

Nebraska Department of Roads

Construction Stormwater

Best Management Practices



First Edition

Acronyms

BFM - Bonded Fiber Matrix

BMP – Best Management Practice

CSW – Construction Stormwater

ECB – Erosion Control Blanket

EPA – Environmental Protection Agency

MCM – Minimum Control Measure

**NDEQ – Nebraska Department of Environmental
Quality**

**NPDES – National Pollutant Discharge Elimination
System**

NOI – Notice of Intent

NOT – Notice of Termination

RECP - Rolled Erosion Control Products

SWPPP – Stormwater Pollution Prevention Plan

TRM – Turf Reinforcement Mat

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10 Keys to Succeed

Every construction project presents a unique set of pollution challenges for Owners and Operators to manage. Best Management Practices (BMPs) must be selected, designed, installed, and maintained correctly to minimize the risk of polluting water resources. Owners, Operators, and/or Inspectors utilize and inspect a variety of BMPs that work together during the project to control stormwater pollution. The following “10 Keys to Succeed” represent the best approaches to maintaining compliance with stormwater permit requirements and protecting water quality during construction.

1. Minimize soil disturbance and protect natural features.
2. Phase construction activity in a manner that minimizes impacts to resources.
3. Control stormwater quantity and velocity flowing onto and through the project.
4. Stabilize soils and protect slopes.
5. Protect storm drain inlets.
6. Establish perimeter controls.
7. Detain runoff, before it is discharged, to provide time for sediment to settle out of suspension.
8. Establish stable construction exits.
9. Inspect and maintain all pollution control measures.
10. Keep chemicals out of traffic and environmentally sensitive areas.

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I. Project Administration

I. Project Administration

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I. Project Administration

A. Stormwater Permit Information

During construction, stormwater Best Management Practices (BMPs) must be used that manage pollutants, such as sediment, that can impact water quality. When a construction project will disturb at least one acre of soil, with few exceptions, stormwater leaving the site is regulated. In Nebraska, the stormwater permitting program is administered by the Nebraska Department of Environmental Quality (NDEQ). The construction project Owner is responsible for applying for coverage and complying with all permit requirements. Both NDEQ and the U.S. Environmental Protection Agency (EPA) can take enforcement action against the project Owner, Operator, and any other responsible party for violating the required permit conditions. NDEQ's General Construction Storm Water Permit can be viewed at: www.transportation.nebraska.gov

Regulated Waters of the State include ***“streams, lakes, ponds, impounding reservoirs, marshes, wetlands, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulation of water, surface and underground, natural or artificial, public or private, situated wholly or partly within or bordering upon the state.”*** Protecting these water resources is not only the right thing to do for the environment, it also protects human health and safety. Uncontrolled erosion during construction can cause large amounts of sediment to adversely impact streams, damage drainage structures, and cause public concern. Soil erosion, expensive maintenance efforts, and potential fines are avoided when BMPs are correctly designed, installed, and maintained.

I. Project Administration

B. SWPPP

A Stormwater Pollution Prevention Plan (SWPPP) documents how stormwater run off—or discharge—from a construction site will be controlled. The construction project owner must develop a SWPPP before applying for coverage under the Nebraska General Construction Stormwater Permit. The SWPPP includes permanent and temporary erosion control plans, specifications and special provisions. The SWPPP describes erosion prevention measures, sediment controls, and good housekeeping practices that will be used to prevent construction-related pollutants from impacting water quality.

A SWPPP also addresses specific information for protecting water quality including a detailed description of the:

- potential construction-related pollutants,
- temporary and permanent BMPs,
- implementation sequence of BMPs,
- inspection and maintenance measures for BMPs,
- corrective actions and changes to the SWPPP.

Basic information and photos of good and poor BMP examples are included in this document to illustrate important aspects of many BMPs. Helpful information for developing and maintaining a SWPPP and Erosion Control Plan can be viewed at: www.transportation.nebraska.gov

C. Qualifications

The General Construction Stormwater Permit issued by NDEQ requires “Qualified Individuals” to prepare a SWPPP and to inspect stormwater BMPs. This broad requirement is intended to provide basic assurances that stormwater BMPs are designed, installed, and maintained correctly. Unless a more specific requirement is provided at the state or local level, the standards of qualification are described in Sections III.A.1 and III.I.3 of the General Construction Stormwater Permit. It is the owner’s responsibility to ensure that these qualification standards are met. Local permitting authorities may have additional requirements for qualified SWPPP Designers and Site Inspectors.



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II. Erosion Control

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II. Erosion Control

A. Mulching

Mulching is an erosion control practice that uses prairie hay or straw to stabilize slopes and exposed soils although rushes and similar materials may also be considered. This temporary practice can also be used when seeding is not practical due to seasonal constraints and for erosion control prior to a rain event. Mulches assist with establishing vegetation in areas that have been temporarily seeded with a cover crop and for areas seeded with permanent vegetation. Hay is preferred to straw and may contain viable seed.



Good installation of mulch.

Mulching information continued on next page.

II. Erosion Control



Poor installation of mulch. Provide a uniform cover and either crimp mulch or apply tackifier to hold mulch in place.

Notes

- Mulch cover must be uniform and should be applied within 24 hours after an area is seeded.
- Apply mulch between 1 and 2 inch depths.
- Hay at 2 tons per acre is preferred to straw.
- Anchor mulch by mechanically crimping, or straight disking, hay/straw approximately six inches into the soil surface.
- A tackifier (Page 12) may be used if needed to keep mulch in place for longer periods of time.
- Mulch should not be applied during windy conditions that can hamper an even distribution.
- Mulch can be kept on-site for quick stabilization of slopes prior to a rain event.

B. Hydraulic Applications

Some erosion control materials can be applied to bare soil using hydraulic applications. These materials assist in establishing erosion-resistant vegetation on disturbed areas and critical slopes. A homogenous slurry of compost, tackifying agents, mulches and soil binders can be uniformly broadcast onto the soil. Hydraulic applications are efficient because erosion and dust control materials can often be applied in one operation.

1. Compost

Composts are engineered soil amendments made of solid organic materials that must meet local, state, and federal quality standards. Compost may be blown onto slopes as an alternative to placement of erosion control blankets. When properly applied, compost protects the soil and provides an organic growth medium to assist vegetation growth.

2. Tackifier

Tackifiers are bonding agents made of synthetic polymers used to stick, or tack, hydraulic seeding and hay or straw mulch to the soil surface. Wind can blow hay and straw away which allows precipitation to cause erosion. Tackifiers provide immediate and extended protection from wind and rain to allow vegetation adequate time to establish.

Notes

- Tackifiers are water-soluble and must be reapplied 6 to 12 months after application if plants have not germinated to stabilize the soil.
- Apply tackifiers the same day as mulch is applied.
- Do not apply tackifiers during precipitation events, over snow, or during periods of high winds.

II. Erosion Control

3. Hydraulically Applied Mulches

The use of hydraulically applied mulches is currently an evolving technology that seeks to improve functional longevity, erosion control effectiveness and vegetation establishment. Fiber Reinforced Matrix, Bonded Fiber Matrix, Stabilized Mulch Matrix, Hydraulic Mulch and other emerging products may be used when referring to this erosion control method. The benefits and considerations for hydraulically applied mulches are still being explored.

