Chapter 2: Access and Source Control BMPs

BMP 201: High Visibility Plastic or Metal Fence

Purpose

Fencing is intended to:

- Restrict clearing to approved limits;
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed;
- Limit construction traffic to designated construction entrances or roads; and
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left undisturbed.
- As necessary to control vehicle access to and within the site.

Design and Installation Specifications

- High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least 4'-0" in height. Posts for the fencing shall be steel or wood and placed every 6'-0" on center (max.), or as needed to ensure rigidity. The fencing shall be fastened to the post every 6" with a polyethylene tie. On long continuous runs of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The plastic fence color shall be high visibility orange. The fence tensile strength shall be 360 pounds per ft. using the ASTM D4595 testing method.
- Metal fences shall be designed and installed according to the manufacturer's specifications.
- Metal fences shall be at least 3'-0" high and must be marked in some way to make them highly visible.
- Fences shall not be wired or stapled to trees.

Maintenance Standard

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP 202: Stake and Wire Fence

Purpose

Fencing is intended to:

- Restrict clearing to approved limits;
- Prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed;
- Limit construction traffic to designated construction entrances or roads; and
- Protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use

To establish clearing limits, plastic or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left undisturbed.

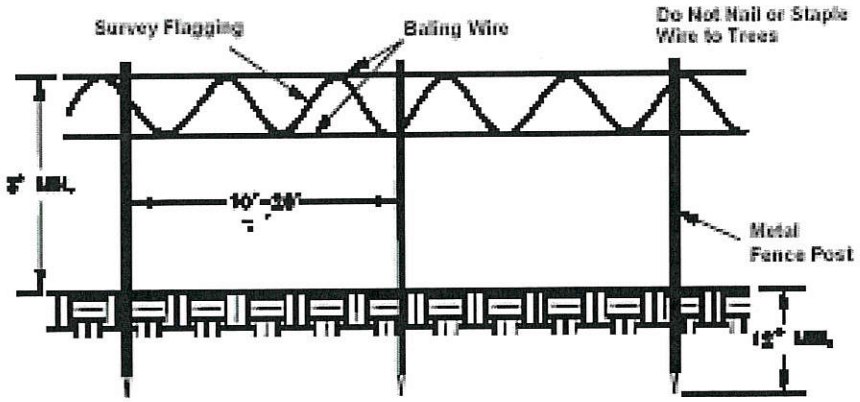
- As necessary to control vehicle access to and within the site.

Design and Installation Specifications

- See the figure below for details.
- More substantial fencing shall be used if the fence does not prevent encroachment into those areas that are not to be disturbed.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.



BMP 210: Stabilized Construction Exit

Purpose

Construction exits are stabilized to reduce the amount of sediment transported by vehicles or equipment leaving the site by constructing a stabilized pad at all possible access points to and from construction sites.

Conditions of Use

Construction exits shall be stabilized wherever traffic will be leaving a construction site and traveling on paved areas within 1,000 feet of the site.

Design and Installation Specifications

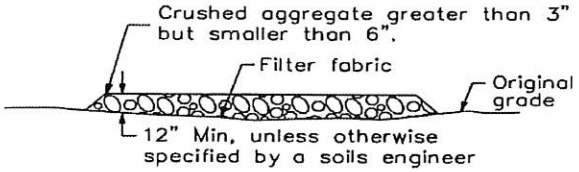
See the figure on the next page for details. **NOTE:** The minimum length of the entrance shall as close to the length required for 4 complete rotations of the largest wheel used during construction. This can be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (preferred length: 100').

- A separation geo-textile **shall** be placed under the pad to prevent fine sediment from pumping up into the pad. The geo-textile shall meet all the standards in the Table below.

Table 2: Geo-Textile Standards for Construction Exit Pads

Grab Tensile Strength (ASTM D4751):	200 psi min.
Grab Tensile Strength (ASTM D4632):	30% max.
Mullen Burst Strength (ASTM D3786-80a):	400 psi min.
AOS (ASTM D4751):	20-45 (U.S. standard sieve size)

- Consider early installation of the first lift of asphalt in areas that will be paved. This can be used as a stabilized exit. Also consider the installation of excess concrete as a stabilized exit.
- Fencing (see BMPs 201 and 202) shall be installed as necessary to restrict traffic to the construction entrances and exits. Whenever possible, the access point shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.



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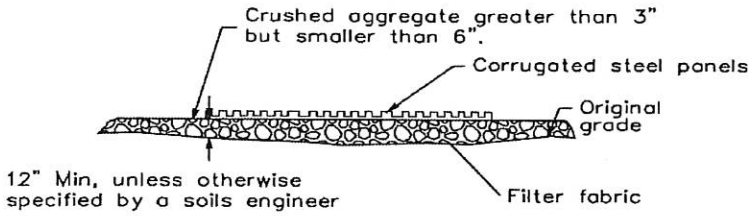

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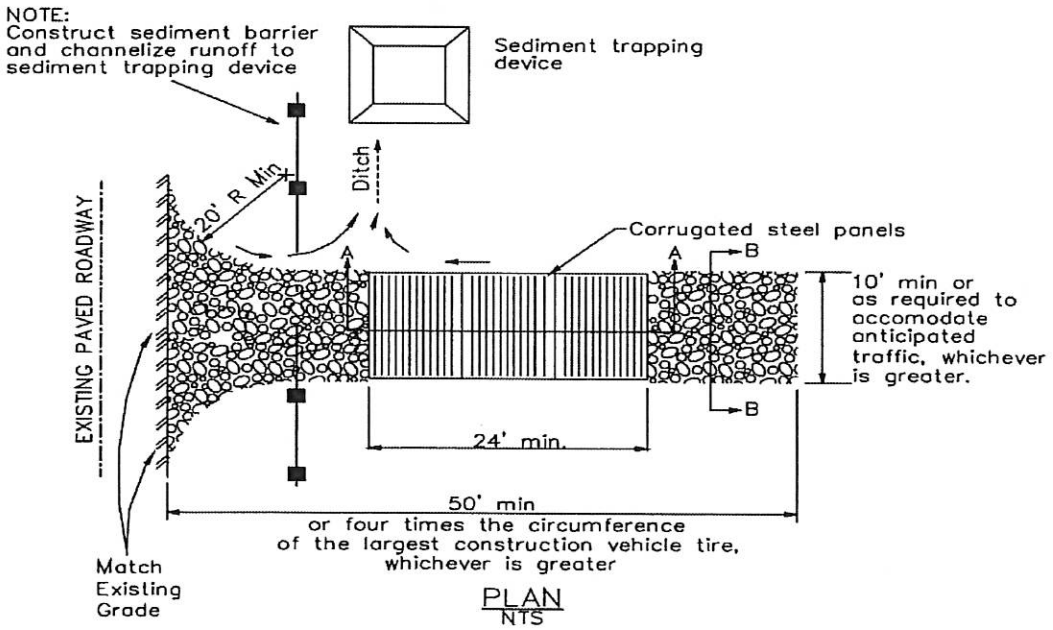

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Maintenance Standards

- Crushed rock shall be added if the pad is no longer in accordance with the specifications.
- If the entrance is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include, but is not limited to, an increase in the dimensions of the exit, the installation of a wheel wash, or street sweeping. Additional measures may be required if sediment continues to leave the site.
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be replaced and stabilized on-site. The pavement shall **not** be cleaned by washing down the street, except when sweeping is ineffective and there is a

threat to public safety. If it is necessary to wash the streets, the construction of a small sump shall be considered. The sediment would then be washed into the sump where it can be controlled.

