CHAPTER 800
EROSION AND SEDIMENT CONTROL

SECTION 800.01
INTRODUCTION

The standard and specifications found in this Chapter are for the material and construction to ensure erosion and sediment control within the Village of Lombard, Illinois.

Specific references made herein refer to the Illinois Procedures and Standards for Urban Soil Erosion and Sedimentation Control manual and the Illinois Urban Manual.

Design procedures and standards are presented in this chapter for implementing sediment, runoff and soil stabilization control measures.

The selection of the appropriate control measure will depend upon an analysis of the existing site conditions, the intended use of the site, and the duration of the control measures.

Site Analysis

A thorough site evaluation is necessary to determine the appropriate control measures.

Included in the evaluation should be an analysis of the existing vegetation, surface topography, and subsurface conditions. The retention of existing vegetation, particularly plants with root systems capable of soil stabilization, may reduce the intensity of the required control measure. The site's surface stability is determined by slope, length and gradient, soil permeability and structural characteristics, and local climate conditions, particularly rainfall amount.

Site Use

The intended use of the site requiring sediment, runoff and soil stabilization should be identified so that a measures may be selected that are compatible with the intended use from the standpoint of expected maintenance, adaptability, and aesthetics. Certain intended uses would preclude certain kinds of control measures. These must be identified before control measures are selected. Also, the surface protection measures must provide the durability and function called for by varying uses that include athletic fields, passive parks, detention basins, and wildlife.

Duration of Control

The length of time for which the control measure will be needed should also be determined. A site needing control measures for 12 months or less could rely upon a temporary control measures while a site needing control measures for more than 12 months would need permanent control measures. Also, certain design quantities, such as sediment volume, are determined from length of exposure of soils to erosion.

SECTION 800.02
SOIL STABILIZATION

A) VEGETATIVE STABILIZATION

Adhering to the following basic procedures can increase the degree of success obtained in establishing vegetative control of an area:

Subgrade Preparation

Following all site construction, but immediately prior to topsoil placement, the subgrade should be scarified to a depth of four inches (4) inches by disking or harrowing to permit the bonding of the topsoil and the subsoil. All final subgrades should have adequate surface drainage prior to the addition of topsoil. In addition, slopes shall be no greater than three feet horizontal to one foot vertical (3:1); however, no greater than four feet horizontal to one foot vertical (4:1) shall be required on residentially zoned lots. If the minimum slope cannot be achieved, then a structurally engineered retaining wall shall be incorporated into the design of the detention/retention facility. Embankments or excavations adjacent to public right-of-way shall comply with 605 ILCS 5/9-115.1.

Topsoil Spreading

If topsoil is to be spread, the following items should be considered:

1. Check if an adequate volume of topsoil exists on the site. Topsoil should be spread at a compacted minimum depth of four (4) inches.

2. Consider the location of the topsoil stockpile so that it meets specifications and does not interfere with work on the site.

3. Allow sufficient time in scheduling for topsoil to be spread and bonded prior to seeding, sodding, or planting.

4. Care must be taken not to apply topsoil to subsoil if the two soils have contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and caused the topsoil to slough.

SEEDING

After subgrade preparation, topsoil spreading, fertilizing and final seedbed preparation are completed, the site is ready for seeding. Whether the seeding is to be permanent or temporary, the time of year significantly influences site conditions, required maintenance and ultimate degree of success.

Seed mixtures should be selected according to site conditions, planned use, and duration of use as well as the date of seeding.

When sowing the selected seed mixture, the mixture should be evenly distributed using a commercial turf seeder, broadcast seeder, grain drill, or hydro-seeder. The seed should be planted at a depth of one-quarter (1/4) to one-half (1/2) inch. In order to obtain the proper seed depth following broadcasting or hydro-seeding, secondary raking, harrowing or rolling with a corrugated roller if necessary.

Mulching immediately after seeding operations is recommended for temporary surface stabilization and moisture retention. The material typically used form this purpose are straw or wood cellulose fiber.

Newly seeded sites should be kept moist, but not wet until the seed has germinated. The quantity of water applied should be increased, and frequency of waterings degreased as the turf becomes established. Inadequate watering greatly increases the chance of seed failure.

SODDING OPERATIONS

The principal advantages of sod in vegetative surface stabilization are instant erosion protection and flexibility in timing of installation. Sod can be laid any time that it can be cut and kept moist until establishment.

After completion of subgrade preparation, topsoil spreading, fertilizing and final raking as was done for seeding, an additional step involving the compaction of the sod bed by rolling should be performed. In addition, during hot period the sod be should be slightly moistened immediately prior to sod laying.

The sod should be unrolled and place so that all joints are tight fitting and staggered like joints in a brick wall. On slopes, sod is place perpendicular to the slope. Rolling following placement provides good contact between root zone and soil surface.

On slopes 4:1 or greater, sod should be fastened to the surface using wooden pegs or thin metal hooks that lock into the plastic webbing used in some commercial sod. This prevents slippage while the roots become established.

MAINTENANCE

Vegetative control measures require follow-up maintenance at regular periods. Follow-up maintenance includes the repair of seeded, sodded, or other vegetatively stabilized areas where the desired degree of stabilization has not been achieved. Spring planting should be inspected during the summer months so that any corrective measures that may be needed can be implemented during the fall planting season. Fall plantings should be inspected during the early spring so that any corrective measures can be performed during the spring planting sessions.

