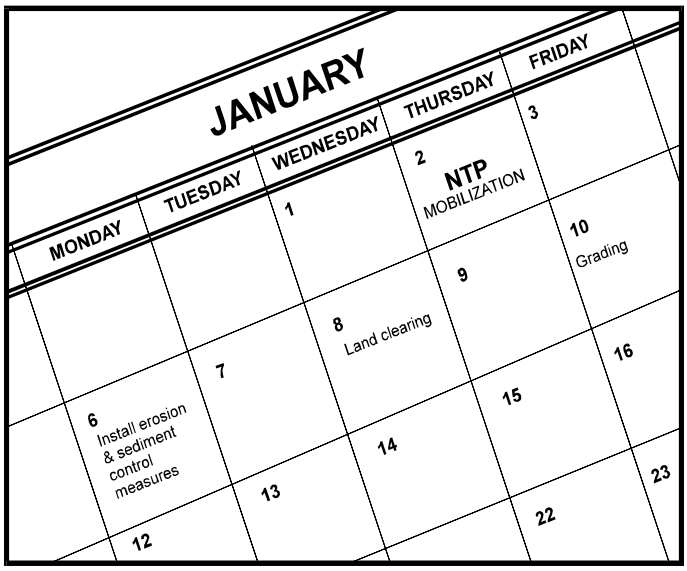
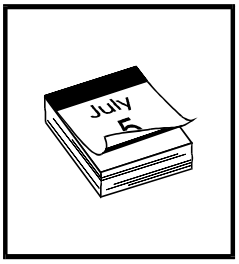
Scheduling SS-1





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

This BMP involves developing a schedule for every project that includes sequencing of construction activities with the implementation of construction site BMPs such as temporary soil stabilization (erosion control) and temporary sediment controls measures. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

Appropriate Applications

Any construction project where soils will be disturbed will benefit from a BMP sequencing schedule that is generated in conjunction with the construction-sequencing schedule. BMP sequencing can help minimize land disturbance during construction.

Limitations

The BMP sequencing schedule must be agreed upon between MDT and the construction contractor. BMP scheduling is only effective if the scheduled is followed closely and modified as required throughout the construction project.

Design Guidelines and Considerations

- Plan the project and develop an implementation schedule of construction site BMPs. The schedule is designed to clearly show how the BMPs relate to soil-disturbing and re-stabilization activities. The construction schedule is typically incorporated into the SWPPP.
- A BMP schedule includes details on the implementation and deployment of:
  - temporary soil stabilization BMPs,
  - temporary sediment control BMPs,

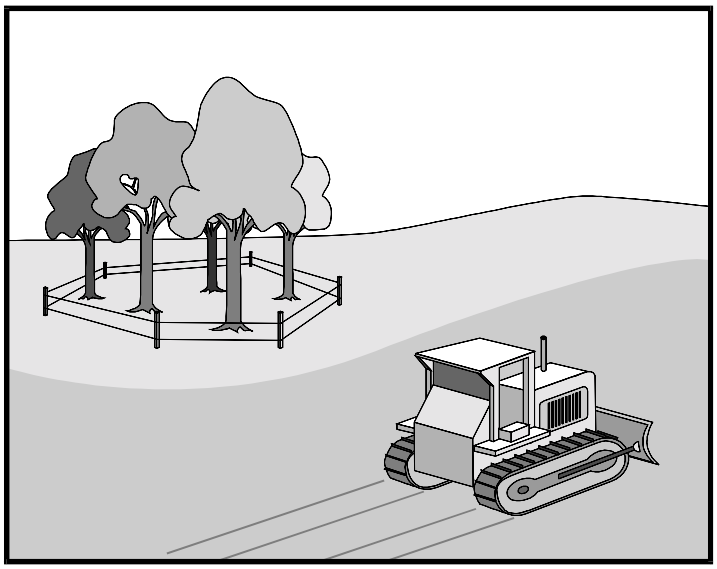
- tracking control BMPs,
- wind erosion control BMPs,
- non-storm water BMPs, and
- waste management and materials pollution control BMPs.

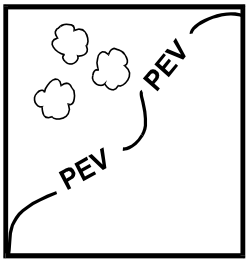
- Also included in the BMP schedule are dates for significant long-term operations or activities that may have planned non-storm water discharges such as dewatering, saw cutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, bridge cleaning, etc.
- Coordinate sequencing and create a timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, pouring foundations, installing utilities, etc., to minimize the active construction area during the peak storm seasons.
- Stabilize non-active areas as soon as practical.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment controls on all disturbed areas prior to the onset of rain.
- Be prepared year-round to deploy soil stabilization and sediment control practices. Erosion may be caused during dry seasons by unseasonable rainfall, wind, and vehicle tracking. Keep the site stabilized year-round, and retain and maintain sediment trapping devices in operational condition.
- Trenching of utility lines is often required on construction projects. Sequence trenching and excavation activities so that most open portions are closed before new trenching or excavations begin.
- Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
- Consider scheduling when establishing permanent vegetation (appropriate planting time for specified vegetation).
- Schedule BMP Maintenance, Inspection, and Removals.

Maintenance, Inspection, and Removal

- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted or when directed by the Engineer.
- Include anticipated BMP removal information on the schedule.