- Any rock that is loosened from the pad and which ends up on the roadway shall be removed immediately.
- If vehicles are entering or exiting the site at points other than the sites' controlled access locations, fencing (see BMPs 201 and 202) shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

BMP 211: Rumble Strips and Wheel Washes

Purpose

Rumble strips and wheel washes reduce the amount of sediment transported by motor vehicles.

Conditions of Use

A rumble strip and/or wheel wash shall be used when a stabilized construction exit is not preventing sediment from being tracked onto pavement.

- A rumble strip is generally an effective BMP as long as the surface roughness is maintained to "knock" as much sediment as possible loose during the drive time over its surface.
- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be *detrimental* if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10'-0" x 10'-0" sump can be very effective.

Design and Installation Specifications

Rumble strips: Generally the same dimensions of a stabilized construction exit pad of 4" to 6" clean stone (aka B Stone) placed at least 8" thick over a geo-textile fabric with an area that has larger stones; reinforced fabric; or a metal grating that is sufficiently long enough to "rumble" off excessive amounts of sediment that has become attached to the vehicle, machinery, or equipment. See corrugated steel panels section shown in detail in BMP 210, Stabilized Construction Exit on previous page.

Wheel washes: Minimum dimensions are total length of 40'-0" by 12'-0" wide by 18" sump depth. The total length includes the ingress to and egress from the sump. The run-out pad should extend about 50'-0" past the egress ramp and drain back towards the sump or other acceptable collection, detention, and/or treatment facility. Fencing may be required to manage traffic.

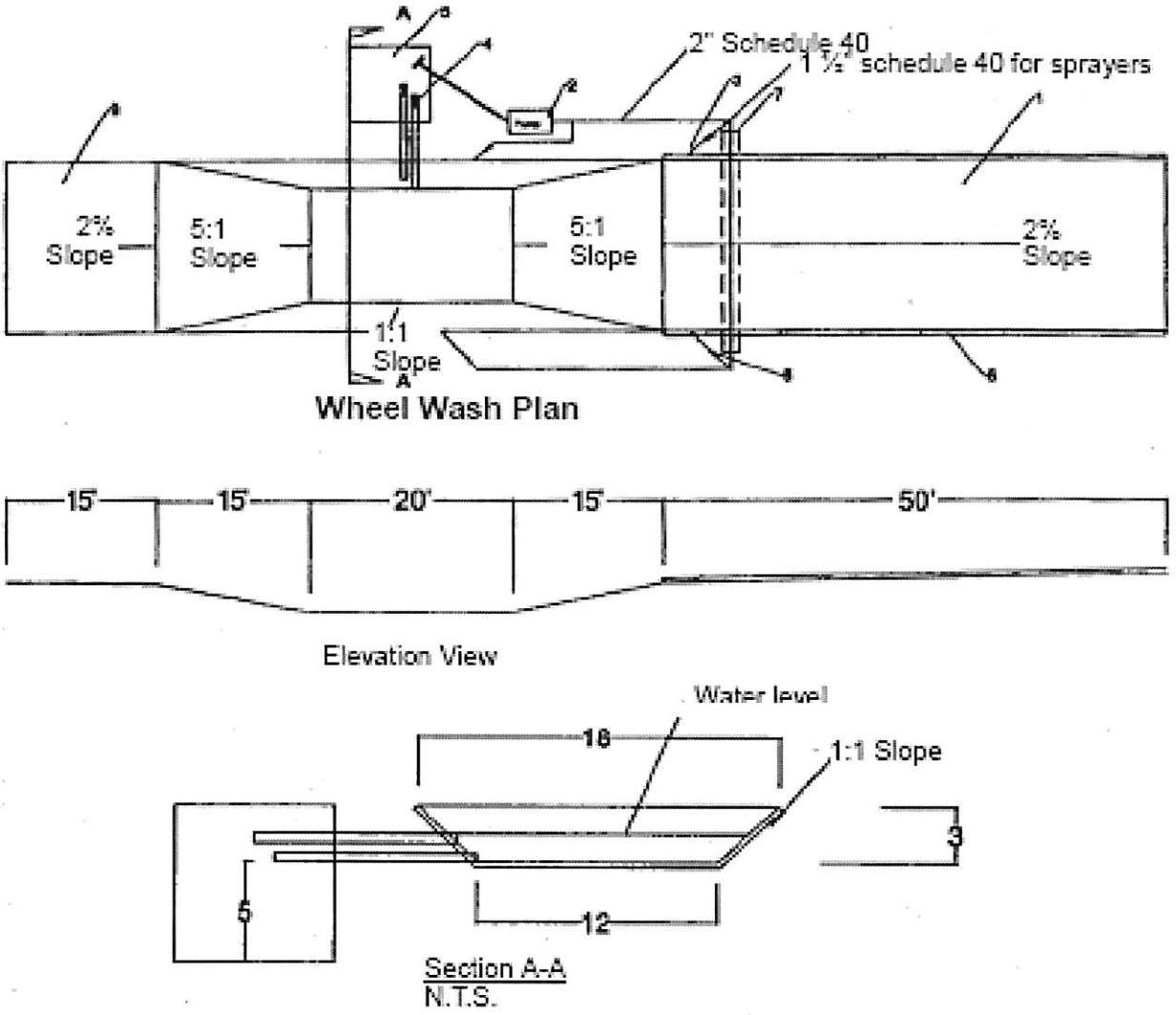
The aggregate size of the pad should be 4" to 6" clean stone (aka B Stone) placed at least 8" thick over a geo-textile fabric to prevent muddying of the stone from the subgrade level and to improve stability. An alternative would be to place a 3" asphalt lift over a stable roadway base or a minimum of 6" of asphalt treated base (ATB) over crushed base material. A good, solid subgrade is recommended for the wheel wash.

Keep the water level from 12" to 14" deep to avoid damage to truck hubs and filling the truck tongues with water. Use a low clearance truck to test the wheel wash before paving. Either a belly dump or lowboy will work well to test clearance. Midpoint spray nozzles are only needed in extremely muddy conditions.