Where groundcover, whether vegetative or mulch material, has not developed as expected, the area should be redone as soon as possible. The cause for failure should be ascertained and

corrected as soon as possible. Physical conditions such as soil conditions may be unfavorable, resulting in the failure, thereby requiring an alternative approach and/or type of soil cover.

Areas requiring reseeding or resodding should be prepared in the same manner as the original installation. In naturalized areas, reseeding where failures occur will maintain desired surface protection and prevent infiltration of undesirable weeds. Where permanent vegetative cover has been successfully established, a regular maintenance program for fertilization and mowing of grasses should be performed.

WATERING

Sod must be watered adequately to prevent desiccation during the first few weeks after installation. All water should be applied as a spray or dispersion to prevent runoff or damage to the sod and to allow the soaking of the sod and sodbed. The watering should be applied in the absence of adequate rainfall according to the generally accepted schedule:

Week Numbers 1 & 2: First watering immediately after laying sod. Three subsequent waterings at 4-day intervals or as needed to prevent desiccation.

Week Number 3: One watering.

Week Number 4: Subsequent waterings, if needed, should be applied at weekly intervals. The sod and sod bed should be soaked to a depth of four inches. During the period of intensive watering, new sod should be protected from heavy traffic to avoid disturbing the established finished grade.

Water shall not be obtained from a fire hydrant without permission from the Department of Public Works. When a fire hydrant is used, a Village of Lombard meter with a backflow preventer shall be used.

B) NON-VEGETATIVE STABILIZATION

As described earlier, mulching newly seeded surfaces helps to control surface erosion and moisture loss. Additionally, mulch is recommended for sites where turf establishment is difficult because of steep slopes or poor soil.

TEMPORARY MULCHING

For temporary erosion control, mulch may be applied any time conditions are suitable for spreading and anchoring regardless of vegetative cover. Some examples of suitable mulch include:

1. Air dried straw spread uniformly so 80 percent of the surface is covered five or six straws thick (approximately two tons per acre).

2. Excelsior blanket, jute netting, paper fabric, or a similar system applied according to manufactures' specifications.

3. Wood cellulose fiber mixed with water and applied with a hydro-seeder to form a dense mat after drying.

When using straw mulch, it should be anchored using one of the following suggestions:

1. Press straw into the soil to a two-inch depth by use of a serrated straight disc or a dull farm disc set straight.

2. Apply a netting on top of mulch and secure with staples. Netting should be one inch by two-inch mesh. Closer spacing may deter plants form emerging through mulch. Install according to manufacturers' specifications.

3. Apply a spray coating of emulsified asphalt. Emulsified asphalt should not be used when air temperatures are below 32 degrees F. Follow manufactures' specifications on mixing and temperature control.

4. Pegs or staples and twine or heavy string may be used to tie down small grain straw or grass soil every four (4) feet in a square pattern leaving two (2) to three (3) inches above the surface. Stretch twine between stakes in a square and crisscross pattern. Secure twine around each stake with two (2) or more turns. Twine may be applied in the same pattern as above and secured with six (6) inch long wire staples.

PERMANENT MULCHING

In situations where the establishment of vegetative stabilization is either not practical or desirable, but where erosion control is needed, permanent type mulches such as wood chips or aggregates may be used.

WOOD CHIPS

Chipped wood or chunk bark are typically combined with landscaping of trees and shrubs.

AGGREGATE COVER

Gravel and crushed stone provide long-term protection against erosion, particularly on short slopes. Before they are applied they should be washed and a black polyethylene sheeting first placed on the ground to prevent seed germination and growth through the aggregate cover. Aggregate should be placed three inches deep at a rate of nine cubic yards per 1,000 square feet. Aggregate cover used as a subbase to roads and parking lots should be placed as soon as final grade is reached. Applicable local or IDOT specifications should govern the requirements of this placement.

MAINTENANCE

Permanent mulches will require maintenance from time to time. This primarily involves the replacement of material to their original level when the level has been substantially reduced due to decomposition for the organic mulches and displacement or disappearance for both the organic and inorganic mulches. Occasional weed removal may be necessary in situations where a polyethylene underlayment was not used. In cases where weed growth becomes a problem, the timely use of the proper herbicide will reduce or eliminate this problem.

800.03 RUNOFF CONTROL

The following information provides guidance for designing drainageways to carry runoff nonerosively and to direct sediment-laden water to sediment trapping facilities. Guidelines for diversions, waterways, enclosed drainage structures, structural spillways, and outlets are contained in this section. Selection of the appropriate runoff control measure will be dependent on analysis of the existing site conditions, the intended use of the site, and the duration of use of the measure as described in the introduction to this Chapter.

A) DIVERSIONS

The standard for diversions in this section relates solely to drainage diversions. (See standard details.)

CROSS-SECTION

A typical diversion cross-section consists of a channel and a supporting ridge. In the case of an excavated-type diversion, the natural ground serves as the diversion ridge. Diversion cross sections must be adapted to the equipment that will be used for their construction and maintenance. The channel may be natural, parabolic or trapezoidal in shape; use of "V" channels is generally discouraged due to erosion problems experienced. All side slopes should be no steeper than 3:1. The diversion ridge should have a minimum top width of four feet at the design elevation. In the case of diversions with a ridge, the design height of the ridge should be 0.5 feet above the design water elevation. In the case of excavated diversion, the lowest bank of the channel should be 0.3 feet above the design water elevation.

GRADE

When permanent vegetated diversions are used in developments to manage stormwater, the grade of the channel should be such as to minimize standing water and wetness problems.