Preservation of Existing Vegetation SS-2





BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Preservation of existing vegetation relates to the identification and protection of desirable vegetation. Benefits of preservation of existing vegetation include minimizing disturbance on construction sites, erosion control, detention, and infiltration of storm water, biofiltration, velocity dissipation and aesthetic value.

Appropriate Applications

- Preserve existing vegetation at areas on a site where no construction activity is planned or where activities may occur at a later date.
- Beneficial for use in wetlands, floodplains, stream banks, steep slopes and other areas where erosion controls would be difficult to establish, install, or maintain.
- Preservation of existing vegetation is also used to maintain pre-construction drainage patterns to avoid vegetation die off as a result of water flows being intercepted and diverted away from the existing vegetation.
- On a year-round basis, temporary fencing can be installed prior to clearing and grubbing operations or other soil-disturbing activities in areas where no construction activity is planned or will occur later. Upon Engineer's approval, flagging or verbal designation of vegetation preservation areas may be substituted for temporary fencing.
- No grading or disturbances occurs in areas identified on the plans to be preserved.
- Protection of existing vegetation requires planning, and may limit the area available for construction activities.

Design Guidelines and Considerations

- Preservation of existing vegetation is best provided prior to the commencement of clearing and grubbing operations or other soil-disturbing activities in areas where no construction activity is planned or will occur later.

- Preservation of existing vegetation needs to conform to scheduling requirements set forth in the special provisions.

- Mark areas to be preserved with temporary fencing made of orange polypropylene that is stabilized against ultraviolet light. MDT Standard Specifications and Detail Drawings outline the installation of temporary fencing.

- Minimize the disturbed areas by locating temporary roadways to avoid stands of trees and shrubs and to follow existing contours to reduce cutting and filling.

- Consider the impact of grade changes to existing vegetation and the root zone.

- Locate construction materials, equipment storage, and parking areas to minimize root compaction. Staging areas should be selected to avoid negatively impacting large areas of existing vegetation.

- Keep equipment away from trees to prevent trunk and root damage.

- Maintain existing irrigation systems.

- Protective devices are only effective if all personnel understand and honor them. No heavy equipment, vehicular traffic, or stock piles of construction materials shall be permitted within the drip line of trees. Removed trees shall not be felled, pushed, or pulled into any retained trees. Fires shall not be permitted within 30 m (100 ft) of the drip line of any retained trees. No toxic or construction materials - including paint, acid, nails, gypsum board, chemicals, fuels, and lubricants - shall be stored within 15 m (50 ft) of the drip line of any retained trees, nor shall they be disposed of in any way which would injure vegetation.

Maintenance, Inspection, and Removal

- During construction, clearly marked limits of disturbance should be observable at all times. Irrigate or maintain the existing vegetation in conformance to the requirements in the landscaping plan. If damage to protected trees still occurs, notify the MDT Agronomist and arrange for any repairs. Remove fencing and flagging according to the BMP removal schedule.

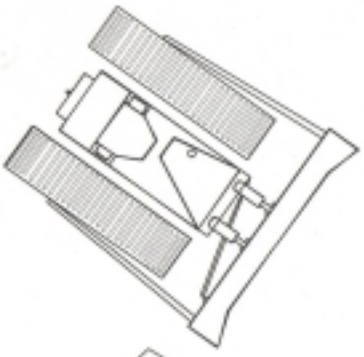
SYMBOL: ——————— ———PEV———

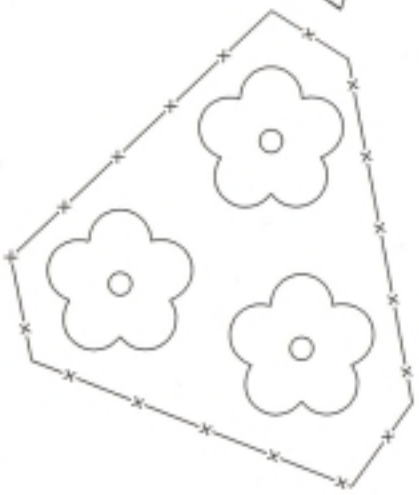
PRESERVATION OF EXISTING VEGETATION SS-21

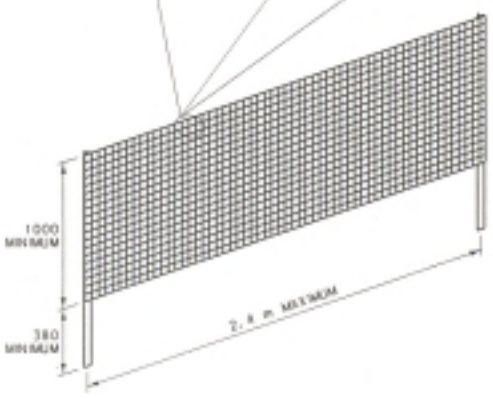
PRESERVATION OF EXISTING VEGETATION IS THE IDENTIFICATION AND PROTECTION OF DESIRABLE VEGETATION THAT PROVIDES EROSION AND SEDIMENT CONTROL BENEFITS. PROVIDE PRESERVATION OF EXISTING VEGETATION PRIOR TO COMMENCEMENT OF CLEARING AND GRUBBING OPERATIONS OR OTHER SOIL DISTURBING ACTIVITIES. MARK THE AREA AS DESIGNATED ON THE CONSTRUCTION PLANS USING TEMPORARY FENCING MADE OF ORANGE POLYPROPYLENE THAT IS STABILIZED AGAINST ULTRAVIOLET LIGHT. AFFIX FENCING TO METAL "T" POST USING 3.05 mm WIRE. PLACE FENCING AN ADEQUATE DISTANCE FROM TREES AND BUSHES TO PREVENT ROOT AND IRRIGATION SYSTEM DAMAGE.

