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MEMORANDUM

DATE: 12/29/2020

TO: Chairman Thomas Burt
Commissioners of the Harbor Coastal Zone Management Commission

FROM: Ms. Lucille V. Munz, RLA, ASLA JMC

RE: JMC Project 18100
1165 Greacen Point Road
Village of Mamaroneck, NY

SUBJECT: Erosion Control

This memo is in response to Commissioner Hain's comments noting his concerns regarding the effectiveness of grasses and the proposed grassed areas for erosion control for the above noted project, and/or whether trees would offer additional erosion control protection. We offer the following information that we believe adequately addresses his concerns as follows:

1) The establishment of grasses as a permanent vegetative cover is the preferred method of stabilization by the NYSDEC. (see the attachment from the NYSDEC Manual).

2) Grasses are quick germinating, provide quick cover and roots knit together to hold smaller soil particles in place.

3) The grasses and mixes chosen for the site are well suited for the site and conditions and will quickly provide erosion protection.

4) Grasses act as buffer strips which helps to slow water velocity and additionally filter sediments from run off.

5) Trees require a lengthy amount of time for establishment before having any substantive rooting and effective erosion mitigation properties.

6) While a tree root system does stabilize the deeper soils, it is the upper layers that are more prone to erosion especially in heavy storms and if unprotected.

7) Large canopy trees generally provide a substantial amount of shade that inhibits the growth of grasses and shrubs beneath its canopy leaving surface soils prone to erosion if the area beneath it is not similarly stabilized.

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8) Trees are prone to uprooting in high winds, especially along shorelines and as our storms have become more frequent and damaging over the years, this will be more problematic.

9) Grasses are planted and mowed as desired heights and offer consistent stabilized protection. Should an area need reseeding/planting this can be accomplished very quickly and easily. Whereas if a tree were to die and/or uproot, it would take a substantial amount of time to provide effective erosion control for the area.

We trust that you find this information helpful and have attached below the following:

A) From the NYSDEC Standards and Specifications for Erosion and Sediment Control Manual: "*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"*

B) A paper prepared by Oklahoma State University Cooperative Extension concluded that *"Trees have greater rooting depth and are able to penetrate moisture levels inaccessible to shallow-rooted vegetation. By reinforcing to greater depths, trees add stability to slopes. However, trees are less effective than grass in stabilizing against erosion. Therefore, it is recommended that areas designated for trees be planted with grass. To avoid competition with trees, give preference to lower- and slower-growing grasses, or phase trees in gradually after the area is stabilized"*

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SECTION 2
EROSION CONTROL PLANNING AND SITE MANAGEMENT

CONTENTS

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EROSION CONTROL PLANNING AND SITE 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, 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.

Site Development Plans

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.

I. Technical Data Requirements

Features of the site including location, 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.

The technical data provides the framework necessary to make informed decisions about a sites ultimate use and the types of erosion and sediment controls that will work. Soils information such as detailed soil maps and interpretation sheets may be available in local NRCS and SWCD offices and will specifically provide the following soils information:

a. Descriptions, erodibility, limitations, and capabilities;
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. Site Plan Design Steps

1. Plan the Development to Fit the Site

Assess the physical characteristics of the site to determine how it can be developed with the lowest risk of environmental damage. 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 and adjacent areas.** 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. 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 borders), which must be disturbed. Staged clearing and grading is necessary to keep areas of disturbance to less than 5 acres.

3. Divide the Site into Natural Drainage Areas

Determine how runoff will drain from the site. Natural drainage channels should not be altered or relocated without the proper approvals. Pursuant to Article 15 of the Environmental Conservation Law (ECL), a protected stream and the bed and banks thereof should not be altered or relocated without the approval of the Department of Environmental Conservation. 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 debris basins; paved or other types of lined chutes, 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 surface water 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.**

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

Natural resources need to be identified in the planning process in order to design an appropriate ESC plan. The plan must 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.

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 sequencing schedule.

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

a. sites on slopes that exceed 15% or sites in areas of severe erosion potential where such areas have been mapped;

b. sites within 100 ft. of a wetland; and/or

c. sites within 100 ft. of any watercourse.

The plan should be prepared and presented during the State Environmental Quality Review Act (SEQRA) process. The plan must be designed so that suspended, colloidal, and settleable solids are not discharged in amounts that cause substantial visible contrast to natural conditions, or cause deposition or impair the waters for their best (classified) uses (6 NYCRR, Part 703.2).

This means that stream reaches on-site and downstream of construction areas shall not have substantial visible contrast to natural conditions relative to color, taste, odor, turbidity, and sediment deposition from the reaches upstream of the construction area.

ESC practices are divided into vegetative and structural controls. While more details on these practices are contained in other sections of this handbook, general guidance 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 grading. ESC plans must contain provisions for permanent stabilization of disturbed areas. Seed type, soil amendments, seedbed preparation, 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 manual. 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.

An ESC plan includes:

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 plan review process: 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 be bold and easily discernible on the plans.

4. Dimensional details of proposed ESC facilities as well as calculations used in locating and sizing of sediment basins.

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 the installation of underground utilities.

A sample ESC checklist is contained in Appendix G.

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:

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 offsite runoff from highly erodible soils and steep slopes to stable 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. Restabilize disturbed areas as soon as possible after construction is completed. On sites greater than two acres, waiting until all disturbed areas are ready for seeding is unacceptable. Fourteen days shall be the maximum exposure period. 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 perimeter sediment control system consisting, for example, of silt fencing or hay bales, 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 entrances 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), or where appropriate, vegetative measures such as sod. Refer to Section 5 for appropriate considerations.

   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 (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 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 all contractors and sub-contractors understand the ESC plan and sign the certification statement required by NYSDEC GP.

7. Designate responsibility for the ESC plan to one individual. This person shall be named in the Notice of Intent.

8. An ESC plan inspection program meeting the requirements of the NYSDEC GP, is necessary to determine when ESC measures need maintenance or repair. Pay particular attention to inspections required after rainfall. The inspection program shall also state the completion of identified repair and maintenance items.