Wheel wash systems should be designed with a small grade change (6"-12" for a 10'-0" wide pond) to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. A drainpipe

with a 2'-0" to 3'-0" riser should be installed on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system. PAM (see BMP 226) added to the wheel wash water at a rate of 0.25 - 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water.

Suggested details are shown in the figure below with the part labels shown. Various cities may allow other designs.



1. Run-out pad
2. Trash pump with floats
3. Midpoint spray nozzles, if needed
4. Sewer pipe with butterfly valves; locate top pipe's invert 12" above bottom of wheel wash
5. Sump with catch basin
6. Direct water back to pond
7. Sleeve under road
8. Ball valves
9. Apron to protect from splashing water

Maintenance Standards

- The wheel wash should start out the day with fresh water. The wash water should be changed a minimum of once per day. On large earthwork jobs where more than 10-20 trucks per hour are expected, the wash water will need to be changed more often. Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system, such as closed-loop recirculation or land application.
- The sump and collection/treatment facility needs to be inspected at least weekly to check for proper drainage; depth of accumulated sediment; any areas that require maintenance; and to make sure that the collection and/or treatment processes are correctly functioning.
- Water levels in the sump need to be verified several times a day to keep at a working level and clarity.
- The ingress and egress pads need to be reviewed weekly for the need to re-grade, or to remove sediment that is clogging or has accumulated on the travel path. If stone has been carried away from the pad, it may need to be replaced. If accumulated sediment can not be removed by washing, pumping, or vacuuming, the area may require complete removal and replacement. Pumped or vacuumed sediment should be either hauled off-site to a licensed waste facility or replaced for re-used on-site.

BMP 212: Construction Road and Parking Area Stabilization

Purpose

Stabilizing entrances, roads, other on-site vehicle routes, and parking areas immediately after grading will reduce the amount of erosion caused by construction traffic.

Mats and pads are available to provide reusable alternatives to rock or paved surfaces that are to be returned to "green" surface conditions.

Conditions of Use

- All areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.
- Roads or parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.
- Fencing (see BMPs 201 and 202) shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design and Installation Specifications

- Reusable mats and pads can be purchased in fiber or plastic rolls; or constructed on-site of plant fibers in planks, pipes, tubes, or channels and placed in locations where equipment travels or sits in an areas that is "soft," "boggy," muddy, or similar condition that can be tracked off-site.
- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6" depth of 2" to 4" crushed rock, gravel base, or crushed surfacing base course shall be applied immediately after grading or utility installation. A 4" course of ATB may also be used, or the road and/or parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for road base stabilization, pH monitoring and BMPs are necessary to evaluate and minimize the effects on stormwater. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15%. Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section,

or on one side in the case of a super-elevated section. Drainage ditches shall be directed to a sediment control BMP.

- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheet-flows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50'-0" of vegetation, then it is generally preferable to use the vegetation to treat runoff, rather than to build a sediment pond or trap. The 50'-0" strip shall **not** include wetlands. If runoff is allowed to sheet flow through adjacent vegetated areas, it is vital to design the roadways and parking areas so that no concentrated runoff is created.
- Storm drain inlets shall be protected to prevent sediment-laden water entering the storm drain system (see BMP 320).

Maintenance Standards

- Inspect stabilized areas regularly, especially after large storm events.
- Crushed rock, gravel base, hog fuel, etc. shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.
- Following construction, these areas shall be restored to pre-construction condition or better to prevent future erosion.
- If a reusable mat or pad is used and depending on what it is made of, the item can be cleaned, "packaged," and transported to another site for multiple years or can be recycled into another product.

BMP 220: Temporary and Permanent Seeding

Purpose

Seeding is intended to reduce erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Seeding may be used throughout the project on disturbed areas that have reached final grade or that will not be worked for more than 30 days.
- Channels that will be vegetated should be installed before major earthwork and hydro-seeded with a BFM. The vegetation should be well established (i.e., more than 75% cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydro-seed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch over hydro-mulch and blankets.
- Retention/detention ponds should be seeded or sodded as required.
- Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- All disturbed areas shall be inspected in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, native stone, gabions or geo-textiles) which will prevent erosion.

Design and Installation Specifications

- Seeding should be done during those seasons most conducive to growth and will vary with the climate conditions of the region.
- The optimum seeding windows for Arkansas are April 1 through June 30 and September 1 through October 1. Seeding that occurs between July 1 and August 30 will require irrigation until over 75% cover is established. Seeding that occurs between October 1 and March 30 will require a mulch or plastic cover until 75% grass cover is established.
- To prevent seed from being washed away, blankets or netting may be required. All required surface water control measures should also be confirmed that they have been correctly installed.
- The seedbed should be firm and rough. All soil should be roughened no matter what the slope. If compaction is required for engineering purposes, slopes must be track-walked before seeding. Back-blading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.
- New and more effective restoration-based landscape practices rely on deeper incorporation than is provided by a simple single-pass roto-tilling treatment. Whenever practical, the subgrade should be initially ripped to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8", the roto-tilling process should be done in multiple lifts, or the soil system shall be properly prepared and then placed to achieve the specified depth.
- Organic matter is the most appropriate form of "fertilizer" because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 2%-10% of its nutrients annually. Chemical fertilizers have been formulated to simulate what organic matter does naturally.
- In general, a 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer can be used at a rate of 90 pounds per acre. Slow-release fertilizers are preferred since they are more efficient with fewer environmental impacts.
- It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. Fertilizer should not be added to the hydro-mulch machine and agitated for more than 20 minutes before it is to be used. If the fertilizer is agitated too much, the slow-release coating will be destroyed.
- There are numerous products available that can take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100% cottonseed meal is used as the mulch in hydro-seed, a chemical fertilizer may not be necessary. Cottonseed meal is a good source of long-term, slow-release, available nitrogen.
- Hydro-seed applications shall include a minimum of 1,500 pounds per acre of mulch with 3% tackifier. Mulch may be made up of 100% cottonseed meal; fibers made of wood, recycled cellulose, hemp, other plant-fibers; compost; or blends of these. Tackifier shall be plant-based (such as guar or alpha plantago), or may be chemical-based (such as PAM or polymers). Any mulch or tackifier product used shall be installed per manufacturer's instructions. Seed and fertilizer are added at time of application.
- Mulch is always required for seeding. Mulch can be applied on top of the seed or simultaneously by hydro-seeding.
- The seed mix shown in Table 3 on the top of the next page is a recommended low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Other mixes may be appropriate, depending on the soil type and hydrology of the area. Recent research suggests that bent grass (*agrostis sp.*) should be emphasized in wet-area seed mixes. Apply this mixture in Table 3 at a rate of 60 pounds per acre.