UPON WRITTEN APPROVAL BY THE ENGINEER, THE CONTRACTOR MAY BE ALLOWED TO FLAG OR VERBALLY DESIGNATE AREAS OF EXISTING VEGETATIVE PRESERVATION.

PRESERVATION OF EXISTING VEGETATION MAY BE USED IN CONJUNCTION WITH VEGETATIVE BUFFER (SS-14), WIND EROSION CONTROL (WE-1) AND SNOW ACCUMULATION (SN-1).





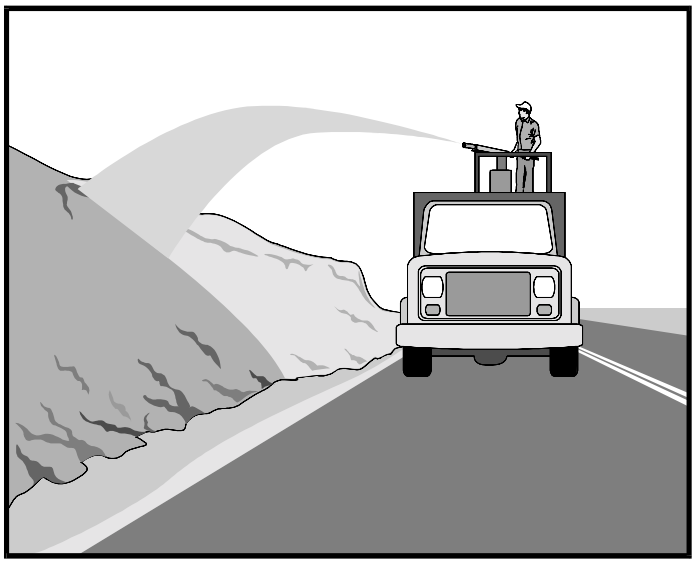


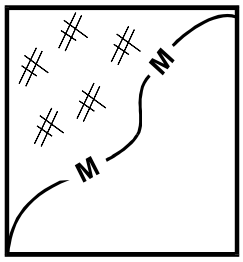
PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-22
PRESERVATION OF EXISTING VEGETATION ISS-21	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

Hydraulic Mulch SS-3





BMP Objectives
- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Hydraulic mulch consists of applying a mixture of small pieces of cellulose fibers that can be made from shredded wood fiber or recycled paper and a stabilizing emulsion and tackifier (if desired) with hydro-mulching equipment. This will protect exposed soil from erosion by raindrop impact or wind. Mulching can also provide protection and warmth for seed growth.

Appropriate Applications

- Hydraulic mulch is applied to disturbed areas requiring temporary protection until permanent vegetation is established or to disturbed areas that must be re-disturbed.
- Avoid use in areas where the mulch would be incompatible with immediate earthwork activities and would have to be removed.
- Hydraulic mulch is most effective when used in conjunction with erosion or temporary seeding applications.

Limitations

- Wood fiber hydraulic mulches are generally short-lived (only last a part of a growing season).
- Hydraulic matrices need 24 hours to dry before rainfall occurs to be effective.

Design Guidelines and Considerations

- Prior to application, roughen embankment and fill areas by rolling with a crimping, punching type roller, or by track walking. Track walking shall only be used where other methods are impractical.
- Avoid mulch over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.

- Selection of hydraulic mulches by the Contractor must be approved by the Engineer.

- Materials for wood fiber based hydraulic mulches and hydraulic matrices shall conform to MDT Standard Specifications.

- Refer to BMP SS-5 (Soil Binder) for tackifier requirements.

- Recycled paper mulch must contain 100% post-consumer paper.

Hydraulic Mulches

- Wood cellulose fiber mulch and recycled paper fiber mulch shall conform to MDT Standard Specifications.

- Apply as a liquid slurry using a hydraulic application machine (i.e., hydroseeder). Follow manufacture's recommendations for application rates, for mulch and stabilizing emulsion, to achieve complete coverage of target area.

Hydraulic Matrices

- Apply a wood fiber base layer and a paper fiber top layer, both mixed with acrylic polymers as binders. Apply as a liquid slurry using a hydraulic application machine (i.e., hydroseeder) at minimum rate of 841 kg/ha (750 lb/acre) wood fiber mulch, 1,140 kg/ha (1020 lb/acre) recycled paper mulch and 520 liters/ha (55 gal/acre) of acrylic copolymer or as specified by the special provisions, to achieve complete coverage of the target area.

- Alternatively, a bonded fiber matrix shall be applied at the rate specified in the special provisions. The bonded fiber matrix shall be applied at a rate of 3,400 to 4,500 kg/ha (3025 to 4000 lbs/acre) based on manufacturers recommendation, to achieve complete coverage of the target area unless specified in the special provision. Do not apply immediately before, during, or after a rainfall.

Maintenance, Inspection, and Removals

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when soils are not being reworked. Inspect mulch before expected rain storms and repair any damaged ground cover and re-mulch exposed areas.

- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

SYMBOL:

HYDRAULIC MULCH SS-3

HYDRAULIC MULCH CONSISTS OF APPLYING A MIXTURE OF SMALL PIECES OF CELLULOSE FIBERS WHICH CAN BE MADE FROM SHREDDED WOOD FIBERS OR RECYCLED PAPER AND A STABILIZING EMULSION AND TACKIFIER (SUBJECT TO ENGINEERS DISCRETION) USING HYDRO-MULCHING EQUIPMENT. HYDRAULIC MULCH IS APPLIED TO DISTURBED AREAS REQUIRING TEMPORARY PROTECTION UNTIL PERMANENT VEGETATION IS ESTABLISHED OR DISTURBED AREAS THAT MUST BE RE-DISTURBED FOLLOWING AN EXTENDED PERIOD OF INACTIVITY.

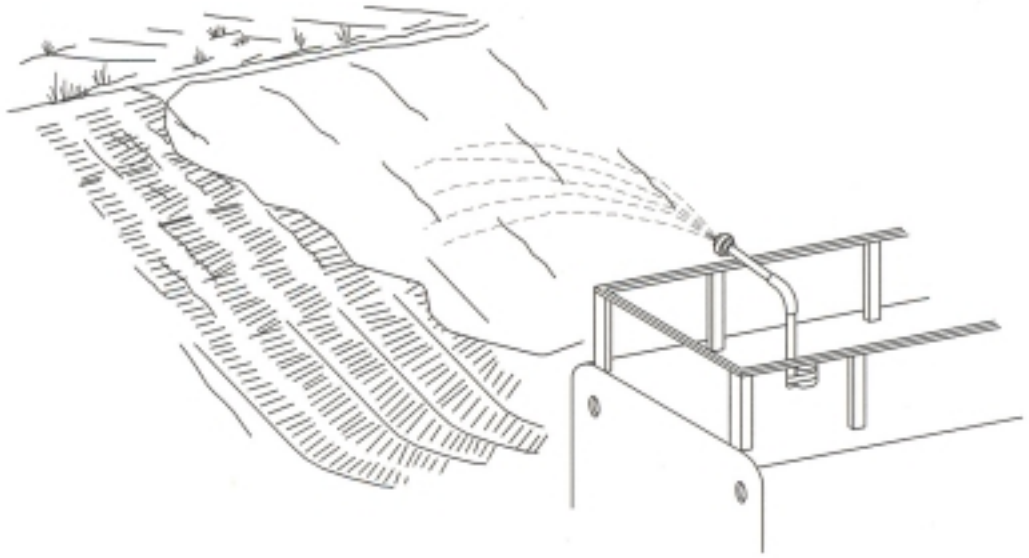
APPLY HYDRAULIC MULCH A MINIMUM OF 24 HOURS PRIOR TO A STORM EVENT TO ALLOW FOR ADEQUATE DRYING.

HYDRAULIC MULCH SELECTION MUST MEET MDT SPECIFICATIONS AND BE APPROVED BY THE ENGINEER PRIOR TO PLACEMENT. ROUGHEN EXISTING EMBANKMENT FOLLOWING GUIDELINES SPECIFIED IN BMP SS-12. WHEN EITHER TEMPORARY SEEDING OR PERMANENT SEEDING IS COMBINED WITH THE HYDRAULIC MULCH BMP, COMPLETE SEEDING OPERATIONS PRIOR TO HYDRAULIC MULCHING OPERATIONS. REFER TO BMPs SS-4 AND SS-5 FOR SEEDING REQUIREMENTS. REMOVE ANY OVER SPRAY FROM ROADWAYS OR SIDEWALKS IMMEDIATELY FOLLOWING APPLICATION.

REAPPLY HYDRAULIC MULCH TO ANY DISTURBED AREAS FOLLOWING A RAIN EVENT OR RESULTING FROM CONSTRUCTION ACTIVITIES.

RECYCLED PAPER MULCH SHOULD CONTAIN 100% POST CONSUMED PAPER.

REFER TO BMP SS-5 (SOIL BINDER) FOR TACKIFIER REQUIREMENTS. ADD ENVIRONMENTALLY SAFE GREEN DYE AS A VISUAL AID DURING APPLICATION.



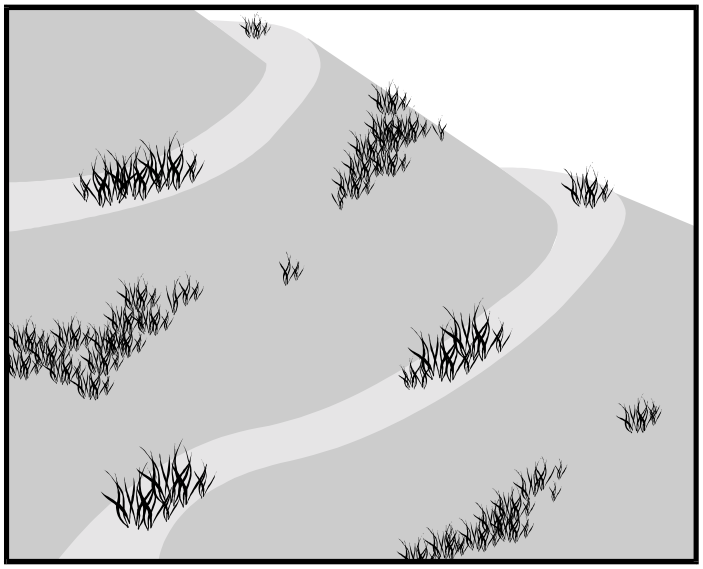
HYDRAULIC MULCH		
PRODUCT	MATERIAL	APPLICATION RATE *
PAPER-BASED HYDRAULIC MULCH	PAPER	1 120 kg/ha (MIN)
WOOD-BASED HYDRAULIC MULCH	WOOD OR WOOD & PAPER	1 120 kg/ha (MIN)