Predicting Soil Losses

Predictions 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 create an 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 430 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 2.2 at the end of this section 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.

Professional Certification

CPESC, Inc. administers a program to evaluate individuals as a Certified Professional in Erosion and Sediment Control (CPESC). Such individuals have acquired specific training and passed an examination in ESC. These individuals are generally available for site design and/or implementation oversight. In addition, state licensed engineers, landscape architects and soil scientists also provide the technical skills required to design plans and inspect construction sites.

ESC Ordinances and Subdivision Regulations

ESC Laws and related 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. An ESC law accomplishes this by regulating and controlling the design, construction, use, and maintenance of any development or other activity that disturbs or breaks the topsoil or results in the movement of earth on land. ESC laws consist of permit application and review, and they typically require an erosion and sediment control plan. Municipalities can ensure successful construction and maintenance of ESC measures by adopting and implementing a law that requires prior review and approval of ESC plans, provides ESC design criteria, and includes an inspection and enforcement procedure.

STEPS IN THE SELECTION AND DESIGN OF CONTROL MEASURES

The following text relates to the planning flow charts on pages 2.6, 2.7 and 2.8.

In the erosion and sediment control process, site designs must be prepared to address erosion control and then sediment control. Erosion control is accomplished by controlling runoff and then stabilizing soil. After erosion control has been planned, sediment control can then be developed.

Step 1: Identify Control Methods—Three basic methods are used to control soil movement on construction sites: runoff control, soil stabilization, and sediment control. **CONTROLLING EROSION SHALL BE THE FIRST LINE OF DEFENSE.** Runoff control and soil stabilization can be used to control erosion. Controlling erosion is very effective for small-disturbed areas such as single lots or small areas of a disturbance.

Sediment control may be necessary on large developments where mass grading is planned, where it is harder or impractical to control erosion, and where sediment particles are relatively large. A minimum of cost for erosion and sediment control is usually accomplished by using a combination of vegetative and structural erosion control and sedimentation control measures.

Step 2: Identify Resources and Potential Problem Areas—Resources need to be identified prior to initiating an ESC plan. These resources include, but are not limited to, receiving waters, tributaries to public water supplies, beaches and other concentrated recreational areas, wetlands, trees, vegetative buffers, steep slopes and cultural resources. Areas where erosion is to be controlled will usually fall into categories of slopes, graded areas or drainage ways. Slopes include graded rights-of-way, stockpile areas, and all cut or fill slopes. Graded areas include all stripped areas other than slopes. Drainage ways are areas where concentrations of water flow naturally or artificially, and the potential for gully erosion is high. Problem areas where sediment is to be controlled fall into categories of large or small drainage areas. Small areas are usually 1 acre or less while large areas are greater than 1 acre.

Step 3: Identify Required Strategy—The third step in erosion and sediment control planning is to follow the planning matrix from the problem area to the strategy that can be taken to solve the problem. Strategies can be used individually or in combination. For example, if there is a cut slope to be protected from erosion, the strategies may be to protect the ground surface, divert water from the slope, or shorten it. Any combination of these strategies can be used. If no rainfall except that which falls on the slope has the potential to cause erosion, and if the slope is relatively short, protecting the soil surface is often all that is required to solve the problem.

Step 4: Identify Control Measure Group—Once required strategies are identified, the planning flow chart leads to the group or groups of control measures that will accomplish one strategy. Control measures within each group have similar purpose, scope, application, design, criteria, standard plans, and construction specifications. Therefore, any measure within a group may solve the problem in question.

Step 5: Design Specific Control Measures—The final step in erosion and sediment control planning is accomplished by completing final design. This involves applying any control measure within a group to solve the specific erosion and sediment control problem. From descriptions given to the right of each control measure in the ESC planning matrix (Table 2.1), the one measure which is most economical, practical, efficient, and adaptable to the site should be chosen.

Step 6: Winter Operations—If construction activities continue during winter , access points should be enlarged and stabilized to provide for snow stockpiling. In addition, a snow management plan should be prepared with adequate storage and control of meltwater. A minimum 25 foot buffer shall be maintained from perimeter controls such as silt fence. In high resource protection areas, silt fence shall be replaced with perimeter dikes, swales, or other practices resistant to the forces of snow loads. Keep drainage structures open and free of snow and ice dams. Inspection and maintenance are necessary to ensure the function of these practices during runoff events.

Once the specific control measure has been selected, the plan key symbol given in the flow chart must be placed on the erosion and sediment control site plan to show where the control measure will be used. Standardized design, plan, and construction specification sheets must then be completed for each control measure. This completes the planning for erosion control and soil stabilization as part of the total natural resource plan.