Table 3: Wet Area Seed Mix*

	% by Weight	% Seed Purity	Germination Rate
Tall or meadow fescue	60%-70%	98%	90%
Seaside/Creeping bent grass	10%-15%	98%	85%
Meadow foxtail	10%-15%	90%	80%
Alsike clover	1% - 6%	98%	90%
Redtop bent grass	1% - 6%	92%	85%

*from Modified Briargreen Inc.; Hydro-seeding Guide Wetlands Seed Mix

The meadow seed mix in Table 4 below is recommended for areas that will be maintained infrequently (or not at all) and where colonization by native plants is desirable. Likely applications include rural road and utility rights-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. The appropriateness of clover in the mix may need to be considered, as this can be a fairly invasive species. If the soil is amended, the addition of clover may not be necessary.

Table 4: Meadow Seed Mix

	% by Weight	% Seed Purity	Germination Rate
Redtop bentgrass	20%	92%	85%
Red fescue	70%	98%	90%
White Dutch clover	10%	98%	90%

Maintenance Standards

- Any seeded areas that fail to establish over 80% cover (100% cover for areas that receive sheet or concentrated flows) shall be reseeded. If reseeding is ineffective, an alternate method (such as sodding, mulching, netting, or blankets) shall be used. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the local authority when sensitive areas would otherwise be protected.
- After adequate cover is achieved, any areas that experience erosion shall be reseeded and protected by mulch. If the erosion problem is drainage-related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Seeded areas shall be supplied with adequate moisture, but not watered to the extent that it causes runoff.

BMP 221: Mulching

Purpose

The purpose of mulching soils is to provide immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture; holding fertilizer, seed, and topsoil in place; and moderating soil temperatures. There is an enormous variety of mulches that are available. Only the most common types are discussed in this section.

Conditions of Use

As a temporary cover measure, mulch should be used:

- On disturbed areas that require cover measures for less than 30 days
- As a cover for seed during the wet season and during the hot summer months
- During the wet season on slopes steeper than 3:1 that have more than a 10'-0" of vertical relief

Mulch may be applied at any time of the year and should be refreshed periodically.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see the Table 5 on the next page.

Table 5: Mulch Standards and Guidelines			
Material	Quality Standards	Application Rate	Remarks
Straw	Air-dried: free from undesirable seed and course material	2" to 3" thick uses one bale per 200 square feet **OR** 2 to 3 tons per acre	Cost-effective protection when applied with adequate thickness. Hand-application requires greater thickness than if blown. The thickness of straw may be reduced by 50% when used with seed. In windy areas, it must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier or will blow it away. Has several deficiencies to be considered when selecting. Often introduces and/or encourages the propagation of weed species. It has no long term benefits. Straws should be used only if mulches with long term benefits are unavailable locally. It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydro-Mulch	No growth inhibiting factors	About 25 to 30 pounds per 1,000 square feet **OR** 1,500 to 2,000 pounds per acre	Shall be applied with appropriate equipment. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers should be kept to less than 3/4" to prevent clogging of machinery.
Compost And Composted Mulch	No visible water or dust during handling. Purchase from supplier with Solid Waste Permit or exempt from solid waste regulations	2" thick min. uses about 100 tons per acre **OR** 800 lbs per square yard	More effective control can be obtained by increasing thickness to 3". Excellent for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Composted mulch has a coarser size gradation than compost. More stable and practical to use in wet areas and during rainy weather conditions.
Chipped Site Vegetation	Average size shall be several inches long. Gradation from fines to 6" in length for texture, variation, and interlocking properties.	2" thick min.	Cost effective way to dispose of debris from clearing and grubbing. Eliminates the problems associated with burning. Generally it should not be used on slopes above **a0%** because tends to be transported by runoff. **Not** recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition may tie up nutrients important to grass establishment.
Wood-based mulch	No visible water or dust during handling. Purchase from supplier with Solid Waste Permit or exempt from solid waste regulations.	2" thick min. uses about 100 tons per acre **OR** 800 lbs per square yard	Often called "hog fuel." Used as a material for stabilized construction exits (BMP 210) and as a mulch. Its use as mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).

NOTE: Thicknesses may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion. Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher densities than straw, wood, plant fibers, or other chipped material.

Maintenance Standards

- The thickness of the cover must be maintained.
- Any areas that experience erosion shall be re-mulched and/or protected with a net or blanket. If the erosion problem is drainage-related, then the problem shall be fixed and the eroded area re-mulched.
- Wind and concentrated runoff flows can dislodge, remove, and/or wash mulch from its application area.
- Inspection is required after each rainfall event to check for stability of mulch and required coverage until the site has been stabilized.
- After site stabilization, inspection should occur at least per quarter and after every unusually large storm.

BMP 230: Nets and Blankets

Purpose

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows. Nets (also called mats) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a bio-degradable or photo-degradable netting (for example, excelsior or straw blankets). They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Nets and blankets often have the option to be pre-seeded, fertilized, and/or mulched which can simply installation or reduce time and labor required for all 3 steps.

Conditions of Use

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2:1 or greater and with more than 10'-0" of vertical relief, and/or
- For drainage ditches and swales (highly recommended).

The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Synthetic nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to native stone. 100% synthetic blankets manufactured for use in ditches may be easily reused as temporary ditch liners.

Disadvantages of blankets include:

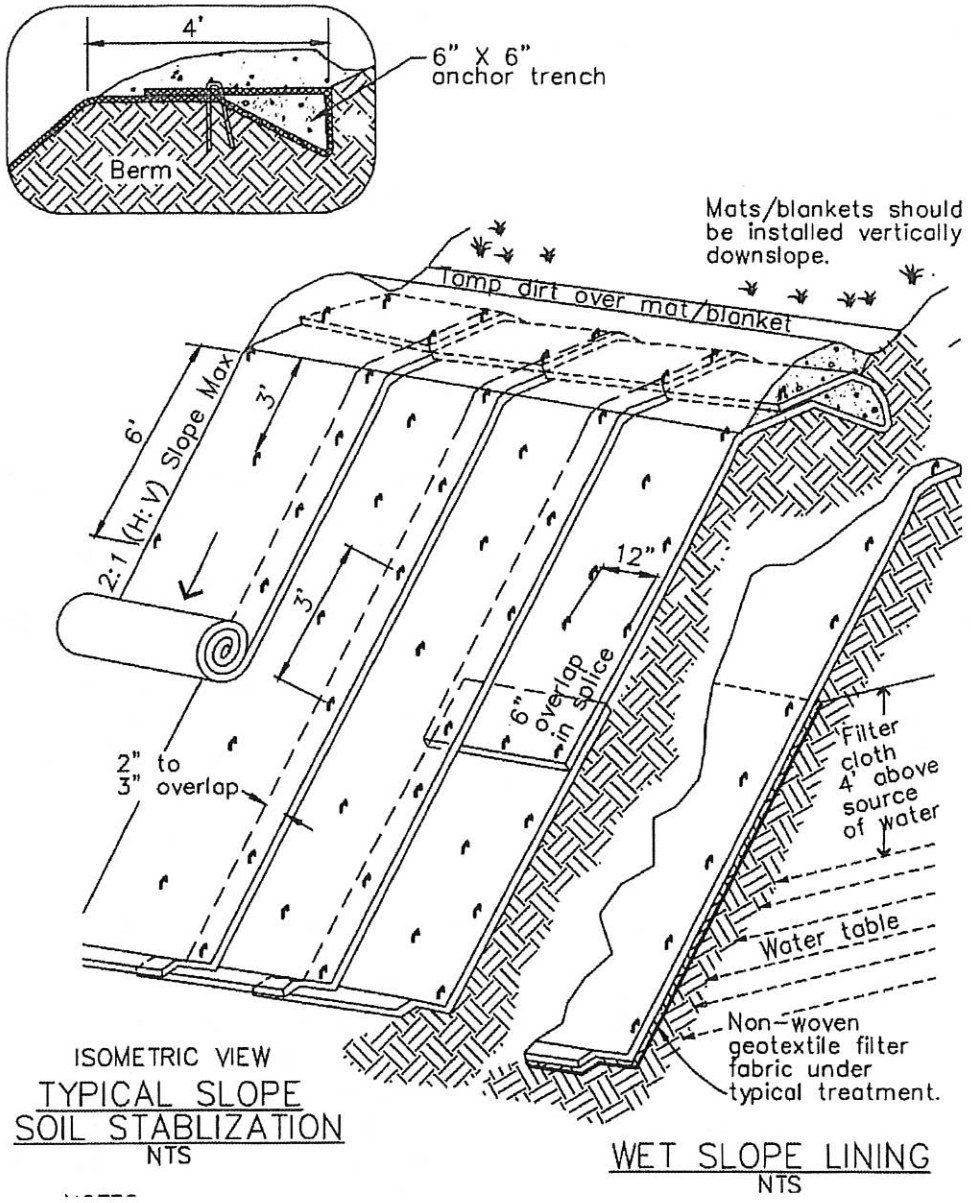
- Surface preparation required;
- On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety;
- They can cost $4,000-6,000 per acre installed. Incorrect installations cost more due to repeated repairs and/or replacements.

Advantages of blankets include:

- Can be installed without mobilizing special equipment;
- Can be installed by anyone with minimal training;
- Can be installed in stages or phases as the project progresses;
- Seed and fertilizer can be hand-placed by the installers as they progress down the slope;
- Can be installed in any weather;

- The numerous types of blankets with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, cost, availability and bio-degradability.

Design and Installation Specifications

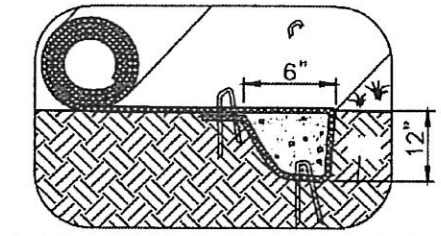


- Installation is critical to the effectiveness of these products. If good ground contact is not achieved, runoff can concentrate under the product, resulting in significant erosion.
- Installation of Blankets on Slopes:
  1. Complete final grade and track walk up and down the slope.
  2. Install hydro-mulch with seed and fertilizer.
  3. Dig a small trench, approximately 12" wide by 6" deep along the top of the slope.
  4. Install the leading edge of the blanket into the small trench and staple approximately every 18". **NOTE:** Staples are: either metal or plastic; "U"-shaped; and a minimum of 6" long. Longer staples are used in sandy soils. Bio-degradable stakes are also available.
  5. Roll the blanket slowly down the slope as installer walks backwards. **NOTE:** The blanket rests against the installer's legs. Staples are installed as the blanket is unrolled. It is critical that the

proper staple pattern is used for the blanket being installed. The blanket is not to be allowed to roll down the slope on its own as this stretches the blanket and makes it impossible to maintain soil contact. In addition, no one should be allowed to walk on the blanket after it is in place.

6. If the blanket is not long enough to cover the entire slope length, the trailing edge of the upper blanket should overlap the leading edge of the lower blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.

- It is critical that the design engineer consults the manufacturer's information and that a site visit takes place in order to insure that the product specified is appropriate.
- Jute matting must be used in conjunction with mulch (BMP 221). Woven blankets, excelsior, and coir (coconut fiber) blankets may be installed without mulch. There are many other types of erosion control nets and blankets on the market that may be appropriate in certain circumstances.
- In general, most nets require mulch in order to prevent erosion because they have a fairly open structure. Blankets typically do not require mulch because they provide complete protection of the surface.
- Extremely steep, unstable, wet, or rocky slopes are often appropriate candidates for use of synthetic



INITIAL CHANNEL ANCHOR TRENCH
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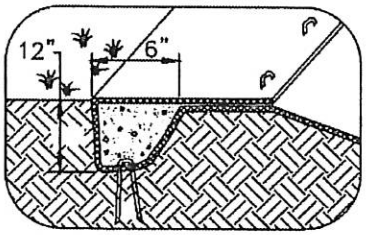
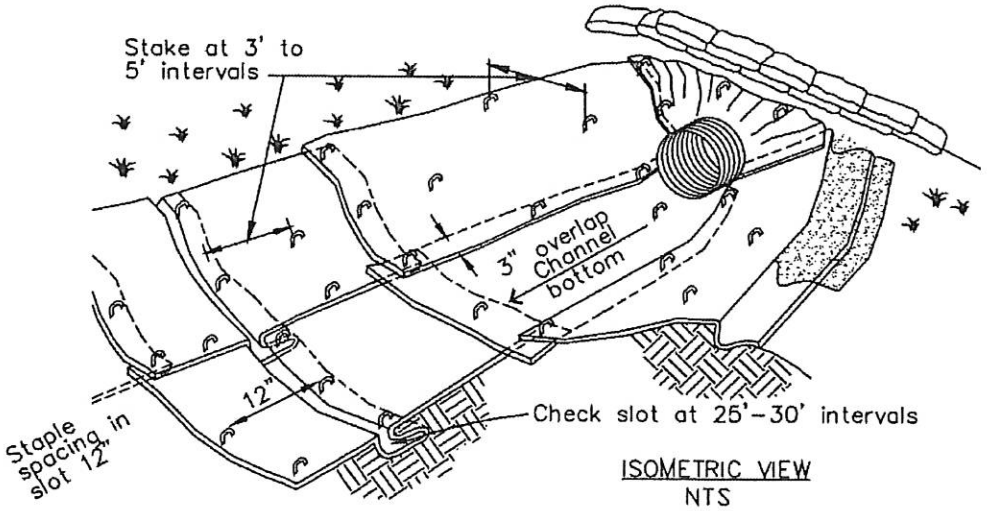
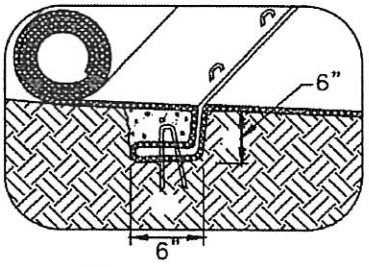