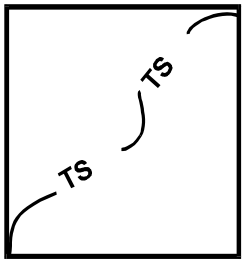
* APPLICATION RATES VARY WITH SLOPE & MUST BE APPROVED BY THE ENGINEER

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-??
HYDRAULIC MULCH (SS-3)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Temporary Seeding SS-4





BMP Objectives
- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Well-established vegetative cover is one of the best erosion control measures available. **Temporary seeding** is the establishment of a temporary vegetative cover on areas with a **slope of 3:1** or flatter that will be exposed for longer than 14 days and that will undergo further disturbance. Temporary seeding is not the same as erosion seeding. **Erosion seeding** (as shown in SS-15) is the immediate seeding of freshly exposed cut and fill **slopes steeper than 3:1** that will not undergo further disturbance. Cereal barley is used as the vegetative cover for temporary seeding. Erosion seeding uses a mixture of seed.

Appropriate Applications

- Temporary seeding is used on disturbed areas requiring temporary protection until permanent vegetation is established, or areas that must be re-disturbed following an extended period of inactivity. Temporary seeding can provide rapid erosion protection on disturbed areas. Once established temporary seeding also traps sediments, promotes infiltration, and improves the appearance of the site. Temporary seeding is a relatively inexpensive erosion control measure.

Limitations

- Rock slopes that cannot be excavated by ripping are not temporarily seeded.
- Temporary seeding may not be appropriate in dry areas or periods without supplemental irrigation.
- Areas impacted by construction traffic will not have successful vegetative growth.
- Temporary seeding should only be utilized when there is sufficient time and conditions are favorable for the vegetation to become established.

- Mulching may be necessary in addition to temporary seeding during the establishment of vegetation because temporary vegetation takes several weeks to establish.

- Steep slopes are not to be seeded with the temporary seeding mix. Erosion seeding shall be substituted for temporary seeding when slopes steeper than 3:1.

- Temporary vegetation is not appropriate for short-term inactivity (less than 14 days).

- Seeding applications may require fertilizer to establish on poor quality soils.

Design Guidelines and Considerations

- Seeding dates and application rates are as follows:

April 1 – June 30	Cereal Barley – 13.5 kg/ha (12.0 lbs/ac)
July 1 – August 31	Temporary Seeding Not Recommended
Sept. 1 – Nov. 15	Cereal Barley – 13.5 kg/ha* (12.0 lbs/ac)

* Do not temporary seed in this timeframe if the area is to be permanently seeded that fall.

- Contact the MDT agronomist, through the Engineer, prior to using substitutions or placing temporary seeding outside these dates. Substitutions shall be approved in writing by the Engineer during the construction phase.

- Drill seed slopes of 3:1 or flatter.

- Following to application, roughen the slopes, or areas to be seeded with the furrows trending along the contours.

- Mulch should be considered in combination with temporary seeding to enhance plant establishment. Mulch will help keep seeds in place and will moderate soil moisture and temperature until the seeds germinate.

- All seeds shall be in conformance with MDT Standard Specifications. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, manufacture's guarantee, and dates of test.

- Follow-up applications shall be made as needed to cover spots of poor germination, and to maintain adequate soil protection.

Maintenance, Inspection, and Removal

- All seeded areas shall be inspected for failures, re-seeded, and mulched within the planting season, using no less than half the original application rates. Any temporary seeding efforts that do not provide adequate cover must be revegetated as required by the Engineer.

- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

SYMBOL: ———————— ———TS———

TEMPORARY SEEDING SS-4:

TEMPORARY SEEDING IS THE ESTABLISHMENT OF A TEMPORARY VEGETATIVE COVER BY SEEDING WITH CEREAL BARLEY. USE TEMPORARY SEEDING ON AREAS 3:1 OR FLATTER THAT WILL BE EXPOSED FOR LONGER THAN 14 DAYS AND THAT WILL UNDERGO FURTHER DISTURBANCE. EXCLUDE ROCK SLOPES THAT CANNOT BE EXCAVATED BY RIPPING.