Figure 2.1
Planning Flow Chart—Runoff Control

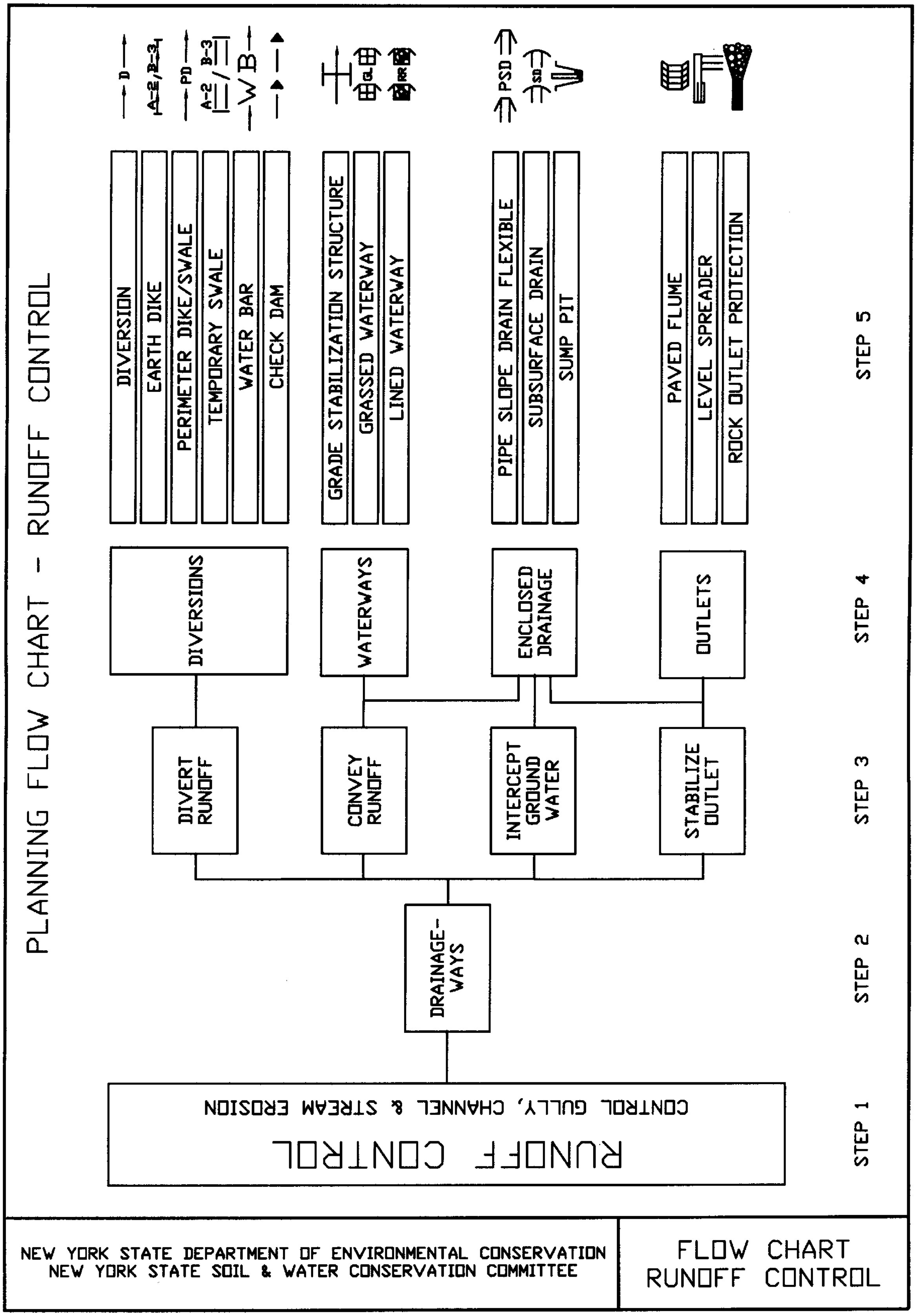

Figure 2.2
Planning Flow Chart—Soil Stabilization

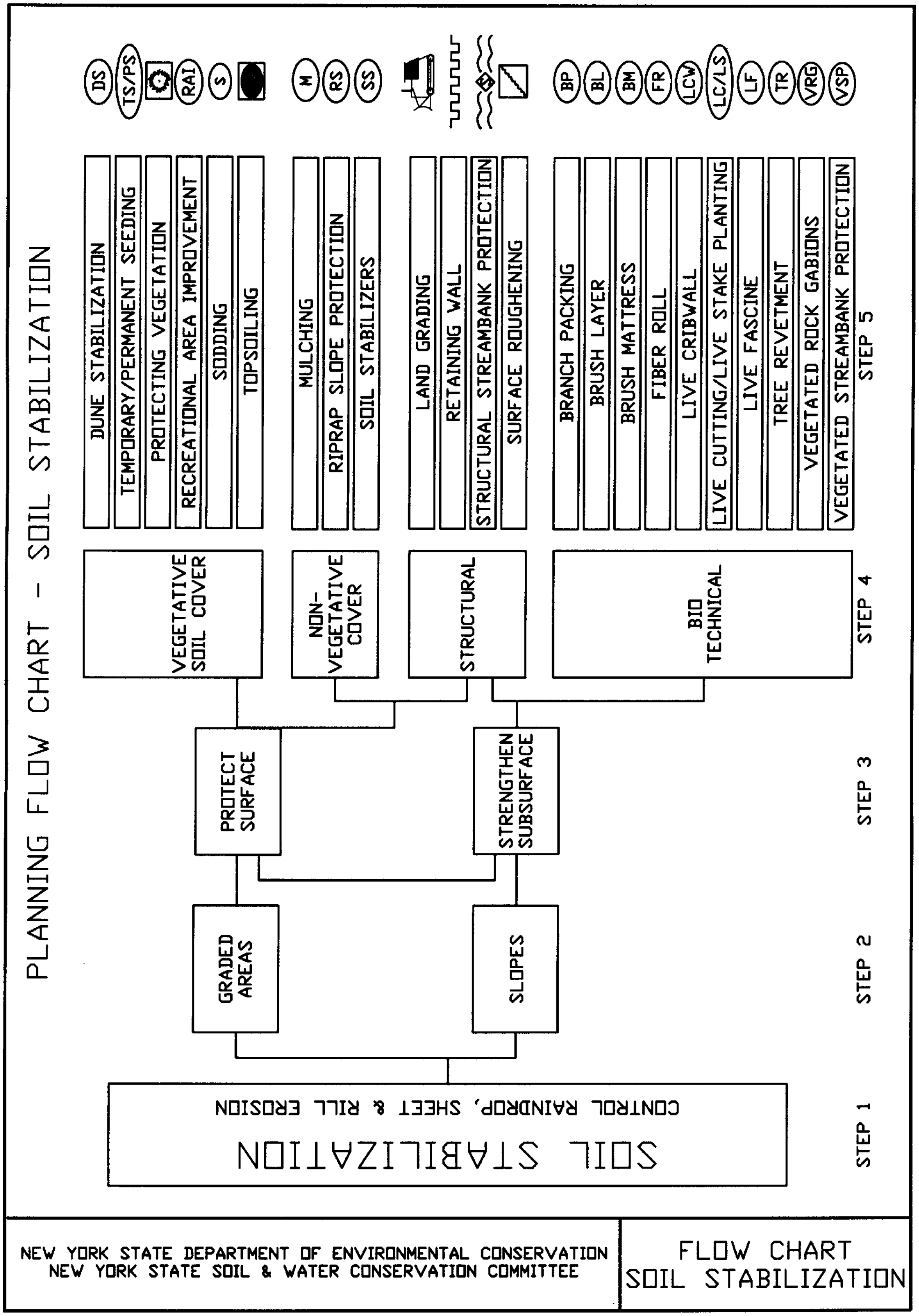

Figure 2.3
Planning Flow Chart—Sediment Control

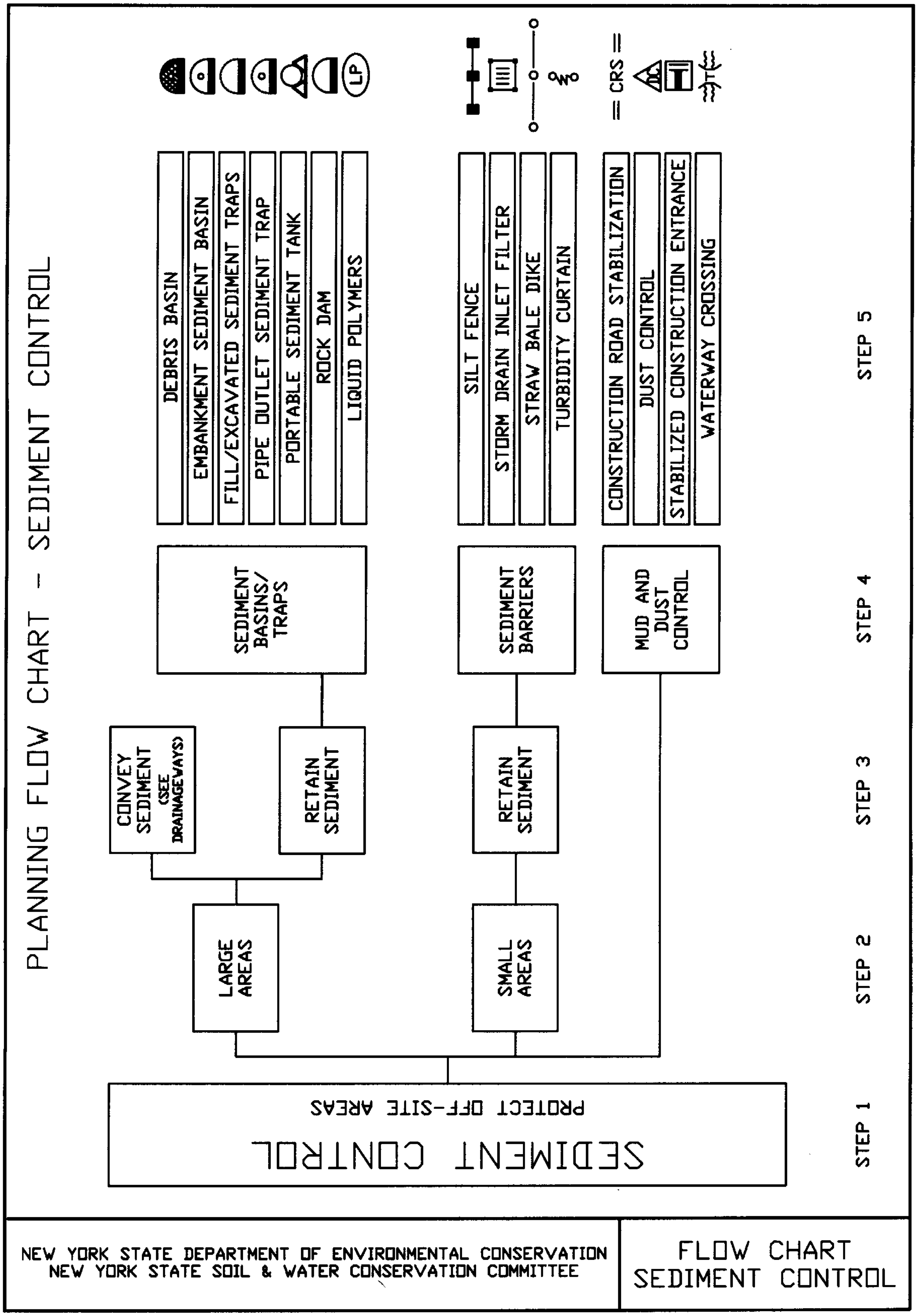

Table 2.1
Erosion and Sediment Control Practices Matrix

Practice	Primary Purpose	Site Characteristics	Estimated Design Life	Associated Practices
Brush Matting	Stabilize soil; prevent erosion	Stream bank slopes	5-10 years	Rock slope protection, structural streambank protection, subsurface drain
Check Dam	Control runoff	Drainage area ≤ 2 Ac.	1 year	Lined waterway, rock outlet protection
Construction Road Stabilization	Control sediment	All construction routes	2 years	Dust control, temporary swales, temporary or permanent seeding
Debris Basin	Capture sediment	Maximum drainage area = 200 Ac.	Up to 25 years	Sediment basin
Diversion	Intercept and divert runoff	Minimum 10 year design Q	10-25 years	Permanent seeding, rock outlet protection, level spreader, sediment basin
Dune Stabilization	Stabilize sand dunes	Sand dune reinforcement	5-10 years	_____