SUBSURFACE DRAINAGE

Underdrains should be used along permanent vegetated diversion channels when adequate grade can not be achieved to prevent ponding water, when hillside seeps or soils with poor internal drainage keep the channel wet or when base flow is intercepted by the diversion.

LOCATION

The location of a diversion and outlet must be in compliance with Illinois drainage law, traditional case law precedent and local ordinances and regulation. Outlet condition, topography, land use soil type and length of slope will dictate diversion location. Diversions must be located so that water will empty on established disposal areas, a stable watercourse, waterway or structure.

The spacing of permanent diversions on long slopes for the control of erosion and runoff after construction is a matter of some engineering judgment.

SEDIMENTATION PROTECTION

Any high sediment-producing area above a diversion should be controlled by good land use management or by structural measures to prevent excessive sediment accumulation in the diversion channel. If movement of sediment into the diversion channel can not be controlled, then one of the following measures should be used:

1. Design the channel to include extra capacity for the storage of sediment. Keep the velocity of flow for the design storm greater than 1.5 feet per second and provide for clean out of the diversion channel when the sediment storage capacity had been depleted.

2. Provide a minimum 15-foot wide filter strip of close growing sod adjacent to the diversion channel. Remove excessive accumulations of sediment to maintain a vigorous growth.

VEGETATION AND CHANNEL LININGS

All permanent diversion ridges and channels designed with a vegetative lining should be seeded or sodded within 15 days after construction is completed.

TRAFFIC CROSSING

At all points where diversion channels will be crossed by construction equipment, the diversion should be protected according to requirement of the stabilized construction entrance practice in this chapter. Bridges or culverts of adequate capacity may also be used.

MAINTENANCE

The success or failure of a properly designed and constructed diversion depends on the adequacy of the outlet and proper maintenance. Vegetation in the outlet, diversion ridge, or channel should be maintained as given for maintenance for vegetative soil cover measures described in the first part of this chapter.

Bare and vegetated diversion channels should be inspected regularly to check for points of scour or bank failure; rubbish, or settling of the diversion ridge; excessive wear from pedestrian or

construction traffic. Repair damage and remove deposits or sediment from the diversion channel and from the vegetative filter strip.

Lined diversion channels should be checked regularly for cracking; spalling; deterioration from freezing, salt or chemicals; plugging of weep holes; channels obstructions; scour or undermining at the inlet and outlet; points of sediment deposition. Cracks should be sealed, protective coatings applied when needed, modification or riprap repairs made where and when necessary, and obstructions and sediment deposits removed.

B) WATERWAYS

The following guidelines and standards relate solely to "Waterways".

CAPACITY

Waterway capacity should be adequate to carry the peak rate of runoff from a ten-year frequency storm. Greater capacity may be provided if a higher level of protection is required for commercial or residential buildings. For bare or grass channels with a grade of less than 1% out-of-bank flow may be permitted if such flow will not cause erosion, property or flooding damage. The minimum in such cases should be the capacity to carry a two-year frequency storm. Channel capacity is determined by the use of Manning's formula using the highest expected value of "n".

STABILITY

Velocity of flow in waterway channels should not exceed that which will be safe for the planned type of channel lining. Velocity is computed using Manning's formula using the lowest expected value of "n".

CROSS SECTION

The cross section or shape of waterway channels may be triangular, parabolic, or trapezoidal. All waterway cross sections should be designed to permit easy crossing of equipment during construction and maintenance.

The parabolic shape is the preferred cross section. Most waterways constructed with a trapezoidal section tend to revert to a parabolic cross section. The triangular cross section concentrates flow in the "v" of the channel causing higher and more erosive velocities. When bare or vegetated triangular channels are used, the minimum side slopes should be (6:1) or flatter.

GRADE

When permanently vegetated waterways are used in developments to manage or convey storm water, the grade of the channel should be such as to minimize standing water and wetness problems.

SUBSURFACE DRAINAGE

Subsurface drainage may be required for bare and vegetated channels in areas with a high water table, seepage problems or prolonged low flows from adjacent property. Underdrains, stone center drains, lined pilot channels, or other suitable subsurface drainage measures may be used. The minimum capacity should be .015 cfs\acre of poorly drained soils in the watershed.

If local ordinances permit, storm sewers may be used to extend existing agricultural tile or base flow across a development. They may also be used as an under drain for the waterway if the conduit is open jointed.

When an under drain is needed along the waterway channel, it should be located at the edge of the waterway channel. The top of the drain should be at least two feet below the bottom of the waterway channel.

LOCATION

The location of waterway channels is considerable importance to a good program of erosion and sedimentation control. Wherever possible, the planner should preserve the natural drainage system. Waterways should generally be located in natural drainageways where water can drain in from all sides. When the establishment of vegetation is required, moisture conditions and soil fertility are usually best in such areas.

Waterways may also be located along development boundaries, road rights-of-way, back lot lines or along storm sewer center lines. In all situations waterway channels should be located so that they do not make sharp, unnatural changes in direction of flow. It is better to design lots to conform to natural features of the land than to have unnatural drainageways result from manipulation of landforms.

All waterway channels should have stable outlets with adequate capacity for the designed flow. The outlet may be another vegetated channel, an earth ditch, a structure, or other suitable outlet. In all cases, the outlet must discharge in such a manner as not to cause erosion. Outlets should be constructed and stabilized prior to the operation of the waterway channel. Applicable Illinois drainage laws, traditional case law precedent and local ordinance and regulations must be observed in locating waterway channels and outlets.