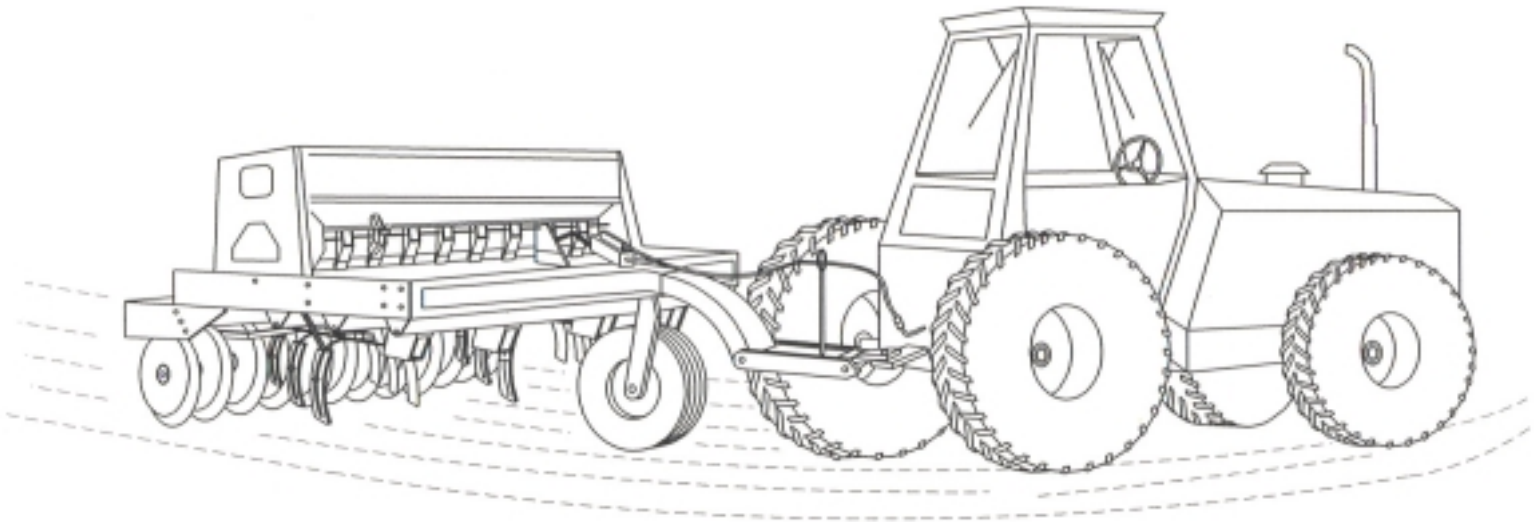
SEEDING DATES AND APPLICATION RATES ARE AS FOLLOWS:

APR. 1 TO JUN. 30: CEREAL BARLEY AT 13.5 kg/ha
JUL. 1 TO AUG. 31: TEMPORARY SEEDING NOT RECOMMENDED
SEP. 1 TO NOV. 15: CEREAL BARLEY AT 13.5 kg/ha

DO NOT TEMPORARY SEED FROM SEP. 1 TO NOV. 15 IF THE AREA IS TO BE PERMANENTLY SEEDED THAT FALL.

CONTACT THE MDT AGRONOMIST, THROUGH THE ENGINEER, PRIOR TO USING SUBSTITUTIONS OR PLACING TEMPORARY SEEDING OUTSIDE THESE DATES. DRILL SEED SLOPES OF 3:1 OR FLATTER. FOR SLOPES STEEPER THAN 3:1, REFER TO EROSION SEEDING.

ANY TEMPORARY SEEDING EFFORTS THAT DO NOT PROVIDE ADEQUATE COVER MUST BE RE SEEDED AS REQUIRED BY THE ENGINEER.



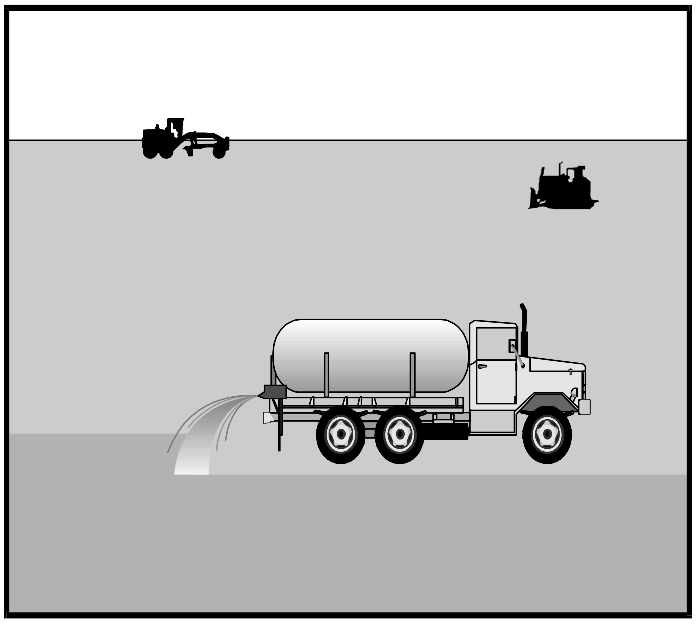
SLOPES 3:1 OR FLATTER

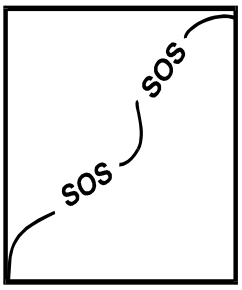
PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
TEMPORARY SEEDING (SS-4)	
EFFECTIVE:	

CDM Camp Dresser & McKee Inc.

Soil Binder SS-5





BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Soil binders consist of applying and maintaining polymeric or lignin sulfonate soil stabilizers or emulsions. Soil binders are materials applied to the soil surface to temporarily prevent water-induced erosion of exposed soils on construction sites. Soil binders typically also provide dust, wind, and soil stabilization (erosion control) benefits.

Appropriate Applications

Soil binders are applied to disturbed areas requiring short-term protection. Because soil binders can often be incorporated into the earth work, they may be a good choice for areas where grading activities will soon resume.

Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time as prescribed by the manufacturer, which may be 24 hours or longer until fully effective.
- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Soil binders do not hold up to pedestrian or vehicular traffic across treated areas.
- Soil binders may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.

- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.

- Soil binders may not cure if low temperatures occur within 24 hours of application.

Design Guidelines and Considerations

General Considerations

- Regional soil types will dictate which soil binders are appropriate for use.

- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and shall not stain paved or painted surfaces.

- Some soil binders are compatible with existing vegetation.

- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.

- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on the Detail Drawings.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders. Soil binders may also be used for dust control using the provided dust control application rates. The dust control application rates will not be adequate to provide protection from water-induced erosion.

- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.

- Frequency of application - The frequency of application can be affected by subgrade conditions, surface type, traffic volumes, climate, and maintenance schedule. Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean-up.

- After considering the above factors, the soil binders are generally appropriate as follows:

  - *Copolymer:* Appropriate for long term soil stabilization in areas where cross-traffic might occur, or where stabilization needs to be achieved in conjunction with preserving existing vegetation. Longevity can be up to 2 years, it has a high resistance to abrasion,

and is compatible with existing vegetation. However, it is also relatively costly which makes it less desirable for short-term or frequent applications.

- *Lignin sulfonate:* Appropriate for short- or medium-term soil stabilization applications in low traffic areas. The moderate relative cost makes it less desirable to reapply frequently, though it typically lasts longer than psyllium or guar. With only moderate penetration and a low resistance to abrasion, it would be more suited to areas which will not be disturbed frequently by construction activities. Lignin sulfonate can have an unpleasant odor when applied.
- *Psyllium/Guar:* Appropriate for typical soil stabilizing situations or short-term applications. Because of the relatively low cost, they can be applied more frequently. Their high penetration provides good stabilization, but their moderate resistance to abrasion limits their longevity. They are not very compatible with vegetation.

Applying Soil Binders

After selecting an appropriate soil binder, the untreated soil surface must be prepared before application. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. Refer to manufacture's specifications, but in general, the following steps shall be followed:

- Follow manufacturer's recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.

- Prior to application, roughen embankment and fill areas. Track walking shall only be used where rolling is impractical.

- Soil binders shall not be applied during or immediately before rainfall.

- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.

- Do not apply soil binders to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 4^0C (40^0F).

- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.

- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's specifications for specific cure times.

- For liquid agents:

  - Crown or slope ground to avoid large depressions.

  - Uniformly pre-wet ground at 0.14 to 1.4 l/m^2 (0.003 to 0.03 gal/ft^2) or according to manufacturer's recommendations.

  - Apply solution under pressure. Overlap solution 150 to 300 mm (6 to 12 in).

  - Allow treated area to cure for the time recommended by the manufacturer, typically, at least 24 hours.

- Apply second treatment before first treatment becomes ineffective, using 50% application rate.

- In low humidities, reactivate chemicals by re-wetting with water at 0.5 to 0.9 l/m^2 (0.01 to 0.02 gal/ft^2).

Maintenance, Inspection, and Removal

- Reapplying the selected soil binder may be needed for proper maintenance. High traffic areas shall be inspected on a daily basis, and lower traffic areas should be inspected on a weekly basis.

- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

SYMBOL:

SOIL BINDERS SS-5:

SOIL BINDERS CONSIST OF APPLYING AND MAINTAINING POLYMERIC OR LIGNIN SULFONATE SOIL STABILIZERS OR EMULSIONS. SOIL BINDERS ARE MATERIALS APPLIED TO THE SOIL SURFACE TO TEMPORARILY PREVENT WATER-INDUCED EROSION OF EXPOSED SOILS ON CONSTRUCTION SITES. SOIL BINDERS TYPICALLY ALSO PROVIDE DUST, WIND AND SOIL STABILIZATION BENEFITS. BECAUSE SOIL BINDERS CAN OFTEN BE INCORPORATED INTO THE WORK, THEY MAY BE A GOOD CHOICE FOR AREAS WHERE GRADING ACTIVITIES MAY SOON RESUME.

DUE TO THE TEMPORARY NATURE OF SOIL BINDERS, REAPPLICATION MAY BE REQUIRED OVER AREAS WITH PEDESTRIAN AND VEHICLE TRAFFIC.

SOIL BINDER TYPE AND APPLICATION PROCEDURES REQUIRE THE ENGINEER'S APPROVAL PRIOR TO PLACEMENT. APPLY PER MANUFACTURES SPECIFICATIONS.

REAPPLY SOIL BINDERS, AS SPECIFIED BY THE ENGINEER, IN HIGH TRAFFIC AREAS AND FOLLOWING RAIN EVENTS TO ENSURE AN ADEQUATELY MAINTAINED SURFACE.