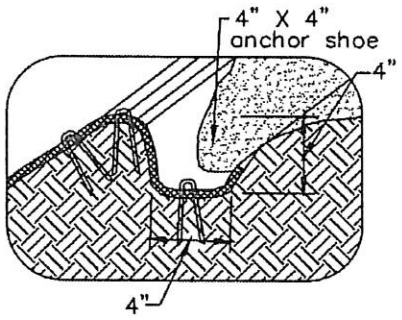
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS



LONGITUDINAL ANCHOR TRENCH
NTS

blankets, in addition to riverbanks, beaches and other high-energy environments. If synthetic blankets are used, the soil should be hydro-mulched first.

- 100% bio-degradable blankets are available for use in sensitive areas. These organic blankets are usually held together with a paper or fiber mesh and stitching which may last up to a year.
- Most netting used with blankets is photo-degradable, meaning they break down under sunlight. However, this process can take months or years even under bright sun. Once vegetation is established, sunlight does not reach the mesh. It is not uncommon to find non-degraded netting still in place several years after installation. This can be a problem if maintenance requires the use of mowers or ditch cleaning equipment. In addition, birds and small animals can become trapped in the netting.
- See the figures on the 2 previous page for typical orientation and installation of blankets used in channels and as slope protection. **NOTE:** These are typical details only. All blankets must be installed per manufacturer's installation instructions.

Maintenance Standards

- Good contact with the ground must be maintained, and erosion must not occur beneath the net or blanket.
- Any areas of the net or blanket that are damaged or that are not in close contact with the ground shall be repaired, replaced, and/or stapled.
- If erosion occurs due to poorly controlled drainage, the problem shall be fixed and the eroded area protected.
- Inspection is required after every rain event until the entire area has been stabilized.
- Improper anchoring and/or installation can result in erosion underneath; washing away of the blanket or net; or complete failure of the slope.

BMP 240: Sodding

Purpose

The purpose of sodding is to establish permanent turf for immediate erosion protection and to stabilize drainage ways where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded, and protected with a net or blanket.

Design and Installation Specifications

Sod shall be free of weeds, of uniform thickness (approximately 1" thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

1. Shape and smooth the surface to final grade in accordance with the approved grading plan. The swale needs to be over excavated 4" to 6" below design elevation to allow room for placing soil amendment and sod.
2. Amend 4" (min.) of compost into the top 8" of the soil if the organic content of the soil is less than 10% or the permeability is slower than 0.6" per hour.
3. Fertilize according to the supplier's recommendations.
4. Work lime and fertilizer 1" to 2" into the soil, and smooth the surface.
5. Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of

water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12". Staple on slopes steeper than 3:1. Staple the upstream edge of each sod strip.

6. Roll the sodded area and irrigate.
7. When sodding is carried out in alternating strips or other patterns, seed the areas between the sod pieces immediately after finishing with the sod.

Maintenance Standards

If the grass is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed. The area should then be seeded with an appropriate mix and protected with a net or blanket.

BMP 241: Topsoiling

Purpose

To provide a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling is an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but they also serve as effective bio-filters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils, but only the material from the top several inches including organic debris.

Conditions of Use

- Native soils should be left undisturbed to the maximum extent practicable. Native soils disturbed during clearing and grading should be restored, to the maximum extent practicable, to a condition where moisture-holding capacity is equal to or better than the original site conditions. This criterion can be met by using on-site native topsoil, incorporating amendments into on-site soil, or importing blended topsoil.
- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.
- Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. If an existing soil system is functioning properly it shall be preserved in its undisturbed and uncompacted condition.
- Depending on where the topsoil comes from, or what vegetation was on site before disturbance, invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.
- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhizal are acclimated to the site and will provide optimum conditions for establishing grasses. Commercially available mycorrhiza products should be used when topsoil is brought in from off-site.

Design and Installation Specifications

If topsoiling is to be done, the following items should be considered:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil depth shall be at least 8" with a minimum organic content of 10% dry weight and pH between 6.0 and 8.0 or matching the pH of the undisturbed soil. This can be accomplished either by returning native topsoil to the site and/or incorporating organic

amendments. Organic amendments should be incorporated to a minimum 8" depth except where tree roots or other natural features limit the depth of incorporation. Subsoils below the 12" depth should be scarified at least 2" to avoid stratified layers, where feasible. The decision to either layer topsoil over a subgrade or incorporate topsoil into the underlying layer may vary depending on the planting specified.

- If blended topsoil is imported, then fines should be limited to 25% passing through a #200 sieve.
- The final composition and construction of the soil system will result in a natural selection or favoring of certain plant species over time. For example, recent practices have shown that incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.
- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.
- Allow sufficient time in scheduling for topsoil to be spread prior to seeding, sodding, or planting.
- Care must be taken not to apply to subsoil if the two soils have contrasting textures. Sandy topsoil over a clay subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough.
- If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method to prevent a lack of bonding is to actually work the topsoil into the layer below for a depth of at least 6".
- Ripping or re-structuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system. Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, clayey loam). Areas of natural ground water recharge should be avoided.
- Stripping shall be confined to the immediate construction area. A 4" to 6" stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping. Stockpiling of topsoil shall occur in the following manner:
  - Side slopes of the stockpile shall not exceed 2:1.
  - An interceptor dike with gravel outlet and silt fence shall surround all topsoil stockpiles between October 1 and April 30. Between May 1and September 30, an interceptor dike with gravel outlet and silt fence shall be installed if the stockpile will remain in place for a longer period of time than active construction grading.
  - Erosion control seeding or covering with clear plastic or other mulching materials of stockpiles shall be completed within 2 days (October 1 through April 30) or 7 days (May 1 through September 30) of the formation of the stockpile. Native topsoil stockpiles shall not be covered with plastic. Topsoil shall not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- Previously established grades on the areas to be topsoiled shall be maintained according to the approved plan.
- When native topsoil is to be stockpiled and reused the following should apply to ensure that the mycorrhizal bacterial, earthworms, and other beneficial organisms will not be destroyed:
  1. Topsoil is to be re-installed within 4 to 6 weeks;
  2. Topsoil is not to become saturated with water;
  3. Plastic cover is not allowed.

Maintenance Standards

Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.