Dust Control	Stabilize soil	Access points, construction roads	Site specific	Stabilized construction entrance, construction road stabilization
Earth Dike	Control runoff	Drainage area ≤ 10 Ac.	1 year	Sediment trap, rock outlet protection, storm drain inlet
Grade Stabilization Structure	Prevent erosion	Minimum design Q = 10 yr. 24 hr.	10 + years	Permanent seeding, rock slope protection structural streambank protection
Grassed Waterway	Convey runoff	Minimum 10 year design Q	Min. 10 years	Rock outlet protection, vegetated waterways, sediment basin, level spreader
Land Grading	Stabilize soil	Site specific shaping	Permanent	Topsoiling, subsurface drain, seeding
Level Spreader	Discharge runoff	10 year Q ≤ 30 cfs; outlet < 10%	1 year	Diversion, grassed waterway, temporary swales
Lined Waterway (rock materials)	Convey runoff	Minimum design Q = 10 yr. 24 hr.	Min. 10 years	Rock outlet protection, subsurface drain
Mulching	Stabilize soil	Site specific	1-2 years	Permanent seeding, recreation area improvement
Paved Channel (concrete)	Convey runoff	Minimum design Q = 10 yr. 24 hr.	Min. 10 years	Rock outlet protection, subsurface drain
Paved Flume	Convey runoff	Minimum design Q = 10 yr. 24 hr.	10 years	Rock outlet protection