These products provide immediate erosion protection while creating an environment that promotes vegetation establishment. Products consist of various mixtures of refined fiber matrices, tackifiers, super-absorbents, flocculating agents, man-made fibers, plant biostimulants and other performance enhancing additives. Each product is unique and may last between 3-12 months before reapplication is needed. The Erosion Control Technology Council (ECTC) is researching and working to improve the specifications of these potentially valuable products.



Place Hydraulically Applied Mulches uniformly over slopes from multiple angles to ensure proper adhesion to soil surfaces.

Notes

- Avoid application if rain is forecasted since the product must dry before controlling erosion.
- Concentrated flows can erode these products therefore application in channels is not ideal.
- Avoid vehicular or pedestrian traffic. Once the surface is broken, the matrix material must be reapplied.

4. Soil Binders

Soil binders are chemical stabilizers, such as polyacrylamide, guar gum, and soybean oil, that provide temporary soil stabilization for stockpiles, berms, haul roads or when slopes cannot be seeded due to seasonal constraints. Soil binders are sprayed onto exposed soil surfaces to hold them in place and minimize wind and runoff erosion.

Soil Binders continued on next page.

II. Erosion Control



Roughen soil surface and apply soil binder uniformly over soil surface.



Visual rill erosion indicates poor product mixture and/or application.

Notes

- Reapply at least every 6 to 12 months or when the surface has been disturbed again.
- Soil binders can be used on stockpiles and along haul roads to reduce wind erosion.
- Soil binders degrade rapidly under vehicular traffic and may need to be reapplied to an exposed soil surface if driven over frequently.

C. Slope Interruption

Breaking up the slope length can reduce the potential for slope erosion. Slope Interruption techniques provide a barrier, diversion, or bypass for stormwater to infiltrate or flow down a slope in a less erosive manner. A few slope interruption techniques can also be applied in channels. A variety of techniques can be implemented depending on the length of the slope, amount of time the slope will remain undisturbed, and the products available on-site.



Slope Interruption will help prevent erosion until final stabilization is established.

Notes

- Use slope interruption as a temporary measure until slopes and channels meet final stabilization requirements.
- Install measures along the slope contour to avoid concentrating flows or provide outlet protection to prevent scour.
- Measures should not be used in high traffic areas.

II. Erosion Control

1. Soil Roughening

Soil roughening involves roughening bare soil surfaces as a temporary BMP to reduce the speed of runoff, increase infiltration, reduce erosion, trap sediment, and prepare the soil for seeding by capturing moisture necessary for the seed germination. Soil roughening can be done over an entire slope face or channel or just along the contour slope at regular intervals.



Good example of soil roughening along slope contour.

Notes

- Soil roughening should be used in conjunction with other BMPs such as mulching, seeding, or soil binders.
- Soil roughening should be at least three to six inches into the soil surface.
- Soil roughened areas should be a minimum of 8-12 feet wide.
- For long slopes, space roughened areas approximately 25 feet apart.

2. Slope Tracking

Slope Tracking refers to roughening soil slopes with horizontal grooves using construction equipment to track the surface. Slope Tracking is a short term BMP that reduces runoff velocity, increases infiltration, and reduces erosion for up to 14 days unless slopes are disturbed by traffic or precipitation. Slope Tracking can always be used in conjunction with other BMPs such as mulching, seeding, or tackifier.



Good example of slope tracking up and down slopes.

Notes

- Use Slope Tracking as a temporary measure until slopes can be stabilized by more effective BMPs.
- Track slopes up and down the hill to improve resistance to erosive overland flow.
- Slopes may be Slope Tracked at the end of the day and should always be used with other BMPs until final stabilization is established.

II. Erosion Control

3. Berms and Diversions

A berm or diversion made of mulch, compost or soil, is a temporary ridge that slows, diverts and sometimes filters runoff. This structural BMP diverts stormwater from an open area or slope and can be used as an effective perimeter control (Page 63).



Soil berms and diversions can be maintained during construction and kept as a permanent BMP after construction is complete.

Notes

- Repair and inspect often for breaches.
- Berm heights should not exceed a height of five feet. The desirable top width is four feet and the side slopes should be 3:1 or flatter.
- Berms should not be used in high traffic areas where they can be damaged by vehicles.
- Direct runoff down slopes in a non-erosive manner and protect outlets to prevent washouts.
- Stabilize soil berms and ditches with vegetation after installation.

4. Benching

Benching is the process of creating level terraces on steep or long slopes to slow runoff velocities and allow infiltration and/or discharge runoff to a stable location. This measure reduces the potential for sheet and rill erosion.



Good example of benching a long slope. Sediment can easily be cleaned out using a front-end loader.

Notes

- Benching is recommended for slopes that are 3:1 or greater and at least 30 feet long.
- Space benches to divide the slope face as equally as possible and convey the water from each bench to a stable outlet point.
- When practical make benched slopes a minimum of eight feet wide for ease of maintenance.
- Compact all fills to reduce erosion.
- Remove accumulated sediment during all phases of construction.
- Stabilize benches with vegetation after installation.

II. Erosion Control

5. Temporary Slope Drains

A temporary slope drain is a flexible conduit for stormwater that extends the length of a disturbed slope to divert stormwater, prevent erosion and serve as a temporary outlet.



Good example of a temporary slope drain that was located and sized correctly. Inlet and outlet protection are needed to prevent washouts.



A temporary slope drain could have protected this embankment from erosion.



Slope drain using plastic pipe. Stake down securely, and install where heavy flows need to be transported down slopes. Be sure to stabilize the inlet and outlet.

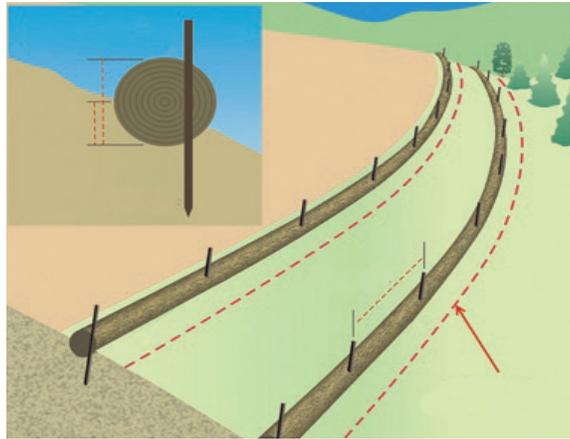
Notes

- Use during grading operations until final drainage structures are installed and slopes are stabilized.
- Direct stormwater to a temporary slope drain inlet using compacted berms and diversions (Page 19)
- Utilize flexible pipe material that is at least 15 inches in diameter or larger.
- Fasten all connections with water tight fittings and securely anchor pipe to the slope.
- Adequate inlet and outlet protection must be installed to prevent scouring from erosive flows.
- Inlets and outlets may need to be cleaned out periodically and open chute protectors should not be undercut or bypassed.

II. Erosion Control

6. Wattles /Compost Logs

Wattles installed along the contour control erosion by breaking up stormwater flows on long slopes. Installing wattles across the contour of a slope will concentrate flows and may cause significant erosion to occur. Additional information about wattles is provided in (Page 39).



Wattles installed along the contour help to break up long slopes.

Notes

- Conform wattles to smooth surface along the contour at a uniform elevation. Ensure contact with the ground and that the ground is free of large clods to prevent rilling under the wattle.
- Wattles can be placed on top of Rolled Erosion Control Products (RECPs) (Page 29) to help reduce impacts of runoff velocity.
- Follow manufacturers staking instructions to ensure proper wattle function and longevity.

