-561-4616
Columbia/ Greene	Ghent Service Center, 1024 State Route 66, Ghent, NY 12075	518-828-4385
Cortland	Cortland Service Center, 100 Grange Place, Cortland, NY 13045	607-753-0851
Delaware	Walton Service Center, 44 West Street, Walton, NY 13856	607-865-4005
Dutchess/ Putnam/ Westchester	Millbrook Service Center, 2715 Route 44, Millbrook, NY 12545	845-677-3952
Erie	East Aurora Service Center, 50 Commerce Way, East Aurora, NY 14052	716-652-1400
Franklin	Malone Service Center, 151 Finney Boulevard, Malone, NY 12953	518-483-2850
Fulton/ Hamilton	Fultonville Service Center, 4001 State Hwy 5S, Fultonville, NY 12072	518-853-4015
Genesee	Batavia Service Center, 29 Liberty Street, Batavia, NY 14020	585-343-9167
Herkimer	Herkimer Service Center, 5653 State Route 5, Herkimer, NY 13350	315-866-2520
Jefferson	Watertown Service Center, 21168 State Route 232, Watertown, NY 13601	315-782-7289
Lewis	Lowville Service Center, 5274 Outer Stowe Street, Lowville, NY 13367	315-376-3520
Livingston	Geneseo Service Center, 11 Megan Drive, Geneseo, NY 14454	585-243-0030
Madison	Hamilton Service Center, 6503 Wes Road, Hamilton, NY 13346	315-684-9076
Monroe	Rochester Service Center, 1200A Scottsville Rd, Suite 160, Rochester, NY 14624	585-473-3440
Montgomery	Fultonville Service Center, 4001 ST HWY 5 South, Fultonville, NY 12072	518-853-4015
Nassau/ Suffolk	Riverhead Service Center, 423 Griffing Avenue, Riverhead, NY 11901	631-727-5666
Niagara	Lockport Service Center, 4487 Lake Avenue, Lockport, NY 14094	716-433-6703
Oneida	Marcy Service Center, 9025 State Route 49, Marcy, NY 13403	315-736-3316
Onondaga	Lafayette Service Center, US Route 11, Lafayette, NY 13084	315-677-3552
Ontario	Canandaigua Service Center, 3037 County Road 10, Canandaigua, NY 14424	585-394-0525
Orange/ Rockland	Middletown Service Center, 225 Dolson Avenue , Middletown, NY 10940	845-343-1872
Orleans	Albion Service Center, 446 West Avenue, Albion, NY 14411	585-589-5320
Oswego	Mexico Service Center, 3306 Main Street, Mexico, NY 13114	315-963-0779
Otsego	Cooperstown Service Center, 967 County Route 33, Cooperstown, NY 13326	607-547-8131

Natural Resources Conservation Service Field Offices in NY (cont'd)

<u>COUNTY</u>	<u>OFFICE LOCATION</u>	<u>PHONE</u>
Rensselaer	Troy Service Center, 61 State St., Troy, NY 12180	518-271-1889
St. Lawrence	Canton Service Center, 1942 Old Dekalb Road, Canton, NY 13617	315-386-2401
Saratoga	Ballston Spa Service Center, Municipal Ctr., 50 W High St., Ballston Spa, NY 12020	518-885-6300
Schenectady/		
Schoharie	USDA Service Center, 108 Holiday Way, Schoharie, NY 12157	518-295-8600
Schuyler/		
Tompkins	Ithaca Service Center, 903 Hanshaw Road, Ithaca, NY 14850	607-257-2737
Seneca	Seneca Falls Service Center, 12 N Park Street, Seneca Falls, NY 13148	315-568-6346
Steuben	Bath Service Center, 415 W Morris Street, Bath, NY 14810	607-776-7398
Sullivan/		
Ulster	Highland Service Center, 652 State Route 299, Highland, NY 12528	845-883-7162
Warren/		
Washington	Greenwich Service Center, 2530 State Route 40, Greenwich, NY 12834	518-692-9940
Wayne	Lyons Service Center, 10 Leach Road, Lyons, NY 14489	315-946-9912
Wyoming	Warsaw Service Center, 31 Duncan Street, Warsaw, NY 14569	585-786-3118
Yates	Penn Yan Service Center, 270 Lake Street, Penn Yan, NY 14527	315-536-4012