Table 2.1 (cont'd)
Erosion and Sediment Control Practices Matrix

Practice	Primary Purpose	Site Characteristics	Estimated Design Life	Associated Practices
Perimeter Dike/Swale	Divert runoff	Drainage area ≤ 5 Ac.	1 year	Sediment trap, level spreader, temporary seeding
Pipe Slope Drain	Convey runoff down slope	Drainage area ≤ 5 Ac.	1 year	Rock outlet protection
Portable Sediment Tank	Retain sediment	16 times pump discharge	2 years	Sediment trap, sediment basin
Protecting Vegetation	Preserve existing vegetation	Site specific	1-10 years	Recreation area improvement
Recreation Area Improvement	Protect areas/soils	Site specific	Permanent	Permanent seeding, mulching, topsoiling
Retaining Wall	Stabilize soil	Site specific constraints	10+ years	Rock slope protection, permanent seeding, subsurface drain
Riprap Slope Protection	Stabilize soil, prevent erosion	Max. 1:5 to 1 slope	10 years	Lined waterway, rock outlet stabilization, structural streambank protection
Rock Dam	Capture sediment	Drainage area ≤ 50 Ac.	3 years	Debris basin, sediment basin
Rock Outlet Protection	Prevent erosion	Rock varies with pipe discharge	10+ years	Diversion, grassed waterway, sediment basin, sediment traps
Sediment Basin	Capture sediment	Drainage area ≤ 100 Ac.	3 years	Rock outlet protection, temporary seeding
Sediment Traps				
I. Pipe Outlet	Trap sediment	Drainage area ≤ 5 Ac.	2 years	Sediment basin, debris basin
II. Grass Outlet	Trap sediment	Drainage area ≤ 5 Ac.	1 year	Rock outlet protection
III. Storm Inlet	Trap sediment	Drainage area ≤ 3 Ac.	1 year	Rock outlet protection
IV. Swale	Trap sediment	Drainage area ≤ 2 Ac.	1 year	Rock outlet protection
V. Stone Outlet	Trap sediment	Drainage area ≤ 5 Ac.	2 years	Rock outlet protection
VI. Riprap Outlet	Trap sediment	Drainage area ≤ 15 Ac.	2 years	Rock outlet protection
Seeding, Temporary	Stabilize soil	Site specific	1-2 years	Surface roughening, topsoiling, sodding
Seeding, Permanent	Stabilize soil	Site specific	Permanent	Surface roughening, topsoiling, sodding

Table 2.1 (cont'd)
Erosion and Sediment Control Practices Matrix

Practice	Primary Purpose	Site Characteristics	Estimated Design Life	Associated Practices
Silt Fence	Control sediment	2:1 slopes maximum 50 ft. spacing	1 year	Straw bale dike
Sodding	Stabilize soil	Need quick cover, aesthetics	Permanent	Inlet protection, topsoiling, permanent seeding
Stabilized Construction Entrance	Control sediment	Access points	2 years	Filter fence, construction road stabilization
Storm Drain Inlet Protection				
I. Excavated	Trap sediment	Drainage area ≤ 1 Ac.	1 year	Sediment traps, storm drain diversion
II. Filter Fabric	Trap sediment	Drainage area ≤ 1 Ac.	6 months	Sediment traps, storm drain diversion
III. Stone and Block	Trap sediment	Drainage area ≤ 1 Ac.	6 months	Sediment traps, storm drain diversion
IV. Curb	Trap sediment	Drainage area ≤ 1 Ac.	6 months	Sediment traps, storm drain diversion
Straw Bale Dike	Control sediment	2:1 slopes maximum 25 ft. spacing	3 months	Silt fence
Streambank Protection				
I. Structural	Prevent erosion	Minimum 10 yr. design Q; velocity > 6 fps	10 years	Rock slope protection
II. Vegetative	Prevent erosion	Minimum 10 yr. design Q; velocity < 6 fps	10 years	Structural streambank protection
Subsurface Drain	Intercept and convey drainage water	Drainage Coefficient—1"	10 years	Rock outlet protection, land grading, retaining wall
Sump Pit	Control sediment	Site specific	6 months	Sediment trap, sediment basin
Surface Roughening	Stabilize soil	Construction slopes	Permanent	Temporary seeding, permanent seeding, mulching
Temporary Access Waterway Crossings				
I. Temporary Access Bridge	Prevent sediment	8 ft. centerline piers	2 years	Rock slope protection
II. Temporary Access Culvert	Prevent sediment	Minimum 12 in.; 40 ft. length	2 years	Structural streambank protection
III. Temporary Access Road	Prevent sediment	Stream banks < 4 ft.	1 year	Structural streambank protection
Temporary Storm Drain Diversion	Divert runoff	On site drainage area > 50% total	1 year	Sediment trap/basin
Temporary Swale	Divert runoff	Drainage area ≤ 10 Ac.	1 year	Sediment traps, storm drain inlets, sediment basin, level spreader

Table 2.1 (cont'd)
Erosion and Sediment Control Practices Matrix

Practice	Primary Purpose	Site Characteristics	Estimated Design Life	Associated Practices
Topsoiling	Provide growing conditions	Poor site soil characteristics	Permanent	Surface roughening, temporary seeding, permanent seeding
Turbidity Curtain	Control sediment	Calm water	Generally < 1 month	Sediment traps, basins
Vegetating Waterways	Stabilize soil	Site specific	Permanent	Grassed waterways, permanent seeding
Water Bars	Divert runoff	Slope areas < 100 ft. width	2 years	Rock outlet protection, level spreader
Wattling	Stabilize soil	Maximum 1.5:1 slopes	10 years	Diversion, subsurface drain, temporary swale

Table 2.2
Erosion Risk

Soil Type and Parameters	Slope %		
	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
Despersive Clay Soils	High	Very High	Extreme

Note: 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.