D. Vegetation

Seeding and sodding are the primary methods of establishing vegetation and stabilizing soils disturbed by construction activity. Vegetation is the most effective, long-term form of erosion control.

1. Cover Crop Seeding – Cover crop seeding is the establishment of a temporary vegetative cover on disturbed areas with appropriate, rapidly growing annual plants. Cover Crop seeding can be used on soil stockpiles, dikes, dams, sediment basin slopes, temporary road banks, or on finished grades that will be exposed for more than 14 days or until permanent seeding can be established.

NDOR Cover Crop Seed Selection Chart

Cover Crop Seed and Limitations	Cover Crop Seed Requirements			Approved Mech. Drill Application Rate
	Minimum Purity (%)	Minimum Germination (%)	Approved Broadcast or Hydraulic Seeder Application Rate	
Oats: Jan. 1 - Aug. 31	80	60	96 lbs/acre (107 Kg/ha)	96 lbs/acre (107 Kg/ha)
Pearl Millet or Foxtail Millet: May 2 - July 15	80	60	25 lbs/acre (27 Kg/ha)	25 lbs/acre (27 Kg/ha)
Winter Wheat: Sept. 1 - Dec. 31	80	60	120 lbs/acre (134 Kg/ha)	120 lbs/acre (134 Kg/ha)
Annual Ryegrass Urban Areas: Jan. 1 - Dec. 31	80	80	50 lbs./acre (55 Kg/ha)	50 lbs./acre (55 Kg/ha)

* NDOR Specific Selection Chart

II. Erosion Control

2. Temporary Seeding – Temporary seeding is the establishment of annual or perennial vegetation using grasses for periods longer than cover crop seeding can protect. It is generally used in staged construction and can be in place for periods longer than a growing season.

3. Permanent Seeding – Permanent seeding is the primary method used to provide a permanent vegetative cover to protect against erosion. NDOR projects may specify different types of seeding and seed mixtures which are determined by regional growth conditions.

NDOR Seed Types

Type A – Includes backslope, ditches, and portions of the foreslope.

Type B – Includes shorter plant varieties placed on shoulder areas and in the medians which are frequently mowed.

Type C – Includes other seed mixtures as needed for special placement.



Good example of a mulched and seeded area.

Notes

- Prepare seed bed along the slope contour by loosening soil surface to a minimum depth of three inches. Fertilizer should be applied after the seed bed is prepared.
- Mulch, mulch tackifier and/or RECP should be applied as soon as possible after seeding.
- The area must be re-seeded if portions of it fail to establish, provide inadequate ground coverage, or are disturbed.
- Seeding should occur during the project as construction is completed and within the specified time frame for seeding operations.
- Do not seed when the ground is frozen, wet or otherwise unillable, or when uniform distribution of seed cannot be achieved.

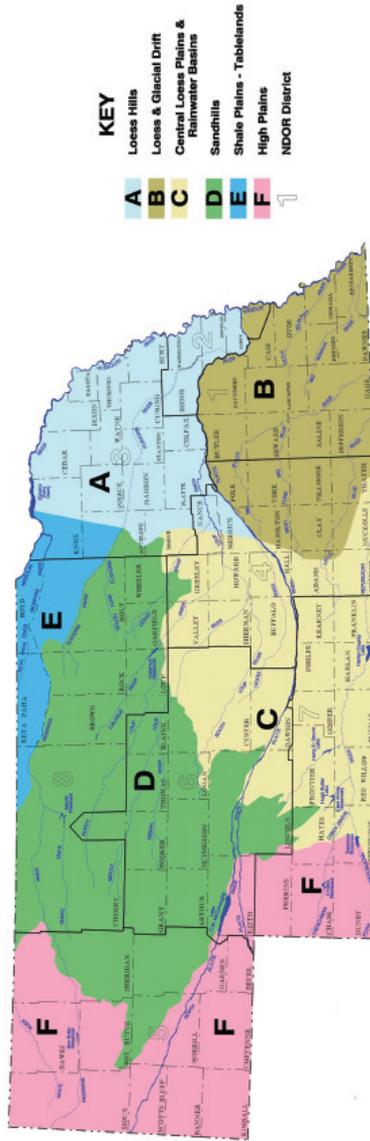
Nebraska Seeding Mixture Species List						
Seeding Species	Seeding Region					
	A	B	C	D	E	F
Big Bluestem (<i>Andropogon gerardii</i>)	X	X	X	X	X	X
Sand Bluestem (<i>Andropogon hallii</i>)				X	X	X
Sideoats Grama (<i>Bouteloua curtipendula</i>)	X	X	X	X	X	X
Blue Grama (<i>Bouteloua gracilis</i>)	X	X	X	X	X	X
Buffalograss (<i>Buchloe dactyloides</i>)		X	X		X	X
Hairy Grama (<i>Bouteloua hirsuta</i>)	X			X		
Buffalograss (<i>Buchloe dactyloides</i>)	X					
Bluejoint (<i>Calamagrostis canadensis</i>)	X	X	X	X		
Prairie Sandreed (<i>Calamovilfa longifolia</i>)	X		X	X	X	X
Canada Wildrye (<i>Elymus canadensis</i>)	X	X	X	X	X	X
Thickspike Wheatgrass (<i>Elymus lanceolatus</i>)			X	X		X
Slender Wheatgrass (<i>Elymus trachycaulus</i>)	X	X	X	X	X	
Virginia Wildrye (<i>Elymus virginicus</i>)	X	X	X	X		
Sand Lovegrass (<i>Eragrostis trichodes</i>)	X			X		X
Prairie Junegrass (<i>Koeleria macrantha</i>)	X	X	X	X	X	X
Green Needlegrass (<i>Nassella viridula</i>)	X			X	X	X
Switchgrass (<i>Panicum virgatum</i>)	X	X	X	X	X	X
Western Wheatgrass (<i>Pascopyrum smithii</i>)	X	X	X	X	X	X
Bluebunch Wheatgrass (<i>Pseudoroegneria spicata</i>)						X
Little Bluestem (<i>Schizachyrium scoparium</i>)	X	X	X	X	X	X
Indiangrass (<i>Sorghastrum nutans</i>)	X	X	X	X	X	X
Prairie Cordgrass (<i>Spartina pectinata</i>)	X	X	X	X	X	
Sand Dropseed (<i>Sporobolus cryptandrus</i>)				X		X
Prairie Dropseed (<i>Sporobolus heterolepis</i>)	X	X				
Eastern Gamagrass (<i>Tripsacum dactyloides</i>)		X				

Refer to NDOR Landscape Region Map on next page.

II. Erosion Control

II. Erosion Control

NDOR Landscape Regions



4. Sodding – Sodding is a permanent erosion control practice that involves laying a continuous cover of grass sod on exposed soils. Sod provides immediate vegetative cover. Project specifications will dictate what times of the year sod should be laid.

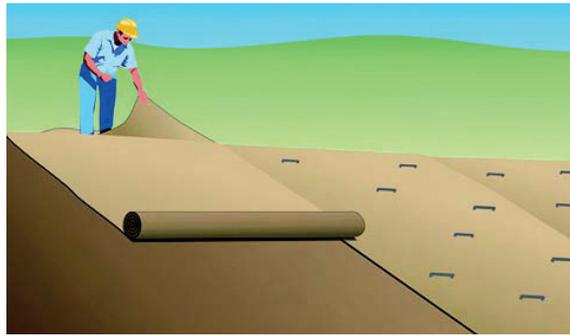
Notes

- Sod must be fertilized and treated for pre-emergent weed control.
- A watering plan helps root systems grow and crowd out weed growth.
- Sod should be watered until moisture in the soil reaches 8-10 inches deep.
- For the first two weeks new sod should be watered three times daily, during daylight hours to maintain soil moisture and watered routinely after that to maintain growth.
- Mowing is the responsibility of the property owner and new sod should not be mowed for 10-14 days after installation.