BMP 250: Poly-acryl amide (PAM) for Soil Erosion Protection

Purpose

Poly-acryl amide (PAM) is used on construction sites to prevent soil erosion. Applying PAM to bare soil in advance of a rain event significantly reduces erosion and controls sediment in 2 ways. First, PAM increases the soil's available pore volume, thus increasing infiltration and reducing the quantity of stormwater runoff. Second, it increases flocculation of suspended particles and aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.

PAM used for coagulation or flocculation of sediment pond waters helps remove solids (such as sediment or organic materials) that have been picked up during stormwater runoff of areas above the pond. See Chapter 4 BMPs and Appendix D for additional information on chemical treatments and ponds.

Conditions of Use

PAM shall not be directly applied or allowed to enter a water body. In areas that drain to a sediment pond, PAM can be applied to bare soil under the following conditions:

- During rough grading operations
- Staging areas
- Balanced cut and fill earthwork
- Haul roads prior to placement of crushed rock surfacing
- Compacted soil road base
- Stockpiles
- After final grade and before paving or final seeding and planting
- Pit sites
- Sites having a winter shut down.

In the case of winter shut down, or where soil will remain unworked for several months, PAM should be used with mulch.

Design and Installation Specifications

Not all jurisdictions allow anything other than water to control dust.

PAM may be applied dissolved in water, or it may be applied as a dry grain or powder. The preferred application method is the dissolved form. PAM should be applied at a maximum rate of 80 mg/L per 1 acre of bare soil.

The table below can be used to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM **do not** provide any additional effectiveness.

Table 6: PAM and Water Application rates

Disturbed Area	PAM	Water
0.50 acres	0.33 lbs	500 gallons
1.00 acres	0.66 lbs	1,000 gallons
1.50 acres	1.00 lbs	1,500 gallons
2.00 acres	1.32 lbs	2,000 gallons
2.50 acres	1.65 lbs	2,500 gallons
3.00 acres	2.00 lbs	3,000 gallons
3.50 acres	2.33 lbs	3,500 gallons
4.00 acres	2.65 lbs	4,000 gallons
4.50 acres	3.00 lbs	4,500 gallons
5.00 acres	3.33 lbs	5,000 gallons

The Preferred Application Method:

- Pre-measure the area where PAM is to be applied and, using the table above, calculate the amount of product and water necessary to provide coverage.

- PAM has infinite solubility in water, but dissolves very slowly. Dissolve pre-measured dry granular PAM with a known quantity of clean water in a bucket several hours or overnight before applying. Mechanical mixing will help dissolve the PAM. Always add PAM to water - not water to PAM.
- Pre-fill the water tank about 1/8 full with water. The water does not have to be potable, but it must have relatively low turbidity – in the range of 20 NTU or less.
- Add PAM-water mixture to the tank
- Completely fill the water truck to specified volume.
- Spray the final PAM solution onto dry soil until the soil surface is uniformly and completely wetted.

An Alternate Application Method:

PAM may also be applied as a powder at the rate of 5 pounds per acre. This must be applied on a day that is dry. For areas less than 5-10 acres in size, a hand-held "organ grinder" fertilizer spreader set to the smallest setting will work best. Tractor-mounted spreaders will work for larger areas.

The following shall be used for application of PAM:

- PAM shall be used as a replacement for other BMPs.
- Do not use PAM on a slope that flows directly into a stream or wetland. All stormwater runoff shall pass through a sediment control BMP prior to discharging to surface waters such as ponds, creeks, streams, and rivers.
- Do not add PAM to water discharging from site.
- When the total drainage area is greater than or equal to 5 acres, PAM-treated areas shall drain to a sediment pond.
- Areas less than 5 acres in size shall drain to sediment control BMPs, such as minimum of 3 check dams per acre. The total number of check dams used shall be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam shall be spaced evenly in the drainage channel through which stormwater flows are discharged off-site.
- On all sites, the use of perimeter sediment controls shall be maximized to limit the discharges of sediment from the site.
- All areas not being actively worked shall be covered and protected from rainfall.
- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.
- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in 3 months after exposure to sunlight and air.
- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.
- PAM, when combined with water, is extremely slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over-spray from reaching pavement as pavement then will become slippery. If PAM powder gets on skin or clothing, wipe it off with a dry, rough towel rather than attempting to wash off with water as the moisture will make clean-up messier and take longer.
- Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.

The specific PAM copolymer formulation must be anionic. **Cationic PAM shall not be used in any application because of known aquatic toxicity problems.** Only the highest drinking-water-grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications. Recent media attention and high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer." All PAM are polymers, but not all polymers are PAM. And not all PAM products comply with ANSI/NSF Standard 60. If PAM use is called for on a project, its use shall be reviewed and approved by the local permitting authority before application to the site.

- PAM designated for these uses should be "water-soluble" or "linear" or "non-cross-linked." Cross-linked or water absorbent PAM, polymerized in highly acidic (pH smaller than 2) conditions, are used to maintain soil moisture content.

- The PAM anionic charge density may vary from 2%-30%; a value of 18% is typical. Studies conducted by the United States Department of Agriculture (USDA)/ARS demonstrated that soil stabilization was optimized by using very high molecular weight (12-15 mg/mole), highly anionic (over 20% hydrolysis) PAM.
- PAM tackifiers are available and being used in place of guar and alpha plantago. Typically, PAM tackifiers should be used at a rate of no more than 0.5-1 lb. per 1000 gallons of water in a hydro-mulch machine. Some tackifier product instructions say to use at a rate of 3 to 5 pounds per acre, which can be too much. In addition, pump problems can occur at higher rates due to increased viscosity.

Maintenance Standards

- PAM may be reapplied on actively worked areas after a 48-hour period.
- Re-application is not required unless PAM-treated soil is disturbed or unless turbidity levels show the need for an additional application.
- If PAM-treated soil is left undisturbed a reapplication may be necessary after 2 months. More PAM applications may be required for steep slopes, silty and clayey soils (USDA Class Type "C" and "D" soils), long grades, and high precipitation areas. When PAM is applied first to bare soil and then covered with straw, a re-application may not be necessary for several months.
- Loss of sediment and PAM may be a basis for penalties.
- Requires inspection after each rainfall event to determine if re-application is needed.
- Over-application can create or increase runoff due to reduced infiltration.

BMP 260: Surface Roughening

Purpose

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping through the provision of a rough soil surface. Perpendicular depressions to the slope should be created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition.