SEDIMENTATION PROTECTION

Permanent waterway channels should be protected from sediment produced in its watershed. When sediment is not controlled before it reaches the waterway, one or any combination of the following should be used:

1. Installing a vegetative filter strip on each side of the waterway channel where surface water enters.

2. Increasing the depth and corresponding top width to store trapped sediment. Normally 0.3 to 0.5 foot of depth is added.

3. Providing for cleaning out of the channel when its design cross section deteriorates.

TRAFFIC CROSSING

Where bare and vegetated waterway channels are to be crossed by construction equipment the channel should be protected according to the requirements of the stabilized construction entrance practice as given in this chapter. Where paved channels are to be crossed, the lining will be designed to carry the expected loads. Culverts or bridges of adequate capacity may also be used.

CHANNEL LINING

Vegetative channel linings should be chosen in accordance with guidelines given in the vegetative section of the chapter. Vegetation should be established within 15 days after construction. Any of the following will help achieve this:

1. Establishing vegetative cover by sodding part or all of the waterway channel.

2. Using mulch on all waterways seedings.

3. Irrigating sod or seedings.

Structural channel linings should be selected, designed and installed according to the following criteria:

Freeboard: The minimum freeboard for lined waterways or outlets should be one (1) foot above design high water in areas where erosion-resistant vegetation cannot be grown adjacent to the paved side slopes. No freeboard is required if vegetation can be grown and maintained.

Side slopes: The steepest permissible side slopes horizontal to vertical should be:

Unreinforced concrete, hand-placed, formed concrete:	
Height of lining, 1.5 ft. or less	Vertical
Hand-placed screeded concrete or mortared in-place flagstone:	
Height of lining, 2 ft. or less	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

Lining thickness: Minimum lining thickness should be:

Concrete (Reinforced)	4 in. (In most problem areas, minimum thickness should be 5 in. with welded wire fabric reinforcing.)
Rock riprap	Maximum stone size plus thickness of filter or bedding.
Flagstone	4 in., including mortar bed.

Related structures: Side inlets, drop structures, and energy dissipaters should meet the hydraulic and structural requirements for both the site and off-site discharge conditions.

Filters or bedding: Filters or bedding should be used to prevent piping. Drains should be used to reduce uplift pressure and to collect water, as required. Weep holes may be used with drains if needed.

Concrete: Concrete used for lining should be proportioned so that it is plastic enough for thorough consolidation and stiff enough to stay in place on side slopes. A dense durable product should be required. Specify an air-entrained mix that can be certified as suitable to produce a minimum strength of at least 3,000 psi. Cement used should be Portland cement, Types I, or II or, if required, Types IV or V. Aggregate used should have a maximum size of one and one-half (1 ½) inch.

Mortar: Mortar used for mortared-in-place flagstone should consist of a workable mix of cement, sand, and water with a water-cement ratio of not more than six (6) gallons of water per bag of cement.

Contraction joints: Contraction joints in concrete linings, if required, should be formed transversely to a depth of about one-third (1/3) the thickness of the lining at a uniform spacing in the range of ten (10) to fifteen (15) feet. Provide for uniform support of the joint to prevent unequal settlement.

Rock riprap or flagstone: Stone used for riprap should be dense and hard enough to withstand exposure to air, water, freezing, and thawing. Flagstone should be flat for ease of placement and have the strength to resist exposure and breaking.

Cutoffs: Cutoff walls should be used at the beginning and ending of concrete linings. Other channel linings should be keyed into the channel at both ends of the lining.

PLANS AND SPECIFICATIONS FOR WATERWAYS

Plans for waterways should at a minimum include the following:

1. Location of the channel and reaches in sufficient detail so that the contractor or engineer can stake it for construction.

2. Design the grade and dimensions for each reach.

3. Size the length and location of underdrain or base flow channel, if used.

4. Vegetative or lining requirements.

5. Specifications and special construction notes as needed.

MAINTENANCE

Maintenance for waterways is the same as for diversions.

C) ENCLOSED DRAINAGE STRUCTURES

Criteria for design and construction of storm sewers for the conveyance of stormwater are referenced in Chapter 200 of this manual. When storm sewers are used in conjunction with erosion and sediment control measures, the following minimum criteria should be met in addition to any other state or local requirements.

DESIGN GUIDELINES FOR STORM SEWERS

CAPACITY

The storm sewer should be designed, either alone or in combination with other drainage and siltation control features, with adequate capacity to drain those features or structures at the rates established by the standards for them. For example, a storm sewer may be used in connection with a grassed waterway or diversion to carry some or all of the design flow.

INLET

An inlet may be a standard inlet, collection box or perforated riser; capacity should be adequate to provide maximum design flow in the conduit. Flow control devices should be installed as necessary to accomplish detention for sediment control, stormwater management, or more efficient design. Perforated risers, if used, should be of durable materials and structurally sound. Inlets must be designed with appropriate trash and safety guards.

OUTLET

The outlet should be stable for all anticipated flow conditions. Velocity attenuation should be provided in any transfer from an erosion-resistant conduit to bare earth or vegetated channels and

waterways. The possibility of silt deposit from reduced velocity should also be considered. A guideline for design of outlet protection is given later in this chapter.

PLANS AND SPECIFICATIONS FOR STORM SEWERS

Drawings and specifications for sewers used in conjunction with erosion and sediment control should be consistent with standard practice for storm sewers.

MAINTENANCE

Maintenance for storm sewers is given in a later section of this chapter.