County Soil & Water Conservation District Offices in NY

<u>COUNTY</u>	<u>OFFICE LOCATION</u>	<u>PHONE</u>
Albany	P.O. Box 497, 24 Martin Road, Voorheesville, NY 12186	518-765-7923
Allegany	5390 County Rt 48, Lot A, Belmont, NY 14813	585-268-5840
Broome	1163 Upper Front Street, Binghamton, NY 13905	607-724-9268
Cattaraugus	P.O. Box 1765, 8 Martha St., Suite 2, Ellicottville, NY 14731	716-699-2326
Cayuga	7413 County House Road, Auburn, NY 13021	315-252-4171
Chautauqua	220 Fluvanna Ave Suite 600, Jamestown, NY 14701	716-664-2351
Chemung	851 Chemung Street, Horseheads, NY 14845	607-739-2009
Chenango	99 North Broad Street, Norwich, NY 13815-1388	607-334-8634
Clinton	6064 Route 22, Suite 1, Plattsburgh, NY 12901	518-561-4616
Columbia	1024 Route 66, Ghent, NY 12075-3200	518-828-4386
Cortland	100 Grange Place, Room 202, Cortland, NY 13045	607-756-5991
Delaware	44 West Street, Suite 1, Walton, NY 13856	607-865-7161
Dutchess	2715 Route 44, Suite 3, Millbrook, NY 12545	845-677-8011
Erie	50 Commerce Way, East Aurora, NY 14052-2185	716-652-8480
Essex	Cornell Cooperative Extension, P.O. Box 407, Westport, NY 12993	518-962-8225
Franklin	151 Finney Boulevard, Malone, NY 12953-9622	518-483-4061
Fulton	113 Hales Mills Road Ext., Johnstown, NY 12095-9742	518-762-0077
Genesee	USDA Center, 29 Liberty Street, Suite #3, Batavia, NY 14020	585-343-2362
Greene	907 County Office Building, Cairo, NY 12413-2868	518-622-3620
Hamilton	P.O. Box 166, 103 County View Dr., Lake Pleasant, NY 12108-0166	518-548-3991
Herkimer	5653 State Route 5, Herkimer, NY 13350	315-866-2520
Jefferson	P.O. Box 139, 21168 NYS Rt. 232, Watertown, NY 13601	315-782-2749
Lewis	5274 Outer Stowe St., Suite #1, Lowville, NY 13367	315-376-6122
Livingston	11 Megan Drive, Suite #2, Geneseo, NY 14454	585-243-0043
Madison	USDA Service Center, 6503 Wes Road, Hamilton, NY 13346	315-824-9849
Monroe	145 Paul Road, Building #5, Rochester, NY 14624	585-753-7380
Montgomery	4001 State Highway 5S, Fultonville, NY 12072-1721	518-853-4015
Nassau	1864 Muttontown Road, Syosset, NY 11791	516-364-5860
New York City	121 Sixth Ave., Suite 501, New York, NY 10013	212-431-9676
Niagara	USDA Service Center, 4487 Lake Avenue, Lockport, NY 14094	716-434-4949
Oneida	121 Second Street (315) 736-3335, Oriskany, NY 13424	315-736-3334
Onondaga	6680 Onondaga Lake Parkway, Liverpool, NY 13088	315-457-0325
Ontario	480 North Main Street, Canandaigua, NY 14424	585-396-1450
Orange	225 Dolson Avenue, Suite 103, Middletown, NY 10940	845-343-1873
Orleans	446 West Avenue, Albion, NY 14411-1589	585-589-5959
Oswego	3105 State Route 3, Fulton, NY 13069	315-592-9663
Otsego	967 County Highway 33, Cooperstown, NY 13326	607-547-8337
Putnam	841 Fair Street, Carmel, NY 10512	845-878-7918
Rensselaer	County Ag. & Life Sciences Building, 61 State Street, Troy, NY 12180-3496	518-271-1740
Rockland	50 Sanitorium Road, Building K, Pomona, NY 10970	845-364-2670
Saratoga	50 West High Street, Building #5, Ballston Spa, NY 12020	518-885-6900

County Soil & Water Conservation District Offices in NY (cont'd)

<u>COUNTY</u>	<u>OFFICE LOCATION</u>	<u>PHONE</u>
Schenectady	24 Hetcheltown Road, Glenville, NY 12302	518-399-6980
Schoharie	173 South Grand Street, Suite 3, Cobleskill, NY 12043	518-823-4535
Schuyler	2400 Meads Hill Rd, Watkins Glen, NY 14891	607-535-9650
Seneca	2041 US Route 20, Suite #2, Seneca Falls, NY 13148	315-568-4366
St. Lawrence	1942 Old DeKalb Road, Canton, NY 13617-3134	315-386-3582
Steuben	USDA Service Center, 415 West Morris Street, Bath, NY 14810	607-776-7398
Suffolk	423 Griffing Avenue, Suite 110, Riverhead, NY 11901	631-852-3285
Sullivan	64 Ferndale-Loomis Road, Liberty, NY 12754	845-292-6552
Tioga	183 Corporate Drive, Owego, NY 13827	607-687-3553
Tompkins	170 Bostwick Road, Ithaca, NY 14850	607-257-2340
Ulster	5 Park Lane, Highland, NY 12528	845-883-7162
Warren	394 Schroon River Road, Warrensburg NY 12885	518-623-3119
Washington	USDA Service Center, 2530 State Route 40, Greenwich, NY 12834-9627	518-692-9940
Wayne	10 Leach Road, Lyons, NY 14489-9798	315-946-4136
Westchester	148 Martine Avenue, Room 432, White Plains, NY 10601-4704	914-995-4423
Wyoming	31 Duncan Street, Warsaw, NY 14569	585-786-5070
Yates	417 Liberty Street, Suite 1034, Penn Yan, NY 14527	315-536-5188