II. Erosion Control

E. Rolled Erosion Control Products

Erosion Control Blankets and Turf Reinforcement Mats are distributed as RECPs. They are typically used on steep slopes (3:1 or steeper) where the erosion hazard is high and vegetation growth is likely to be too slow to provide adequate stabilization. RECPs may also be used in conjunction with erosion checks for slopes in excess of three percent. RECPs are composed primarily of straw, coconut or synthetic materials and are selected based on the steepness of the slope and the longevity of the product.



Vertical installation of RECPs on long slopes is preferred. Always install RECPs according to manufacturer's instructions.

- 1. Straw** – Straw blankets are composed of threshed grain, typically wheat, and usually biodegrade within 12 months.
- 2. Excelsior** – Excelsior blankets are composed of fine wood shavings (typically from aspen or poplar), and usually biodegrade within 12 to 24 months.

3. Coconut Fiber – Coconut fiber blankets, also known as coir fibers, hold up to eight times their weight in water and usually biodegrade within 36 months.

4. Combinations – Combination blankets composed of straw and coconut may be mixed in various ratios to improve the longevity of the blanket.

5. Degradable Netting - Degradable netting is a synthetic mesh or woven natural fiber that is used on slopes to protect mulch from wind erosion.

6. Turf Reinforcement Mat - TRMs are composed of interwoven layers of degradable and/or non-degradable, geosynthetic materials that provide a three-dimensional matrix. A TRM provides stronger root structure for vegetation to resist higher runoff velocities and shear stresses compared to other RECPs.



Good example of TRM installation in a channel with mulch on the backslope.

Rolled Erosion Control Products continued on next page.

II. Erosion Control

Erosion Control Selection Charts

Slope Erosion Control Usage Chart <small>(NDOR specific chart)</small>									
Slope Steepness	Slope Length ¹	Type of Erosion Control ²							
		Seed with Mulch	Sod	Slope Protection Mulch	Type 1A	Type 1B	Type 1C	Type 1D	Type 1E
6:1 or Flatter	0-30								
	30-60								
	60+								
4:1	0-30								
	30-60								
	60+								
3:1	0-30								
	30-60								
	60+								
2.5:1	0-30								
	30-60								
	60+								
2:1	0-30								
	30-60								
	60+								
1:1	0-30								
	30-60								
	60+								

■ - Designates instances where a particular Erosion Control Type will be used.

■ - Designates instances where a particular Erosion Control Type may be used.

¹ All measurements are given in feet.

² Full names of Erosion Control Types:

- Seed with Property Anchored Mulch
- Sod
- Slope Protection (Mulch)
- Type 1A – Slope Protection Netting
- Type 1B – Light Weight Quick Degrading Erosion Control Blanket
- Type 1C – Light Weight Single Net Erosion Control Blanket
- Type 1D – Light Weight Double Net Erosion Control Blanket
- Type 1E – Medium Weight Double Net Erosion Control Blanket

Ditch and Channel Erosion Control Usage Chart (NDOR specific Chart)											
Ditch Grade (%)	Maximum Length ¹	Type of Erosion Control ²									
		Seed with Mulch	Sod	Type 1D	Type 1E	Type 1F	Type 2A	Type 2B	Type 2C	Cellular Confinement	Conc. Block / Riprap
< 1	300	■	■		■	■	■	■	■	■	■
	600	■	■		■	■	■	■	■	■	■
	600+	■	■		■	■	■	■	■	■	■
1 - 3	300	■	■		■	■	■	■	■	■	■
	600	■	■		■	■	■	■	■	■	■
	600+	■	■		■	■	■	■	■	■	■
3 - 5	300					■	■	■	■	■	■
	600					■	■	■	■	■	■
	600+					■	■	■	■	■	■
5 - 7	300						■	■	■	■	■
	600						■	■	■	■	■
	600+						■	■	■	■	■
7 - 10	300							■	■	■	■
	600							■	■	■	■
	600+							■	■	■	■
10+	300								■	■	■
	600								■	■	■
	600+								■	■	■

■ - Designates instances where a particular Erosion Control Type will be used.

■ - Designates instances where a particular Erosion Control Type may be used.

¹ All measurements are given in feet.

² Full names of Erosion Control Types:

-Seed with Property Anchored Mulch

-Sod

-Type 1D – Light Weight Double Net Erosion Control Blanket

-Type 1E – Medium Weight Double Net Erosion Control Blanket

-Type 1F – Heavy Duty Erosion Control Blanket

-Type 2A – Turf Reinforcement Mat

-Type 2B – Turf Reinforcement Mat

-Type 2C – Turf Reinforcement Mat

-Cellular Confinement

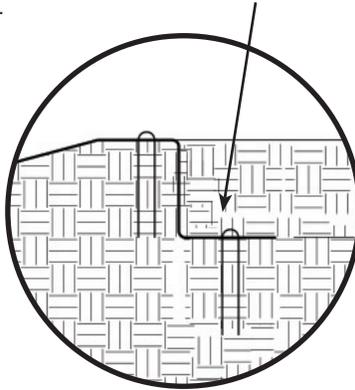
-Articulated Concrete Block or Riprap (Consult with Hydrology Unit)

Rolled Erosion Control Products continued on next page.

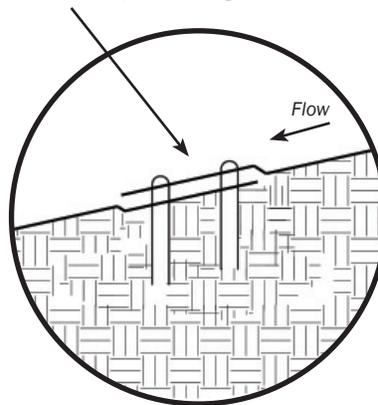
II. Erosion Control

II. Erosion Control

Staple upslope end of product in a trench six inches deep by six inches wide.



Place blankets parallel with the direction of flow. A minimum overlap of eight inches is used to splice rolls together.



For stapling patterns and additional information on RECP installation refer to NDOR Standard Plan No.501-R5.



Good Erosion Control Blanket installation.



Poor Erosion Control Blanket installation. Blankets were not anchored properly and need to be repaired.

Rolled Erosion Control Products continued on next page.

II. Erosion Control



Poor example of RECP installation. Products must be installed over a smooth surface to prevent the material from tenting.

Notes

- The ground should be smooth, with no large clods, rocks, or standing vegetation in place before placing RECPs.
- Areas where RECPs are to be used should be properly prepared with topsoil or soil conditioning, including fertilizer if required, and seeded before the RECPs are installed.
- The RECPs shall be placed smoothly but loosely on the soil surface without stretching.
- Trench the top of the RECP into the ground to prevent runoff from flowing under the RECP.
- Overlap the ends of RECPs at least eight inches, while you move downslope, to prevent runoff from undercutting installed products.
- Staple RECPs according to specifications.
- Re-anchor loosened RECPs and replace missing areas and staples as required.