D) PIPE SPILLWAYS

The principal spillway, commonly termed the mechanical or structural spillway, is designed to convey the shorter recurrence-interval discharged through an earthen embankment. The minimum capacity of pipe structures used as principal spillways should be that required to pass the peak flow.

EMERGENCY SPILLWAY

The emergency spillway is usually a vegetated channel designed to discharge flood flows in excess of the design storm or as a relief for the principal spillway in case of clogging or damage. The crest of the emergency spillway is set at the maximum water level that will develop when the principal spillway is discharging at its maximum required rate. The minimum capacity of the combined flows of the principal and emergency spillways should be that required to pass the peak flow.

EMBANKMENTS

The minimum elevation of the top of the settled embankment should be one (1) foot above the water surface in the emergency spillway flowing at design depth. The minimum difference in elevation between the crest of the emergency spillway and the settled top of the embankment should be two (2) feet for all dams having more than a 20-acre drainage area.

SIDE SLOPES

The upstream and downstream side slopes of the settled embankment should not be more than either 3:1 or 4:1 in stormwater detention basins on residentially zoned lots. All slopes must be designed to be stable.

SETTLEMENT

The height of the berm should be increased by 5% where fill material is placed in eight (8) inch layers and compacted by heavy equipment such as rubber-tired scrapers. If controlled compaction is specified, suitable allowance should be made.

FENCING

Near urban areas, safety protection may be required to control traffic that may endanger the vegetative cover on the embankment and spillway areas.

VEGETATION

The exposed surfaces of the embankment, earth spillway, borrow area, and other areas disturbed during construction, should be seeded or sodded, according to recommendations given in the vegetative section of this chapter, within 15 days after completion.

COMPLIANCE WITH LAWS AND REGULATIONS

Design and construction of pipe structures must comply with applicable state and local laws, ordinances, rules and regulations.

PLANS AND SPECIFICATIONS FOR PIPE SPILLWAYS

Plans for pipe structures should, as a minimum, show the following:

1. Location on the site and enough information for the contractor or project engineer to stake the structure for construction.

2. Necessary dimensions and elevations.

3. Typical cross-section of the embankment.

4. Location, profile and typical cross section of emergency spillway.

5. Area to be vegetated and type of vegetation to be used.

6. Specifications and special construction notes as appropriate.

7. Safety features to be provided.

MAINTENANCE

Maintenance is of paramount importance for the continued effectiveness of pipe structures. Guidelines for maintenance are given later in this chapter.

E) WEIR SPILLWAYS

The scope of this standard is the same as those for sediment basins. It is intended to cover routine applications in connection with erosion and sedimentation control.

EMERGENCY SPILLWAY

Emergency spillways should have capacities and should meet the same requirements as for pipe spillways.

EARTH EMBANKMENT

Earth embankment which direct the flow through the weir should have a settled height of at least one (1) foot above the top of the headwall extension. The minimum top width will be four (4) feet and side slopes should be no steeper than 3:1 or 4:1 if on a residentially zoned lot. A wider top width may be easier to construct and maintain.

INLET PROTECTION

When the depth of flow over the weir exceeds two feet, riprap or equivalent protection should be provided at the entrance.

LOCATION

For weir spillways with definite approach channels, the site should be selected so that the spillway can be located on a reasonably straight section of channel, with no upstream or downstream curves within at least 100 feet of the structure.

It often will be desirable to straighten the channel alignment above and below the spillway so that it merges smoothly with the existing channel. Poor alignment may result in a reduction in discharge capacity and excessive scour of the embankment and channel banks. There should be no channel restrictions or obstacles in the approach channel that would interfere with the design flow entering the spillway inlet.

The site selected should provide an adequate foundation for the spillway. The foundation material must have the required supporting strength resistance to sliding and piping, and be sufficiently homogeneous so as to prevent uneven settlement of the structure.

STABILITY OF CHANNEL BELOW SPILLWAY

The outlet of a spillway should be so designed that scour or deposition in the exit channel will not reduce its function or stability.

The channel grade below the spillway should be stable to prevent undercutting of the spillway. Stability should be determined by comparing velocities for the design flow in the downstream channel with the permissible velocities for the soils and vegetation in the channel.

FENCING

Near urban areas, safety protection may be required. Temporary fencing may be required to control traffic that may endanger the vegetative cover on the embankment and spillway areas.

VEGETATION

All areas around the structure should be vegetated according to recommendations in the vegetative section of this chapter.

PLANS AND SPECIFICATIONS FOR WEIR SPILLWAYS

Plans for weir structures will, as a minimum, show the following:

1. Location on the site and enough information for the contractor or project engineer to stake the structure for construction.

2. Necessary dimensions and elevations.

3. All necessary structural detail drawings.

4. Location, profile and typical cross-section of emergency spillway.

5. Area to vegetated and type of vegetation to be used.

6. Safety features to be provided. Specifications and special construction notes as appropriate.

MAINTENANCE

Maintenance for weir structures is given later in this chapter.

F) OUTLET PROTECTION STRUCTURES

The design guidelines in this section are limited to those items directly related to erosion and sedimentation control features of outlet protection; in general they coincide with other engineering considerations. Outlet protection features of weir structures are usually incorporated into their design.

EROSION OF SUPPORT

The outlet of any conduit should be protected against erosion and undermining of the conduit. A continuous section of closed conduit properly supported with earth or other means (headwall, etc.) may be used to accomplish this. Protection against undermining may also be accomplished by use of energy dissipation basins or plunge pools.