Conditions for Use

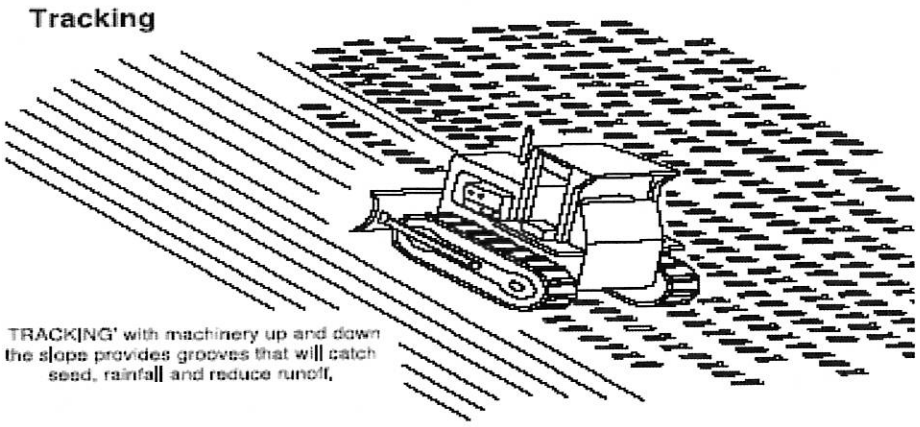
- All slopes steeper than 3:1 and greater than 5'-0" vertical should be roughened to a depth of 2" to 4" prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

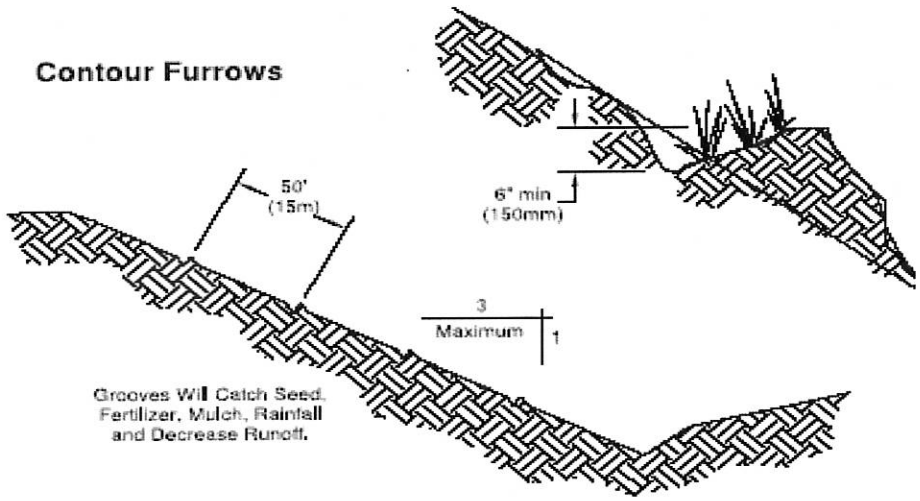
Design and Installation Specifications

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, gradient terracing (BMP 261), grooving, contour furrows, and tracking. See the figure on the next page for tracking and contour furrows.

Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can





become established. Stairs should be wide enough to work with standard earth moving equipment. Stair-steps must be on contour or gullies will form on the slope. Steps should be wider than the vertical cut and their slope should lay back towards the vertical cut.

- Areas that will be mowed (these areas should have slopes less steep than 3:1) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.
- Graded areas with slopes larger than 3:1 but smaller than 2:1 should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.
- Grooving can be accomplished using a plow with furrows 3" deep and less than 15" apart.
- Surface roughening should NOT be done with soils with high clay contents.
- All disturbed areas on slopes should be immediately seeded, sodded, mulched, and/or chemically-stabilized once all work has been completed.

Maintenance Standards

- Areas that are graded in this manner should be seeded as quickly as possible.
- Inspections should be made of the area after each rain event until the site is stabilized. If rills appear, they should be re-constructed, re-graded and re-seeded immediately.

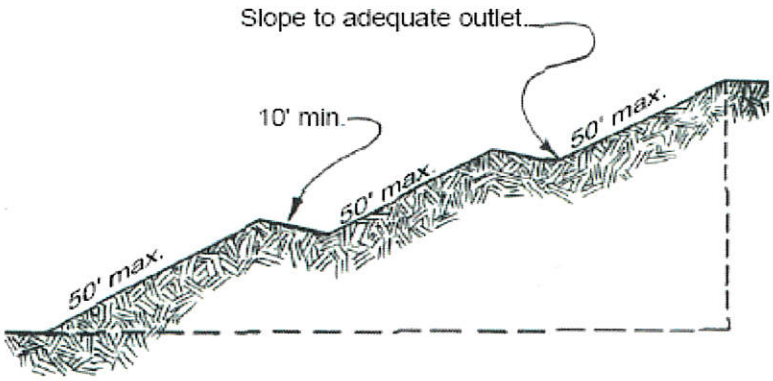
BMP 261: Gradient Terraces

Purpose

Gradient terraces reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a non-erosive velocity.

Conditions of Use

Gradient terraces normally are limited to denuded land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance. Gradient terraces may be used only where suitable outlets are or will be made available. See the figure on the right for an example of gradient terraces.



Design and Installation Specifications

- The maximum spacing of gradient terraces should be determined by the following method where:

  VI = 0.8s

  VI = vertical interval in feet
  s = land rise per 100'-0", expressed in feet

- The top of the constructed ridge should not be lower at any point than the design elevation plus the specified overfill for settlement. The opening at the outlet end of the terrace should have a cross section equal to that specified for the terrace channel.
- Channel grades may be either uniform or variable with a maximum grade of 7.5" per 100'-0" length. For short distances, terrace grades may be increased to improve alignment. The channel velocity should not exceed that which is non-erosive for the soil type with the planned treatment.
- All gradient terraces should have adequate outlets. Such an outlet may be a grassed waterway, vegetated area, or tile outlet.
- In all cases the outlet must convey runoff from the terrace or terrace system to a point where the outflow will not cause damage. Vegetative cover should be used in the outlet channel.
- The design elevation of the water surface of the terrace should not be lower than the design elevation of the water surface in the outlet at their junction, when both are operating at design flow.
- Vertical spacing determined by the above methods may be increased as much as 6" or 10%, whichever is greater, to provide better alignment or location, to avoid obstacles, to adjust for equipment size, or to reach a satisfactory outlet.
- The drainage area above the top should not exceed the area that would be drained by a terrace with normal spacing.
- The terrace should have enough capacity to handle the peak runoff expected from a 2-year, 24-hour design storm without overtopping.
- The terrace cross-section should be proportional to the land slope. The ridge height should include a reasonable settlement factor. The ridge should have a minimum top width of 36" at the design height. The minimum cross-sectional area of the terrace channel should be 8 square feet for land slopes flatter than 5%; 7 square feet for slopes from 5% to 8%; and 6 square feet for slopes steeper than 8%. The terrace should be wide enough for be maintenance using a small dozer.

Maintenance Standards

- Maintenance should be performed as needed.
- Terraces should be inspected regularly: at least once a year, and after large storm events.