NDOR's Roadside Stabilization Unit (402-479-4499) can provide more information about the appropriate types of RECPs for highway construction projects.

III. Sediment Control

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III. Sediment Control

III. Sediment Control

A. Erosion Checks

Erosion checks are relatively small, temporary structures constructed across a ditch to slow water velocity and capture sediment. Erosion checks are typically constructed out of rock, compacted soil, or synthetic materials and are most effective when used in conjunction with other BMPs such as RECPs (Page 29) and temporary silt traps (Page 44).

Straw or hay bales have historically been used on construction sites as erosion checks in ditches. The application of straw bales for this purpose is proving ineffective. Straw bales are maintenance-intensive and can be expensive to purchase. They have proven ineffective due to the inconsistent nature of the bale materials, inappropriate placement, and insufficient installation. Because many applications of straw and hay bales have been ineffective, EPA recommends that other BMP options are carefully considered.

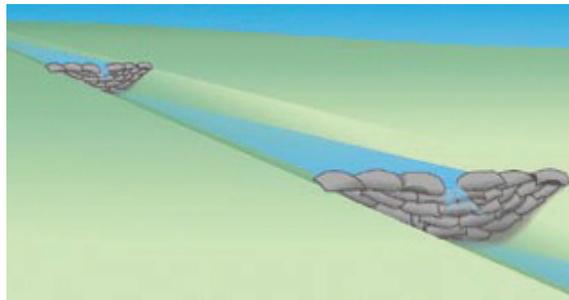


Illustration of proper erosion check spacing.

Notes

- Temporary checks should be removed when their useful life has been completed. The useful life of an erosion check is complete when the check cannot be cleaned out and has become ineffective.
- Space erosion checks where the top elevation of the downstream check is level with the base elevation of the up stream check for maximum effectiveness.
- In the case of grass-lined ditches, checks should be removed when the grass has matured sufficiently to protect the ditch or swale from erosion.
- The area beneath the check should be seeded and mulched immediately after the checks are removed.
- Erosion checks should be cleaned out once sediment has accumulated to half the height of the check material.
- Inspect for erosion along the ends of the checks and make repairs before the next inspection or rain event.

III. Sediment Control

1. Wattles

Wattle erosion checks are biodegradable barriers typically composed of cellulose, compost, coir, or straw. They are held together with a biodegradable net. Wattles can be installed in low flow ditches or on contours of longer side-slopes to break up flows. Wattles also work well as perimeter controls.



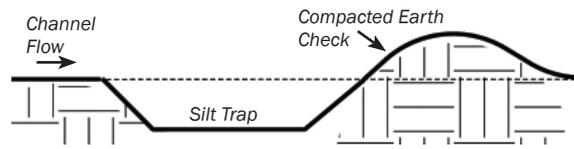
Good example of wattle installation during construction of box culvert extensions.

Notes

- Ensure contact with the ground for the length of the wattle by installing them in a shallow depression.
- Wattles are highly effective when they are used in combination with other BMPs such as silt traps, straw mulching and RECPs.
- Follow appropriate staking specifications.

2. Earth Checks

Earth check dams are small temporary earth berms constructed across a swale or drainage ditch using compacted earth. Their purpose is to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch.



Silt traps can be used in conjunction with compacted earth checks to provide additional sediment storage.



Good example of an earth check that can be cleaned out easily.

Notes

- Inspections should determine if earth checks need to be repaired or if they must be cleaned out because the storage capacity has been reduced by one half.
- Ensure that the center of the earth check dam is lower than the edges.
- Erosion around the edges should be corrected immediately.
- The strength of earth checks can be improved by compacting the earth berm to help prevent the checks from being eroded.

III. Sediment Control

3. Rock Checks

Temporary rock checks are used on steeper ditch slopes, where riprap will be placed as a permanent hydraulic control. The steeper the ditch the closer the rock checks are placed to each other.



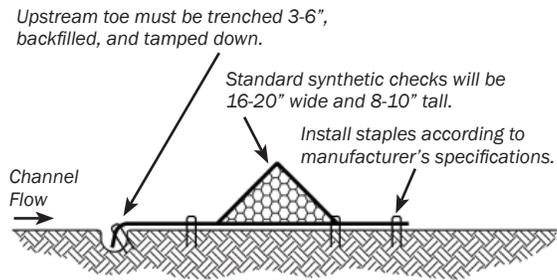
Good example of rock check installation.

Notes

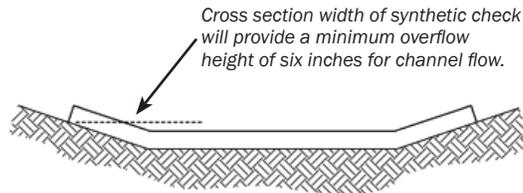
- Rock checks should extend up the slope to prevent washout around the edges.
- When placing rock checks in medians or close to the road, ensure that the high flow point is below the roadway surface to avoid flooding.
- As a general rule, the maximum spacing between rock checks should be such that the toe of the upstream rock check is at the same elevation as the top of the downstream rock check.

4. Synthetic Checks

Synthetic checks, such as triangular silt barriers, are typically used as temporary controls for ditch and channel stabilization during construction. These products are made of synthetic materials and are designed so that they can be relocated throughout the project as needed to control silt.



Side cross section illustration of Synthetic Check installation.



Front cross section illustration of Synthetic Check installation.

Synthetic Checks continued on next page.

III. Sediment Control



Good example of synthetic check installation. Placement, spacing and surface contact provide sediment control until permanent vegetation is established.



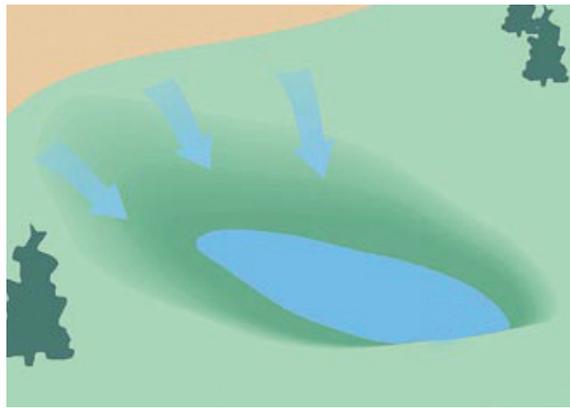
This synthetic check is no longer effective. All checks should be cleaned out when sediment reaches one half the height of the check.

Notes

- Extend the synthetic checks up the foreslope and backslope of the ditch to contain the runoff and prevent erosion and washout at the edges of the installation.
- The upstream edge must be slightly buried and pinned with wire staples and the downstream edge must also be pinned down.
- Install pins or staples according to manufacturer's instructions.

B. Traps And Basins

Silt Traps, Sediment Traps and Sediment Basins are depressions or embankments created in the stormwater flow path that causes sediment-laden water to slow and pool, and allows soil particles to drop out before the water exits the BMP. The drainage areas leading to the BMP and the length-to-width ratio of the depression significantly influence the amount of sediment that can settle out of suspension.



Silt traps, sediment traps and sediment basins provide some of the same benefits for sediment and pollutant capture on different scales.

1. Silt Traps

Temporary silt traps are shallow excavations (typically one foot deep by six feet wide and varying lengths) constructed behind erosion checks (Page 37) and placed along a drainage path to dissipate energy, induce sediment deposition, and provide temporary storage. Silt Traps generally do not include outlet drains; trapped water either evaporates or percolates into the ground.