DOWNSTREAM PROTECTION

All pipe or storm sewer outlets should have a structurally lined apron or suitable dissipating device immediately downstream from the outlet where discharge channels from pipe flow to channel

flow. Channel stability should also be ensured below the outlet protection structure and velocity of discharge reduced, as necessary to match downstream channel limits of erodibility.

PLANS AND SPECIFICATIONS

In addition to plans and details of structural features involved, show a plan view, profile, and cross-section of each channel reach between the storm drain outlet under consideration and the existing publicly-maintained system or the natural stream channel receiving the discharge flow. Indicate the velocity of discharge for each of the following:

1. The outlet under consideration (pipe, structure or paved channel).

2. Any riprap or paved apron sections.

3. Each successive channel reach from the end of the apron to the point of entry into the existing drainage system or natural stream.

4. Show on the plan the proposed method of stabilizing each channel reach needed to establish conditions consistent with computed velocities.

MAINTENANCE

Maintenance of outlet protection structures is given in the following section of this chapter.

G) POND AERATION

Aerators shall be provided for all wet-bottom detention/retention basins. The type and size of aerators shall be as follows unless otherwise recommended by the manufacturer and approved by the Director of Community Development.

AERATOR TYPE	MAX. POND DEPTH
Fountain	Less than 15 feet
Diffuser	Greater than 10 feet
Horizontal aspirator	Between 3 and 15 feet

Pump size: 1.5 HP per acre of water surface area.

800.04 MAINTENANCE OF STRUCTURAL MEASURES

All structural measures for control of erosion and disposal of sediment and water must have timely maintenance if those measures are to endure and perform their function. Maintenance is essential

both during and after construction. A comprehensive program should be outlined for use of those who have maintenance responsibility.

Maintenance items should include but not be limited to the following:

1. Check for fills or cracks and damage form wave action and burrowing rodents.

2. Removing undesirable vegetative growth and obstructions in principal and emergency spillways.

3. Check gates, trash racks, metal work, anchors, conduits and appurtenance for damage from corrosion, ice and debris.

4. Fill scour holes, repair riprap, replace damaged vegetative cover, remove obstructions; all on a timely basis.

5. Control tampering or vandalism and correcting unauthorized modifications.

6. Clean, lubrication and operate valves and gates through their full range periodically.

7. Remove silt from approach channels, spillways, storm sewers and outlet channels.

Embankments and emergency spillways are an attraction for adventurous cycle and snowmobile operators; heavy use destroys vegetation and induces gullying. Fencing and regular patrols may become necessary.

The developer as well as the recipient community or homeowner's association should be made aware of which permanent control structures require future maintenance. A brochure describing all maintenance actions needed for continuing protection and maximum enjoyment of the newly developed property should be made available for distribution to future owners. It should be noted that some interim erosion and sediment control measures serving more than one lot or parcel of land may be converted to other uses after they have served their original function; they may be more properly maintained by the immediate or overall community after modification.

800.05 SEDIMENT CONTROL MEASURES

This section provides guidelines for designing measures for removing sediment form runoff before it flows off the site and for preventing soil from being carried off-site by wind or vehicles. Guidelines for sediment basins, sediment filters, and mud and dust control measures are contained in this section.

Selection of the appropriate sediment control measure will be dependent on analysis of the existing site conditions, the intended use of the site, and the duration of use of the measure as described in the introduction to this chapter.

A) SEDIMENT BASINS

The scope of this section is limited to routine applications of sediment basins and structures used in connection with sediment control.

SEDIMENT STORAGE

The minimum sediment storage volume should be determined to provide for either the volume of sediment anticipated during the development stage of the land or the extended planned use of the facility, whichever created the greater demand. If use is to be extended beyond the construction or development stage, de-silting after that stage could provide sufficient storage capacity for the future.

When periodic cleanout is planned, the minimum storage volume should be sufficient to provide for the period established but at least for the volume of sediment generated in one year.

If at any time sediment storage capacity is depleted prior to stabilization of the sediment source the basin should be cleaned out. It is possible that the sediment pool area may not be dewatered between storm events, this possibility should be considered in relation to possible downstream effects.

PRINCIPAL SPILLWAY

All basins should have a principal spillway to control the rate of outflow from the basin and to dewater the temporary detention storage before the next storm event.

A conduit is usually used as a principal spillway. When conduits are used, they should meet the requirements of the guidelines given in Pipe Spillway sections of this chapter.

Control of the flow through the pipe to meet detention requirement is usually accomplished by controlling either the pipe size or the size of the orifice at the inlet to the pipe. In all cases when a control device is used, it should provide for uniform discharge rates relatively independent of the depth of water ponded.

The use of slotted risers is desirable as a device to help keep orifices at the entrance to pipes from plugging, however, they should not be used as the orifices per se. Gravel placed around slotted risers in not recommended. When nonslotted risers are used, they must be anchored such that downward forces exceed upward forced by a safety factor of 1.25.

A skimming device of half-round pipe is useful in keeping trash from plugging orifices.

Where additional dewatering of the sediment pool is desirable, an underdrain may be installed in trenches in the bottom of the basin with outlets discharging either into the principal spillway or into another suitable outlet.

EXCAVATIONS

Side slopes of excavated basins should be stable and not be steeper than a 3:1 slope or 4:1 on residentially zoned lots.

Material excavated from the basin should be placed so that its weight will not endanger the stability of the basin side slopes and so that it will not be washed back into the basin.