References

1. Northeastern Illinois Soil and Sedimentation Control Steering Committee. October 1981. Procedures and Standards for Urban Soil Erosion and Sediment Control in Illinois.

Using Vegetation for Erosion Control on Construction Sites

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Erosion and sediment control on construction sites is a critical issue. Construction activities account for about five percent of the nonpoint source (NPS) impacts to our Nation's surface waters. Runoff from construction sites is by far the largest source of sediment in urban areas under development.

Four primary factors determine the potential for erosion—soil type, vegetative cover, topography, and climate. **This fact sheet explains the importance of vegetative cover, its role in erosion control, and its establishment on construction sites.**

What is Soil Erosion?

Soil erosion is the process by which wind, water, ice, and gravity wear away the land's surface. Sediment pollution is soil out of place. There are two categories of erosion—natural erosion and accelerated erosion. Natural erosion and soil formation are essential landscape processes and are in balance when the soil surface thickness remains fairly constant over time. Vegetative cover is the biggest factor in this balance; anything that disturbs it tends to accelerate erosion.

Accelerated erosion is most often caused by a disturbance or alteration of the landscape, such as floods, earthquakes, or construction activities. The typical construction site can erode at a rate as high as 100 to 500 tons/acre/year. This is 100 times greater than erosion from cropland and 2,000 times greater than erosion from woodland.

Types of Erosion

Splash, rill, gully, and channel erosion are depicted in Figure 1. **Raindrop splash erosion** is caused by the impact of raindrops that detach soil particles. **Sheet erosion** transports soil particles in the shallow flow of water as it runs off the land. **Rill erosion** is caused by flowing water concentrating in small channels. **Gully erosion** occurs where rills become larger and deeper. Finally, **channel erosion** results from high velocities and volumes of flow.

Of all the types of erosion, splash erosion from raindrop impact causes the most problem. Raindrops strike the earth at about 20 mph—10 to 100 times faster than flowing water.

Influence of Vegetation and the Impact of Rain on Soil

Vegetation intercepts rain, reducing its energy and preventing splash erosion. It also slows runoff, reduces sheet erosion, and anchors and reinforces the soil with its root system. Figure 2 shows how erosion rate decreases as the soil is covered by vegetation.

Surface water runoff from vegetated areas is much less than that from bare soil due to a combination of surface roughness, infiltration, and interception. Runoff generally does not exceed 10 to 20 percent of the rainfall received on small watersheds covered with trees or grass. Without vegetation, however, this could be as high as 60 to 70 percent.

Water moving across a bare soil surface erodes soil and transports particles already detached. Vegetation limits the

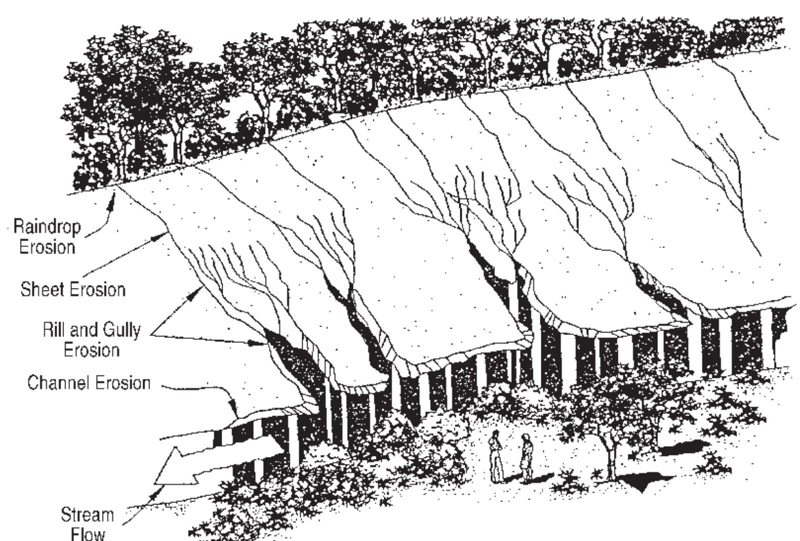


Figure 1. Types of erosion. (Michigan Department of Natural Resources, 1975)

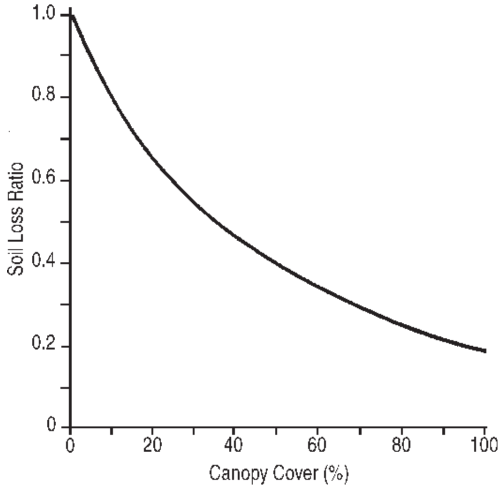


Figure 2. Change in erosion rate due to increasing vegetative cover. (Coppin and Richards, 1990)

capacity of flowing water to detach soil particles and transport sediment by decreasing runoff volume, slowing velocity, and protecting the soil surface from flowing water.

As shown in Figure 3, infiltration rate increases under vegetation. Plant roots create openings or cracks where roots have decayed, increase surface roughness, lower the density of the soil, and improve the structure of surface soils. This increase in the infiltration rate of rainfall and surface flow increases the moisture content of the soil. Plant roots also physically anchor the soil from movement induced by gravity, raindrop impact, or surface runoff.