Silt Traps continued on next page.

III. Sediment Control



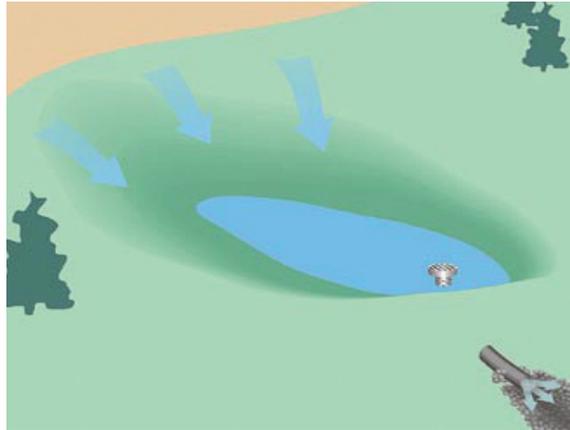
Good example of a silt trap used in the right-of-way.

2. Sediment Traps

Sediment Traps are small impoundments placed in a drainage path that serves one or more common drainage locations. They are typically a deeper excavation (three to four feet depth) placed behind an embankment. Sediment traps are sized to detain/retain the first inch of runoff and induce sediment deposition. They are designed to handle drainage areas up to five acres with large storms flowing out through a stabilized outlet.

3. Sediment Basins

Sediment basins are larger impoundments placed in or adjacent to a drainage path that serves several common drainage locations. They should be located at low lying areas of the site where flows converge. They are designed by a hydraulic engineer and can be either excavations, embankments, or a combination of both. Sediment basins are sized to detain/retain up to the 10-year, 24-hour storm event for sites that exceed five acres in drainage area. They are designed to both induce sediment deposition and reduce peak discharges. They will have both primary and secondary stabilized outlets.



Sediment traps and basins must be designed with an adequate overflow structure and outlet protection.



Good example of a constructed sediment basin for a linear construction project.

Traps and Basins continued on next page.

III. Sediment Control

Notes

- Install sediment traps and basins before any land disturbance takes place in the drainage area. Install silt traps as needed during construction.
- Sediment must be removed from the trap and basin when the storage volume has been reduced by one half.
- Sediment traps and basins should provide 3,600 cubic feet of storage per acre of disturbed area.
- The outlet of a sediment basin must be underlaid with geotextile and be at least one and one-half foot high and be designed to control overflow.
- Sediment basin outlets may be made up of both coarse aggregate and riprap.
- Sediment basins, sediment traps and silt traps are not intended for installation in creeks or other areas of major flow.

C. Barriers

Installing stormwater barriers is a practice used to slow down runoff and allow sediment to settle out. Barriers are not intended to wrap the project site. Instead they provide small areas for containment of stormwater. Stormwater flows are either contained behind the barrier or allowed to pass over the top of them. Barriers are not installed along steep slopes or in channels like slope interruption (Page 16) techniques. Barriers function best when controlling sheet flow below the toe of a slope, adjacent to stream banks, and around storm drain inlets located in a recessed slump.

1. Topsoil

Protecting and preserving topsoil is also a good BMP. Compacted topsoil can be used as a temporary barrier around the construction site and then re-applied during final grading. Topsoil barriers must be stabilized if they will be left undisturbed for more than 14 days.



Topsoil can be used as a perimeter control during construction and reapplied as a growth medium during final grading.

III. Sediment Control

2. Mulch (Slash)

Trees removed for construction may be ground up into slash mulch consisting of coarse pieces ranging in size from 3 to 24 inches. The mulch can be used in place of, or in addition to, using a silt fence by piling the mulch into a triangular dike, approximately three feet high and six feet wide at the base.



Good example of slash mulch installation.

Notes

- Consider maintaining a stockpile of mulch on-site until an erosion control contractor can be mobilized to the site.
- Consider using slash mulch in combination with silt fence to reduce the risk of stormwater undercutting the silt fence.

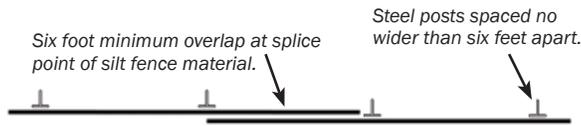
3. Silt Fence

Silt fence is a geotextile product used for temporary sediment control on construction sites where soil will be disturbed and sheet flow is expected. This material provides an effective barrier to flow when it is trenched into the soil and reinforced by attaching steel posts on the down slope side of the product.

Silt fence is used to create small containment areas that detain stormwater on the construction site. Sediment settles out of stormwater runoff and is deposited behind the silt fence, allowing cleaner water to discharge from the construction site.



Good example of silt fence installation using a silt fence plow on a tractor.



Plan view of silt fence showing material overlap.

Silt Fence continued on next page.

III. Sediment Control

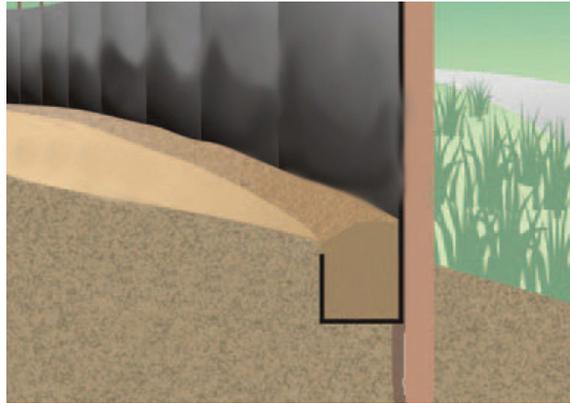


Illustration of silt fence installation. Silt fence should be properly trenched to prevent undercutting. Trenching is not required if a silt fence plow is used for installation.



Poor example of silt fence installation. The silt fence was not trenched into the soil.



Good silt fence installation. Accumulated sediment has been removed from the fence and the area has been mulched.



Poor example of silt fence use. Excessive quantities do not provide additional benefits and waste project resources.

Silt Fence continued on next page.

III. Sediment Control

Notes

- Silt fence should be installed prior to any grubbing or grading activity.
- Install along contours to avoid concentrated flows.
- Inspect silt fence regularly for sediment accumulation, tears, undermining, and separation from posts.
- Silt fence should be installed approximately six feet away from the toe of the fill, when feasible, for ease of maintenance.
- Sediment should be removed when it accumulates to one third of the exposed fabric height and be disposed of properly.
- Maximum drainage area is one-quarter acre per 100 feet of silt fence length.
- Silt fence should be removed once it has served its purpose and the area has been stabilized.
- Reinforce silt fence material with steel posts that are spaced no wider than six feet apart.
- Do not excavate silt fence trenches wider or deeper than necessary for installation and compact soil around the toe of the material.

D. Inlet/Outlet Protection

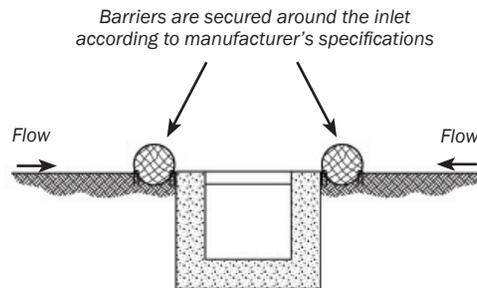
Culverts and ditches are designed to carry moderate to large amounts of stormwater. They also can carry sediment to streams, rivers, wetlands, lakes and sensitive areas if they are not properly protected. Culvert and swale outlets can become severely eroded if stormwater flows are not controlled.