BASIN ENTRANCE

Points of entrance of surface runoff into excavated sediment basins should be protected to prevent development of erosion problems. Diversions should be installed as needed to ensure direction of runoff to protected points of entry. Points of entrance should be located so as to ensure maximum travel of runoff from point of entry to point of exit from the basin.

SAFETY

Sediment basins are attractive to children and can be dangerous. They should be protected from intrusion by fencing or posting or by other means made inaccessible to persons or animals, unless such measures are deemed unnecessary due to the remoteness of the site or for other reasons. In all cases, local ordinances and regulations regarding health and safety must be adhered to.

VEGETATION

The exposed surfaces of the embankments, earth spillways, borrow areas, and other areas disturbed during construction should be seeded or sodded according to recommendations given in the vegetative section of this Chapter within fifteen (15) days after construction has been completed.

COMPLIANCE WITH LAWS AND REGULATIONS

Design and construction should comply with state and local laws, ordinances, rules and regulations.

SEDIMENT DISPOSAL

The sediment basin plans should indicate the method(s) of disposing of the sediment removed form the basin and areas to which it should be transported. The sediment must be placed so that it will not be washed from the site; it should not be deposited downstream from the basin, in or adjacent to stream, or upon a floodplain.

PLANS AND SPECIFICATIONS

Plans for sediment basins should show the following:

1. Plan view of the basin showing location and layout.

2. Cross-sections of embankment, principal spillway and emergency spillway as well as profile of emergency spillway.

3. Details of pipe connections and appurtenances such as riser, anti-seep collars, trash rack, safety guard and outlet protection.

4. Area to be vegetated and vegetative specifications.

5. Location and type of fence or other means of protection of the public in needed.

6. Specifications and special construction notes as appropriate.

7. Level of sediment at which cleanout shall be required as measured from some fixed point on the principal spillway.

8. Computations of necessary quantities.

MAINTENANCE

Maintenance for sediment basins should be the same as indicated for other structural measures; in addition, sediment must be cleaned out when it has filled the sediment pool. Inspection of the principal spillway after each storm and removal of debris is essential for satisfactory operation.

B) FILTER BARRIERS

For filter barrier considerations the drainage area should be limited to half an acre. For individual lots, the drainage area may be increased to one acre.

When barriers are used along property lines or at the base of slopes, they should be installed parallel to the contours. When used at storm sewer inlets, as much filter area as possible should be provided.

Filter barriers may be made of Filtrexx® Sediment & Perimeter Control or other filter material. All of the filter materials demonstrate very high filtering efficiency for sandy sediments, while there is less efficiency and considerable variation in filtering clay and fine silt particles. The table below demonstrates relative efficiencies of materials.

Material	Flow Rate (gal./sq.ft./min.)	Filter Efficiency (%)
burlap (10 oz. fabric)	2.4	84
Synthetic Fabric	0.3 (avg.)	97 (avg.)
Filtrexx® Sediment Control*	min. 5 gpm/ft^2	60

Source: VA Highway and Transportation Research Council
* Filtrexx® Design Manual

DESIGN GUIDELINES FOR SYNTHETIC FILTER FENCES

Materials

1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the following requirements:

PHYSICAL PROPERTY	REQUIREMENTS
Filtering Efficiency	75 % (min.)
Tensile Strength at 20% (max.) elongation	Extra Strength - 50lbs./lin.in.

2. Burlap shall be 10 ounce per square yard fabric.

3. Posts for filter fences shall be either four (4) inch diameter wood or 1.33 pounds per linear foot steel with a minimum length of five (5) feet. Steel posts shall have projections for fastening wire to them.

4. Stakes for filter fences shall be 1" x 2" wood (preferred) or equivalent metal with a minimum length of three (3) feet.

5. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of forty-two (42) inches in height, a minimum of 14 gauge and shall have a maximum spacing of six (6) inches.

DESIGN GUIDELINES FOR Filtrexx® SEDIMENT CONTROL

Materials

1. Filtrexx® Sediment Control is a three-dimensional tubular sediment control and storm water runoff filtration device and shall be certified by the manufacturer or supplier as conforming to the following requirements:

PHYSICAL PROPERTY	REQUIREMENTS
Filtering Efficiency	75 % (min.)
Tensile Strength at 20% (max.) elongation	Extra Strength - 50lbs./lin.in.

2. Filtrexx® Soxx™ material shall be per manufacture's requirements for photodegradable or biodegradable Soxx netting material.

3. Soxx™ filler material shall be Certified Filtrexx FilterMedia™ and is a coarse composed material that is specifically designed for removal of solids and soluble pollutants from storm water runoff.

4. Stakes shall be installed through the middle of the Sediment control on 10 ft centers, using 2 in x 2 in x 3 ft wooden stakes. In the event staking is not possible, i.e., when Sediment control is used on pavement, heavy concrete blocks shall be used behind the Sediment control to help stabilize during rainfall/runoff events. Staking depth for sand and silt loam soils shall be 12 in, and 8 in for clay soils.

CONSTRUCTION

This sediment barrier utilizes burlap or standard strength or extra strength synthetic filter fabrics. It is designed for situations in which only sheet or overland flows are expected. In special cases burlap may be used in drainageways.

1. The height of the barrier shall not exceed thirty-six (36) inches (higher barriers may impound volumes of water sufficient to cause failure of the structure).

2. The fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filtercloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.

3. Posts shall be spaced a maximum of 10 feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the sure support fence, post spacing shall not exceed six (6) feet.