Laterally spreading root systems, especially rhizomes, are more effective in reducing surface erosion than vertically structured ones with tap roots. Roots form a backbone of fibers of relatively high tensile strength and adhesion within a matrix of lower tensile strength. The sheer strength of the soil mass is enhanced by the presence of a root matrix. Figure 4 shows different patterns of root growth. Erosion control plantings should have relatively deep, branched root systems.

Restoration

Measures that stabilize, maintain, and protect existing vegetation include stockpiling topsoil for reuse, seeding or sodding, and selecting plants and a planting design appropriate for the site. First, conduct a detailed site appraisal to identify the conditions and environmental factors that can restrict or promote the growth of vegetation. These factors include:

- Soil types, fertility, pH, climate (temperature and moisture).
- Slopes.
- Roles and functions of the vegetation.
- Properties required of the vegetation and thus the types needed (herbaceous, shrubby, woody, etc.).
- Ecological and plant community factors for long-term stability.
- Long-term management objectives and review requirements for maintaining the vegetation.

Native Species

Use species that are native to the area whenever possible. A native plant landscape is naturally water conserving. They are adapted to local rainfall averages and, once established, do not need supplemental watering. Native grasses and wildflowers provide seasonal color and species diversity and are low maintenance.

Natural landscaping is an excellent example of how to create less intensively managed landscapes, which help reduce maintenance costs, conserve natural resources, increase biodiversity, and benefit wildlife.

Plant Material Selection

Except where a manicured lawn is needed, it is unlikely that one species alone will fulfill all site requirements. Mixtures of

Native plants are adapted to local rainfall and, once established, do not need supplemental watering.

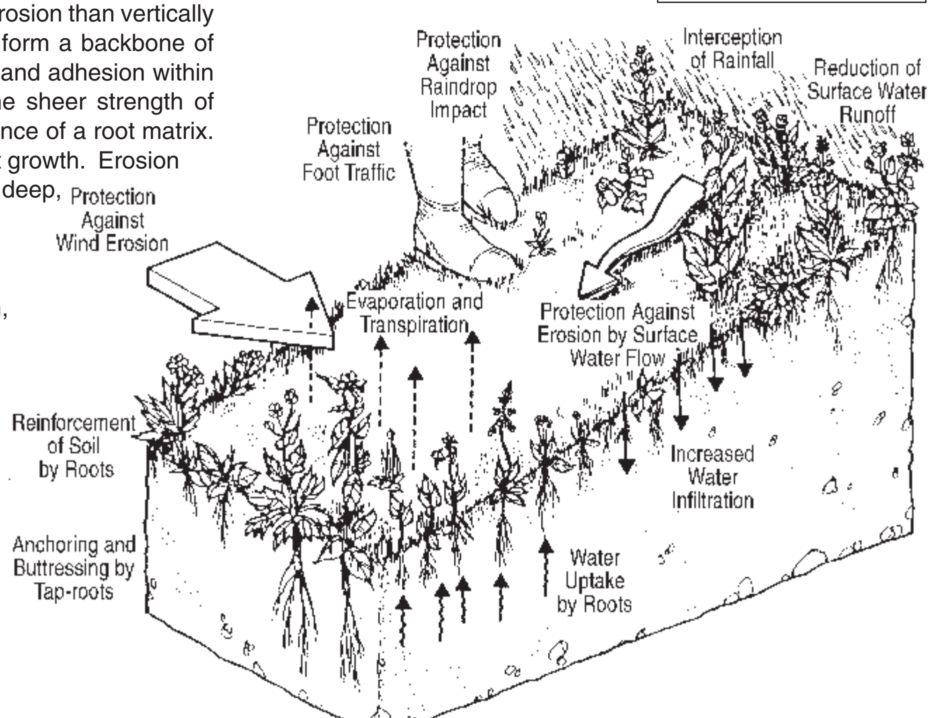
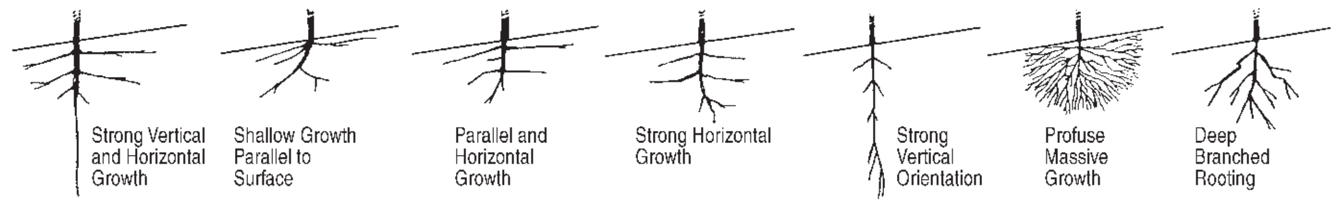


Figure 3. Some influences of vegetation on the soil. (Coppin and Richards, 1990)

Vegetation increases the strength of the soil by reinforcement from fibrous roots and anchoring from tap roots, thereby contributing to its stability.

Figure 4. Different patterns of root growth. (Coppin and Richards, 1990)



species with complementary characteristics allow vegetation to fill voids and respond to varying environmental conditions. Mixtures should be designed with the plant community and the environmental dynamics in mind. The proportion of each species will depend on the role each plays, its competitive ability, and succession status.

Grasses are usually selected as the main component of ground cover. They can be mixed with 10 to 50 percent legume and other herbaceous species. Legumes should usually be a significant component of mixtures, particularly on soils with low fertility. A nurse crop such as annual rye grain can hold soil in place, allowing a perennial to germinate when weather conditions change. Nurse species density should be kept to a low proportion, 10 percent or less, so that they do not dominate the area and suppress more slowly growing species. A diverse mixture of grasses, legumes, forbs, and shrubby species with a range of 6 to 10 species will allow for variability and flexibility in site conditions. Mixtures with a majority of shrubby species would be more suitable where deeper rooting is required.