DEC Region 5
State Office Building
207 Genesee Street
Utica, NY 13501-2885
Tel. (315) 793-2554

DEC Region 7
615 Erie Blvd. West
Syracuse, NY 13204-2400
Tel. (315) 426-7500

DEC Region 5
Hudson Street Extension
Warrensburg, NY 12885-0220
Tel. (518) 623-3671

DEC Region 4
1150 North Westcott Road
Schenectady, NY 12306-2014
Tel: (518) 357-2046

DEC Region 3
200 White Plains Road, 6th Floor
Fairfield, NY 10521-5005
Tel: (914) 332-1826

DEC Region 1
Bldg 40 - SUNY @ Stony Brook
Stony Brook, NY 11790-2356
Tel. (631) 444-0405

DEC Region 9
270 Michigan Ave.
Buffalo, NY 14203-2999
Tel. (716) 851-7070

DEC Region 2
1 Hunter Point Plaza
47-40 21st St.
Long Island City, NY 11101-6807
Tel: (718) 482-4933

New York City Department of Environmental Protection

East of Hudson Engineering Office, Valhalla	914-773-0343
West of Hudson Engineering Office, Ashokam	845-657-5767

U.S. Army Corps of Engineers

Baltimore District	410-962-7608
Buffalo District	716-879-4209
Auburn Field Office	315-255-8090
New York District	212-264-0100
Troy Field Office	518-270-0589
Philadelphia District	215-656-6728
Pittsburgh District	412-395-7154

Delaware River Basin Commission

609-883-9500

Susquehanna River Basin Commission

717-238-0423

Regional Planning Councils

Capital District Regional Planning Commission One Park Place, Suite 102, Albany, NY 12205	518-453-0850
Central New York Regional Planning and Development Board 126 N. Salina Street, Suite 200, Syracuse, NY 13202	315-422-8276
Genesee/Finger Lakes Regional Planning Council 50 West Main Street, Suite 8107, Rochester, NY 14614	585-454-0190
Herkimer-Onieda Counties Comprehensive Planning Program 321 Main Street, Utica, NY 13501-1229	315-798-5710
Hudson Valley Regional Council 1010 D Street, New Windsor, NY 12553-8474	845-567-9466
Lake Champlain-Lake George Regional Planning and Development Board P.O. Box 765, 310 Canada Street, Lake George, NY 12845	518-668-5773
Mohawk Valley Economic Development District 26 West Main Street, P. O. Box 69, Mohawk, NY 13407-0069	315-866-4671
Southern Tier Central Regional Planning and Development Board 145 Village Square, Painted Post, NY 14870	607-962-5092
Southern Tier East Regional Planning Development Board 375 State Street, Binghamton, NY 13901-2385	607-724-1327
Southern Tier West Regional Planning and Development Board 4039 Route 219, Suite 200, Salamanca, NY 14779	716-945-5301