4. A trench shall be excavated approximately four (4) inches wide and four (4) inches deep along the line of posts and upslope form the barrier.

5. When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one (1) inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two (2) inches and shall not extend more than thirty-six (36) inches above the original ground surface.

6. The standard strength filter fabric shall be stapled or wired to the fence, and eight (8) inches of the fabric shall be extended into the trench. The fabric shall not extend more than thirty-six (36) inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

7. When extra strength filter fabric or burlap and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of item No. 6 above.

8. The trench shall be backfilled and the soil compacted over the filter fabric.

9. Filter barriers shall be removed when they have served their useful purpose, but not before the upslope area had been permanently stabilized.

PLANS AND SPECIFICATIONS

Plans should show the location and all dimensions of filter barriers. Sufficient details must be shown that control measures are installed as designed. Material requirements must be specified.

MAINTENANCE

1. Filter barriers shall be inspected immediately after each rainfall and at least daily during prolong rainfall. Any required repairs shall be made immediately.

2. Should the fabric decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.

3. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately half the height of the barrier.

4. Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded or sodded.

C) VEGETATIVE FILTER

DESIGN GUIDELINES FOR VEGETATIVE FILTERS

Vegetative filters should only be used to filter sediment from overland flow, since this control practice is intended to be used only where concentrations of sediment and rates of runoff are low.

Vegetation, either existing or established, should have a deep root system, and dense, well-ramified top growth, be resistant to flooding and drought, plus the ability to recover growth subsequent to inundation with sediment. Establishing vegetation by seeding or sodding should be done in accordance with the vegetative section of this chapter and such vegetation should be established prior to land disturbance if it is intended to be used to protect adjacent properties.

When used to protect adjacent property or streams, the minimum width of the filter strip should be 15 feet.

The width of the filter strip should be increased proportionately for longer slopes or for higher sediment concentrations. When using filter strips at inlets to storm sewers, as large an area as possible should be provided to insure it will function as intended. Filters should be placed along the contours whenever possible. No construction should be allowed within filter strip areas.

PLANS AND SPECIFICATIONS

Plans should show the location, width, and length of filter strips. The type of vegetation and specifications for soil preparation and seeding should be included. If existing vegetation is to be used, directions should be provided as to how it will be protected or improved.

MAINTENANCE

Maintenance for vegetative filter strips is the same as that recommended for any vegetation as given in vegetative section of this chapter. A healthy growth of vegetation can best be maintained by fertilizing, removing sediment when the filter becomes clogged, and by preventing construction traffic from driving upon or across filter strips.

D) STABILIZED CONSTRUCTION ENTRANCE

DESIGN GUIDELINES

This measure consists of stabilizing points of ingress and egress from the construction site by using stone, asphalt, or other durable surfacing materials.

Minimum stone size shall be two (2) inches in diameter.

Minimum stone thickness shall be six (6) inches.

Asphalt quality and subgrade should be in keeping with industry standards for temporary construction.

Entrance width should be not less than the width required for two-way ingress and egress. Entrance length should be no less than 50 feet.

When mud or other debris carried form the site on wheels or tracks of construction equipment may be offensive, present a safety hazard, or cause damage to other property, the wheels or tracks should be cleaned to remove mud or debris prior to vehicles leaving the construction site.

When washing is required, it should be done on a stabilized area and runoff from this area should not be allowed to leave the construction site.

PLANS AND SPECIFICATIONS

Plans, at a minimum, should show the location, length, width, thickness, and type of materials to be used. Specifications should describe materials, thickness, and methods of application.

MAINTENANCE

The entrance should be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. This could require periodic top dressing with additional surface

materials as conditions demand. Repair and/or cleanout of any features used to trap sediment is essential and all sediment spilled, dropped, washed or tracked onto public rights-of-way should be removed immediately.

E) DUST AND TRAFFIC CONTROL

DESIGN CONTROL

When dust blowing from construction sites or roads may become a traffic hazard, or a danger to the health, comfort, or well-being of persons downwind, it should be controlled either permanently or temporarily, depending upon the stage of development of the site.

Some of the methods and materials for dust control are given below:

TEMPORARY METHODS

1. Mulches - See standards for critical area stabilization with mulches only. Chemical mulch binders may be used instead of asphalt to bind mulch materials. Binders such as Curasol or Terratack should be used according to manufacturer's recommendations.

2. Vegetative Cover - See standards for temporary vegetative cover.

3. Spray-on Adhesives - For use on mineral particle soil (not effective on muck soil). Traffic must be kept off these areas after spraying as per manufacturer's specifications.

4. Tillage - This roughens surface and brings clods to the surface. This is an emergency measure, which should be used before soil blowing starts. Begin plowing on windward side of site. Chisel-type plows spaced about twelve (12) inches apart, spring-toothed harrows, and similar plows are examples of equipment that may produce the desired effect.

5. Irrigation - This is an emergency treatment. Site is sprinkled with water until the surface is moist. Constant repetition is required for effective control.

6. Barriers - Solid board fences, snow fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and soil.

7. Calcium Chloride - Apply at rate that will keep surface moist. This material is best used on road surfaces.

PERMANENT METHODS

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

2. Non-vegetative soil cover measures such as rock, asphalt, or concrete.

PLANS AND SPECIFICATIONS

Specifications should indicate when dust control is needed and the method of control to be used. Appropriate industry standards should be used. Vegetative and mulching specifications should be according to those given in this chapter.

MAINTENANCE

When temporary dust control measures are used, repetitive treatment should be applied as needed to accomplish control.