Trees are an excellent means of improving the appearance of the landscape and disguising its scars. Trees have greater rooting depth and are able to penetrate moisture levels inaccessible to shallow-rooted vegetation. By reinforcing to greater depths, trees add stability to slopes. However, trees are less effective than grass in stabilizing against erosion. Therefore, it is recommended that areas designated for trees be planted with grass. To avoid competition with trees, give preference to lower- and slower-growing grasses, or phase trees in gradually after the area is stabilized.

Tree Protection

When existing trees are left on a site, they require protection from construction activities. Compaction and grading close to trees often cause trees to decline and die. Sometimes the damaged trees die slowly, after construction is finished.

Roots of established trees cannot tolerate significant changes in soil depth. Removing soil can sever and expose the root system and render the tree structurally unstable. Digging out large areas near trees can also adversely change the water table leading to a tree's demise. Soil should not be piled (even temporarily) over roots of trees. This can produce anaerobic conditions resulting in the suffocation of roots.

Vehicles driven or parked near trees results in soil compaction. Soil becomes more dense, restricting the movement of water and gases. This reduces the capacity of the roots to absorb moisture, oxygen, and nutrients.

It is impossible to avoid all site disturbance during construction, but measures can be taken to diminish tree injury. Leave the soil beneath the trees undisturbed and mark off the area with stakes and tape. When lowering the grade, terrace around the tree and support the soil with a retaining wall. Avoid

Table 1. Seed rates to use for vegetative cover.

Plant Name	Rate per Acre	Rate per 1,000 sq. ft.	Planting Date
Temporary Species:			
Annual rye	40 lbs.	1.0 lb.	Feb.-April Sept.-Nov.
Rye grain	120 lbs.	3.0 lb.	Aug.-Nov.
Wheat	120 lbs.	3.0 lbs.	Aug.-Nov.
Sorghums	80 lbs.	2.0 lbs.	Mar.-Sept.
Sweet clover	20 lbs.	0.5 lbs.	Sept.-Oct.
Sudan grass	40 lbs.	1.0 lb.	Apr.-Sept.
Millet	60 lbs.	1.0 lb.	Apr.-Sept.
Cowpeas	60 lbs.	1.0 lb.	May-June
Permanent Species:			
Lawn grasses:			
Bermudagrass*	80 lbs.	2.0 lbs.	April-July
Bluegrass	160 lbs.	4.0 lbs.	March-May Sept.-Nov.
Perennial Rye	200 lbs.	5.0 lbs.	Sept.-Dec.
Fescue	200 lbs.	5.0 lbs.	March-May Sept.-Nov.
Zoysia	80 lbs.	2.0 lbs. 2-3 sq. yd. sod if sprigging	April-July
Natives:			
Buffalograss**	80 lbs.	2.0 lbs.	April-June
Bluestem	40 lbs.	1.0 lb.	March-June
Lespedeza	40 lbs	1.0 lb.	April-June
Weeping lovegrass	40 lbs.	1.0 lb.	April-June

* Most seeded bermudagrass is not winter hardy. One of the best ways to plant is by spreading topsoil that contains bermudagrass stolens and rhizomes.

** Buffalograss should not receive more than 2 lbs./1,000 sq.ft. of Nitrogen.

(Source: Oklahoma County Conservation District)

Table 2. Vegetation management.

Vegetation Type	Establishment Method	Aftercare	Management
Grass or grass-legume swards	Seeding	Fertilizing; mowing to encourage tillering.	Soil fertility management. Cut or graze to maintain desired height and prevent scrub invasion. Removal of noxious or undesirable weeds.
Diverse herbaceous swards	Seeding, maybe some planting	Mowing to control nurse species, fertilizing.	Cutting, grazing, or burning to prevent succession to scrub; timing is important to allow desired species to flower and set seed. Removal of noxious or undesirable weeds.
Short shrubs	Seeding, maybe some planting	Fertilizing, weed control may be necessary on fertile soils.	Depends on whether succession to trees is necessary. If not, the occasional cutting or burning, the regime depends on the species.
Trees and shrubs	Seeding	Little, maybe fertilizing and weed control.	Maybe some selective weeding and fertilizing around individual plants. Selective thinning of seedlings to obtain desired balance of species.
	Planting	Weed control, replacement, pruning, fertilizing, maintaining protection.	Fertilizing as necessary, thinning to encourage proper stand structure, removal of nurse species. Coppicing of some species for dense, shrubby cover.

(Source: Coppin and Richards)

cutting off root systems by carefully tunneling under roots instead of trenching through them. For more information, see OSU Extension Facts HLA-6429, "Site Disturbance and Tree Decline."

It is impossible to avoid site disturbance during construction, but measures can be taken to diminish the injury to trees.

Site Preparation

Careful site preparation will enhance vegetation growth and help to overcome problems that often arise on construction sites. The method of vegetation establishment, to a large extent, will dictate surface preparation. A smooth finish is only required where the vegetation is to be closely mown, or in water channels to reduce surface roughness. Drilling seed requires a reasonably level surface with loose tilth, but a rough surface will work for broadcast or hydroseeding.

For best results, spread four to six inches of topsoil. Fertilize according to soil test recommendation, or apply 10 lbs. per 1,000 sq. ft. of a balanced fertilizer, such as 10-10-10 or 13-13-13. Seed with an appropriate mix for the site. Table 1 shows the seeding rates to use for vegetative cover. Mulch with straw at two square bales per 1,000 sq. ft. Water gently as needed to keep the soil moist until the grass is about two inches tall.

Plant Spacing

Plant spacing will depend on the type of vegetation required. Shrubs are planted more closely than trees, from two to five feet apart, depending on the species. For planting wooded areas, space trees six to 10 feet apart, depending on the species. On slopes where stability of the surface soil layers is critical, avoid digging a row of pits across the slope. This can introduce a weakened zone that may slough when water enters the pits. Plant spacing and pattern should be carefully considered to avoid such potential failure zones.

Vegetation Management

A planned management program must be designed to take into account the desired functions of the vegetation, the soil and climatological conditions of the site, and the management capacity of the owner or maintaining authority. Table 2 summarizes the main management activities for different vegetation types.

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