1. Inlet Protection

Storm drain inlet protection measures prevent sediment and debris from entering the inlets. Inlet protection is installed at existing inlets prior to construction. New inlets are protected as they are installed and brought on-line. Inlets can be protected with silt fence, wattles, straw bales, or other sediment control devices.

a. Wattles and Synthetic Barriers

Installation and maintenance details for wattles and synthetic barriers are described on page 37 as erosion checks.



Section view of median inlet protection using wattles. Synthetic barriers such as checks and silt fence can also be used instead of wattles.

Wattles and Synthetic Barriers continued on next page.

III. Sediment Control



Poor example of inlet protection. This silt fence has been overwhelmed by high velocity flows. Repair the fence and consider additional BMPs upstream to reduce velocities and minimize the volume of sediment reaching the inlet.



Good example of inlet protection.

b. Straw Bales

Straw bales can be an effective inlet protection BMP when installed in combination with synthetic barriers. Bales must be trenched into the soil. They will not provide effective stormwater control if used on paved surfaces.



Good use of straw bales to protect inlet. Silt fence is used to improve the stability of the bales and simplify maintenance.

Notes

- Straw bales should be trenched in a minimum of eight inches into the soil.
- Reinforce square bales with wood stakes that are two-inches square and at least three feet long.
- Straw bales tend clog with sediment and may need to be maintained or replaced often.
- When placing straw bales around inlets ensure that the low-flow point is below the roadway surface to avoid flooding.
- Straw bales should be certified to be free of noxious weeds.
- Remove accumulated sediment when it reaches half the height of the bale.

III. Sediment Control

c. Curb Inlet Protection

Curb inlet protection is a temporary measure used to block sediment from entering storm drain inlets. Some methods used to provide curb inlet protection may include rock filled mesh bags (rock socks) and other synthetic proprietary products. Curb inlet protection is most effective appropriate erosion control measures are used to minimize sediment migrating toward inlets.



This inlet protection is no longer effective. Remove accumulated sediment after each precipitation event.

Notes

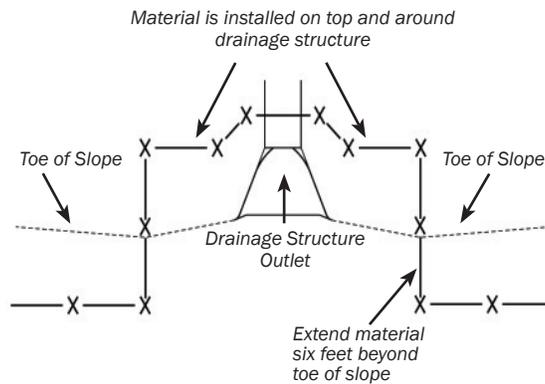
- For new inlets, install inlet protection as soon as storm drain inlets are constructed. For existing inlets, install inlet protection before land-disturbance activities begin.
- Check inlet protection during rain events to make sure they are not creating a flooding hazard.
- Clean-up and dispose of accumulated sediment.
- Replace or repair the damaged inlet protection.
- Sweep streets, sidewalks, and other paved areas regularly.

2. Outlet Protection

Outlet protection prevents scour and erosion at the outlet of a channel or conduit by reducing the velocity of stormwater. Outlet protection is generally comprised of geotextile and riprap or Turf Reinforcement Mat placed at the outlet point. For use with sediment basins (Page 45), a plunge pool may be necessary.

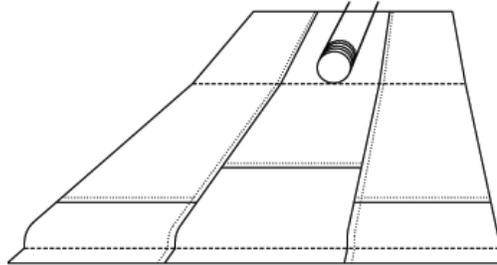


Outlet is protected with riprap and adjacent areas are mulched and seeded to prevent erosion. Additional barriers around outlet could prevent sediment from getting into the channel until final stabilization is established.



Use silt fence or wattles around the outlet, as shown, until the surrounding area is stabilized with vegetation.

III. Sediment Control



TRM can be placed around an outlet to provide stabilization instead of using riprap and geotextile.

Notes

- Prepare outlet areas with proper top soil dressing to assist establishment of a vegetative cover.
- Ensure that TRM is applied to smooth surfaces and follow manufacturers specifications to prevent tenting.
- Prevent soil from falling into the outlet by installing appropriate soil barriers (Page 48) until final stabilization is established.
- Place geotextile under rip rap to prevent undercutting.

IV. Good Housekeeping

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IV. Good Housekeeping

IV. Good Housekeeping

A. Preservation of Vegetated Buffers

By carefully delineating and controlling the areas not to be disturbed by grading or construction activities, the potential for soil erosion and stormwater pollution problems is reduced. Vegetated buffers provide erosion and sediment control, detention, filtration, and add aesthetic values to a site during and after construction. Preserved vegetation intercepts rainfall, promotes infiltration, and processes higher quantities of stormwater runoff than newly planted areas that have to become established.



Use vegetated buffers to your advantage as natural erosion control. Add an extra layer of protection with perimeter controls before starting construction.

1. Environmentally Sensitive Areas

Specific precautions may be required to prevent impacts to environmentally sensitive areas. Vegetated buffers should be used to keep construction away from streams, lakes, wetlands, special habitats, historical properties, trees to be preserved and other special assets. Many of these assets are likely to be regulated by special permits or special provisions agreed to in the project planning phase. Vegetated buffers are an excellent method to comply with permit and contract requirements and protect these areas.

2. Construction Staging and Phasing

Contractors should preserve vegetated buffers as a temporary BMP during the construction project. Preserve areas that are already vegetated for as long as possible to provide an inexpensive sediment and erosion control BMP.

Notes

- Mark off vegetated buffer areas before construction begins using appropriate perimeter controls (Page 63).
- Limit disturbed areas to only those necessary for construction of the project.
- Supplement buffer areas for waterways and wetlands with construction barrier fence, silt fence and/or wattles.
- Educate equipment operators or use signs to warn vehicular traffic to avoid preservation areas. Keep preservation areas clear of construction materials.

IV. Good Housekeeping

B. Perimeter Control

Perimeter controls such as fences, berms and mulches are used to control sediment laden runoff from leaving a construction site and to divert upland clean stormwater from entering the site. They are also used to define the construction site perimeter and environmentally sensitive areas. It is important that perimeter controls are in place before any earth-moving activities begin.

1. Construction Safety Barrier Fencing

Safety barrier fencing (orange fencing) creates a visual obstruction that can notify people operating equipment on-site to stay clear of certain areas. Fence material does not provide erosion or sediment control, but this BMP can be installed near wetlands and other areas where soils are not to be disturbed so that erosion is prevented.



Construction safety barrier fencing (orange fencing) can be used to protect wetlands, other sensitive areas and areas to remain undisturbed from construction traffic.

2. Berms and Diversions

A mulch, compost or soil berm or diversion is a temporary ridge that slows and filters flow and diverts stormwater from an open area or slope. Diversions are designed to intercept and divert upland runoff around bare soil areas. Berms and ditches diverting upland runoff around construction sites reduce erosion and sedimentation problems.



Good example of a soil berm used for perimeter control.



If possible, divert stormwater around your site.

Berms and Diversions continued on next page.