County Cornell Cooperative Extension Offices in NY

<u>COUNTY</u>	<u>OFFICE LOCATION</u>	<u>PHONE</u>
Albany	PO Box 497, Voorheesville, NY 12186-0497	518-765-3500
Albany Regional	90 State Street, 6th Floor, Suite 600, Albany, NY 12207	518-462-2553
Allegany	5435A County Road 48, Belmont, NY 14813	716-268-7644
Broome	840 Upper Front Street, Binghamton, NY 13905-1542	607-772-8953
Cattaraugus	28 Parkside Drive, Suite A, Ellicottville, NY 14731	716-699-2377
Cayuga	248 Grant Avenue, Auburn, NY 13021-0167	315-255-1183
Chautauqua	3542 Turner Road, Jamestown, NY 14701-9608	716-664-9502
Chemung	425 Pennsylvania Avenue, Elmira, NY 14904-1793	607-734-4453
Chenango	99 North Broad Street, Norwich, NY 13815-1386	607-334-5841
Clinton	6064 Route 22, Plattsburgh, NY 12901-9601	518-561-7450
Columbia	479 NYS Route 66, Hudson, NY 12534-9706	518-828-3346
Cortland	60 Central Avenue, Room 105, Cortland, NY 13045-5590	607-753-5077
Delaware	PO Box 184, Hamden, NY 13782-0184	607-865-6531
Dutchess	Farm and Home Center, 2715 Route 44, Suite 1, Millbrook, NY 12545	845-677-8223
Erie	21 South Grove Street, East Aurora, NY 14052-2398	716-652-5400
Essex	PO Box 388, Westport, NY 12993-0388	518-962-4810
Franklin	63 West Main Street, Malone, NY 12953-1817	629-483-7403
Fulton	55 East Main Street, 2nd Floor, Suite 210, Johnstown, NY 12095	518-725-6441
Genesee	420 East Main Street, Batavia, NY 14020-2599	716-343-3040
Greene	HCR3, Box 906, Cairo, NY 12413-9503	518-622-9820
Hamilton	Box 7, NYS Route 8, Piseco, NY 12139	518-548-6191
Herkimer	5657 State Route 5, Herkimer, NY 13350-9721	315-866-7920
Jefferson	223 J.B. Wise Place, Watertown, NY 13601-2597	315-788-8450
Lewis	PO Box 72, Lowville, NY 13367	315-376-5270
Livingston	158 South Main Street, Mt. Morris, NY 14510-1595	716-658-3250
Madison	PO Box 1209, Morrisville, NY 13408-0640	315-684-3001
Monroe	249 Highland Avenue, Rochester, NY 14620	585 461-1000
Montgomery	55 East Main Street, 2nd Floor, Suite 210, Johnstown, NY 12095	518-853-3471
Nassau	1425 Old Country Road, Plainview, NY 11803-5015	516-454-0900
Niagara	4487 Lake Avenue, Lockport, NY 14094	716-433-6731
NYC	16 East 34th Street, 8th Floor, NY, NY 10016-4328	212-340-2900
Oneida	121 Second Street, Oriskany, NY 13424-9799	315-736-3394
Onondaga	220 Herald Place, 2nd Floor, Syracuse, NY 13202-1045	315-424-9485
Ontario	480 North Main Street, Canandaigua, NY 14424-1099	716-394-3977
Orange	1 Ashley Avenue, Education Ctr. Comm. Campus, Middletown, NY 10940	845-344-1234
Orleans	PO Box 150, Albion, NY 14411-0150	716-589-5561

County Cornell Cooperative Extension Offices in NY (cont'd)

<u>COUNTY</u>	<u>OFFICE LOCATION</u>	<u>PHONE</u>
Oswego	3288 Main Street, Mexico, NY 13114-3499	315-963-7286
Otsego	123 Lake Street, Cooperstown, NY 13326	607-547-2536
Putnam	10 Geneva Road, Brewster, NY 10509	845-278-6738
Rensselaer	61 State Street, Ag & Life Science Building, Troy, NY 12180	518-272-4210
Rockland	PO Box 1000, Thiells, NY 10984	845-429-7085
St. Lawrence	1894 State Highway 68, Canton, NY 13617-1477	315-379-9192
Saratoga	50 West High Street, Ballston Spa, NY 12020	518-885-8995
Schenectady	Schaffer Heights, 107 Nott Terrace, Suite 301, Schenectady, NY 12308	518-372-1622
Schoharie	41 South Grand Street, Cobleskill, NY 12043	518-234-4303
Schuyler	208 Broadway, Montour Falls, NY 14865	607-535-7161
Seneca	PO Box 748, Waterloo, NY 13165	315-539-9252
Steuben	3 East Pulteney Square, Bath, NY 14810	607-776-9631
Suffolk	246 Griffing Avenue, Riverhead, NY 11901-3086	631-727-7850
Sullivan	69 Ferndale-Loomis Road, Liberty, NY 12754-2903	845-292-6180
Tioga	56 Main Street, Owego, NY 13827-1588	607-687-4020
Tompkins	615 Willow Avenue, Ithaca, NY 14850-3555	607-272-2292
Ulster	10 Westbrook Lane, Kingston, NY 12401-2928	845-340-3990
Warren	377 Schroon River Rd, Warrensburg, NY 12885-4807	518-623-3291
Washington	Lower Main Street, Hudson Falls, NY 12839	518-746-2560
Wayne	1581 NYS Route 88N, Newark, NY 14513-9739	315-331-8415
Westchester	26 Legion Drive, Valhalla, NY 10595	914-285-4630
Wyoming	401 North Main Street, Warsaw, NY 14569	716-786-2251
Yates	110 Court Street, Penn Yan, NY 14527	315-536-5123