IV. Good Housekeeping

Notes

- Seed soil berms and ditches after they are constructed.
- Repair and inspect perimeter controls often for breaches.
- Berm heights should not exceed a height of five feet. The desirable top width is four feet and the side slopes should be 3:1 or flatter.
- Berms should not be used in locations where they can be damaged by vehicle traffic.
- Direct runoff down slopes in non-erosive manner and protect outlets to prevent washouts.

C. Dust Control

Wind is capable of causing erosion, particularly in dry climates or during periods of dry weather. Wind erodes soils and transports the sediments off site, where they may be washed into the receiving water by the next rainstorm. Therefore, various methods of dust control may be needed to prevent dust on construction sites.



Water, with a soil binder added, can be a useful tool for controlling dust on haul roads and other traffic routes.

Notes

- For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control.
- When properly applied, mulch (Page 10) offers a fast, effective means of controlling dust.
- The site may be watered until the surface is wet. Water is especially effective for dust control on haul roads and other traffic routes when a soil binder (Page 14) is added.
- Stone used to stabilize construction roads; can also be effective for dust control.

IV. Good Housekeeping

D. Stabilized Construction Exits

When vehicles and equipment drive off of a construction site, mud and sediment can be tracked onto paved surfaces unless the exit area is stabilized. Stabilized exits made of crushed rock or other approved materials provide an area for vehicles to drive over before leaving the construction area. Driving over these areas will vibrate the vehicle, knocking the sediment loose from the tires. Exits should be installed in strategic locations to encourage operators to use them as much as possible. When a stabilized construction exit is specified, geotextile is used to separate the stabilizing material from the soil below.



Install stabilized exits in strategic locations to encourage operators to use them as much as possible.



Good construction exit. When areas fill with sediment, more rock should be added to keep the exit effective.



Poor example of a construction exit. Vehicles are tracking sediment off-site.

Notes

- Ensure material does not get tracked onto nearby roads or travel routes. Clean roads throughout the day to maintain safety.
- Encourage all vehicles to use the stabilized construction exits.
- Replace and/or add material as needed to maintain the effectiveness of the BMP.

IV. Good Housekeeping

E. Solid Waste Management

Building materials and other construction site wastes, including sanitary wastes, must be properly managed and disposed of to reduce the risk of pollution. Practices such as trash disposal, recycling, proper sanitary facility maintenance, and spill prevention and cleanup reduce the potential for stormwater runoff to move construction site wastes into surface or ground water.



Good example of portable toilet placement on level surface within containment area.



Waste should be segregated properly into various categories such as hazardous materials, toxic liquids, non-hazardous materials, and recyclable materials.

Notes

- Designate trash and bulk waste collection areas on-site. Keep them away from high traffic areas, watercourses and other protected areas.
- Recycle materials whenever possible.
- Segregate and provide proper disposal options for hazardous material wastes.
- Clean up litter and debris from the construction site daily.
- Locate portable toilets away from drainage facilities, watercourses, and from traffic circulation.
- Secure portable toilets to prevent overturning.
- Provide secondary containment around portable toilets.

IV. Good Housekeeping

F. Stockpiles

Stockpiles of soil and other erodible materials must be managed so that stormwater does not wash pollutants into state waters including waterways and wetlands.



Poor example of stockpile management. Protect stockpiles with silt fence or other BMPs and seed if left undisturbed for more than 14 days.



Good installation of silt fence around stockpile. The fence is placed at least six feet from the toe of the slope to provide a catchment area and easy clean out. Stockpiles must be stabilized if left undisturbed for more than 14 days.

Notes

- Topsoil/embankment stockpiles should be sprayed with soil tackifier, a hydraulically applied mulch or have mulch/mulch tackifier applied to prevent wind erosion.
- Provide temporary stabilization where work on stockpiles is paused at least 14 days.
- The toe of erodible stockpiles must be protected with silt fence or other applicable BMPs.
- Do not place stockpiles in drainage ways or near state waters.

IV. Good Housekeeping

G. Secondary Containment

All building materials that have the potential to contaminate stormwater or groundwater must be placed in areas with secondary containment. Secondary containment prevents a spill from spreading across a site.



Good example of secondary containment. Be sure to replace the drain plug after clean water has been allowed to drain out.



Good use of a soil berm for secondary containment. Containment area must be large enough to capture a complete tank rupture.



Poor example of secondary containment. All drums need to be contained and stored up-right. Punctured drums need to be handled as a waste and disposed of properly.

Notes

- Communicate how hazardous materials and waste handling, storage, disposal and cleanup will be handled on-site.
- Provide secondary containment for all hazardous materials and follow all regulatory specifications for sizing when applicable.
- Hazardous materials stored on-site should be minimized and designated to specific areas.
- Secondary containment areas should be placed away from vehicular traffic and waterways.
- Spill kits should be readily available and maintained on all sites.
- Hazardous waste containers should be inspected to ensure that all containers are labeled properly and that no leaks are present.

IV. Good Housekeeping

H. Concrete Washout

Concrete washout structures are used to contain concrete and liquids when the chutes of concrete mixers and hoppers of concrete pumps are rinsed out after delivery. The washout facilities can be constructed or ready-made. Washout facilities consolidate solids for easier disposal and prevent runoff of liquids. The wash water is alkaline and contains high levels of chromium, which can leach into the groundwater or migrate to nearby waterways and harm aquatic life.



Good installation of a concrete wash-out facility. Be sure the location is visible and easily accessible.

Notes

- It is recommended that facilities be cleaned out once they are two-thirds full, or new facilities should be constructed to provide additional concrete waste storage.
- Allow concrete washout to harden before removing the material for disposal.
- Do not place concrete washouts in areas prone to flooding, ditches, or adjacent to state waters.
- Permanent disposal of concrete washout waste should be done according to project specifications.

I. Street Sweeping and Vacuuming

Constructing streets, roads, highways, and parking lots can cause the accumulation of significant amounts of pollutants which can potentially contribute to stormwater pollutant runoff to surface waters. Pollutants, including sediment, debris, and trash, can be minimized by street sweeping.



Street sweeping is an effective BMP for removing sediment on streets before it can reach storm drains.

Notes

- Inspect potential sediment tracking locations daily and sweep or vacuum daily.
- All sweepings should be disposed of properly.
- Be careful not to sweep up any unknown substance or objects that may be potentially hazardous.
- Do not use kick brooms or sweeper attachments when the combination of dust and winds will cause a safety hazard.

References and Acknowledgements

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Colorado Department of Transportation for providing BMP information and photos.

Minnesota Department of Transportation for providing BMP photos.

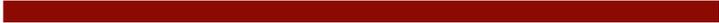
US Environmental Protection Agency for providing BMP information and photos.

Erosion Control Technology Council for providing reference information.

For Additional References:
www.transportation.nebraska.gov
keyword search: stormwater

Disclaimer

This handbook was drafted in 2008 by a consultant for the Nebraska Department of Roads in an effort to provide a general overview of techniques and methods constituting best practices for handling of construction stormwater. The information in this Guide is general guidance and does not supersede or replace any project plan, specifications, special provision, SWPPPs or other project specific commitments. The information in the handbook should not be considered to be legal advice. Please consult an attorney before taking any action concerning your specific rights, obligations or duties under local, state or federal law.



Nebraska Department of Roads

Planning & Project Development

Roadside Stabilization Unit

1500 Hwy 2

Lincoln, NE 68502



www.transportation.nebraska.gov