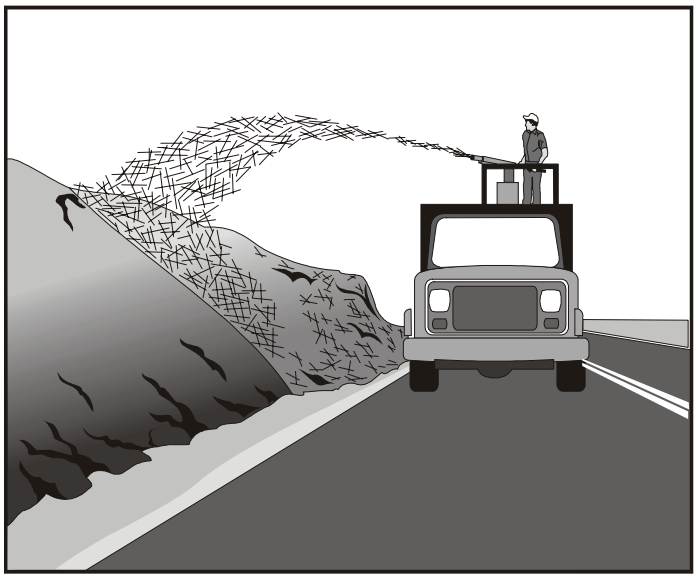
PROPERTIES OF SOIL BINDERS FOR EROSION CONTROL

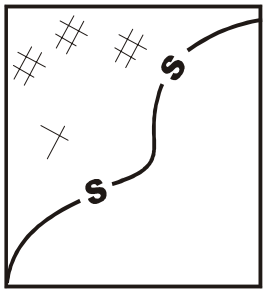
CHEMICALS	COPOLYMER	LIGNIN SULFONATE	PSYLLIUM	GUAR
COMMENTS	FORMS SEMIPERMEABLE TRANSPARENT CRUST. RESISTS ULTRAVIOLET RADIATION & MOISTURE INDUCED BREAKDOWN.	PAPER INDUSTRY WASTE PRODUCT. ACTS AS DISPERSING AGENT. BEST IN DRY CLIMATES. CAN BE SLIPPERY.	EFFECTIVE ON DRY, HARD SOILS. FORMS A CRUST.	EFFECTIVE ON DRY, HARD SOILS. FORMS A CRUST.
RELATIVE COST	HIGH	MODERATE	LOW	LOW
ENVIRONMENTAL HAZARD	LOW	LOW	LOW	LOW
PENETRATION	MODERATE	MODERATE	HIGH	HIGH
EVAPORATION	MODERATE	MODERATE	MODERATE	MODERATE
LEACHING RESISTANCE	LOW	HIGH	HIGH	HIGH
ABRASION RESISTANCE	HIGH	LOW	MODERATE	MODERATE
LONGEVITY	1 TO 2 YEARS	6 MONTHS TO 1 YEAR	3 TO 6 MONTHS	3 TO 6 MONTHS
MINIMUM CURING TIME BEFORE RAIN	24 HOURS	24 HOURS	24 HOURS	24 HOURS
COMPATIBILITY WITH EXISTING VEGETATION	GOOD	POOR	POOR	POOR
MODE OF DEGRADATION	CHEMICALLY DEGRADABLE	BIOLOGICALLY/PHYSICALLY/CHEMICALLY	BIOLOGICALLY DEGRADABLE	BIOLOGICALLY DEGRADABLE
LABOR INTENSIVE	NO	NO	NO	NO
SPECIALIZED APPL. EQUIPMENT	YES	YES	YES	YES
LIQUID/POWDER	LIQUID	POWDER	POWDER	POWDER
SURFACE CRUSTING	YES	YES, BUT DISSOLVED ON REWETTING	YES, BUT DISSOLVED ON REWETTING	YES, BUT DISSOLVED ON REWETTING
CLEAN-UP	SOLVENTS	SOLVENTS	WATER	WATER
EROSION CONTROL APPLICATION RATE	APPLY 800-1000 l/ha	APPLY 5600-6500 l/ha)	APPLY 170 kg/ha WITH 560-2200 kg/ha FIBER MULCH	APPLY 110-220 kg/ha WITH 560-2200 kg/ha FIBER MULCH
DUST CONTROL APPLICATION RATE	APPLY 280-520 l/ha	LOOSEN SURFACE 25-50 mm. NEED 4-8% FINES. APPLY 470-1900 l/ha.	APPLY 170 kg/ha.	APPLY 45-70 kg/ha.

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
SOIL BINDERS (SS-5)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Straw Mulch SS-6





BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier.

Appropriate Applications

- Straw mulch is used for soil stabilization as a temporary surface cover on disturbed areas until soils can be prepared for re-vegetation and permanent vegetation is established.
- Also typically used in combination with temporary and/or permanent seeding strategies to enhance plant establishment.

Limitations

- Availability of erosion control contractors and straw may be limited due to high demand.
- When straw blowers are used to apply straw mulch, the treatment areas must be within 45 m (150 ft) of a road or surface capable of supporting trucks.
- Straw mulch applied by hand is more time intensive and potentially costly.
- May have to be removed prior to permanent seeding or soil stabilization.
- "Punching" of straw does not work in sandy soils.

Design Guidelines and Considerations

- Straw shall be certified weed free and shall follow MDT Standard Specifications.
- A tackifier is the preferred method for anchoring straw mulch to the soil on slopes.

- Crimping, punch type rollers, or track-walking may also be used to incorporate straw mulch into the soil on slopes. Track walking shall only be used where other methods are impractical.

- Avoid placing straw onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.

- Straw mulch with tackifier shall not be applied during or immediately before rainfall.

Application Procedures

- Apply loose straw at a minimum rate of 4,490 kg/ha (4000 lbs/acre), or as indicated in the Special Provisions, either by machine or by hand distribution.

- The straw mulch must be evenly distributed on the soil surface.

- Anchor the mulch in place by using a tackifier or by "punching" it into the soil mechanically.

- A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall be selected based on longevity and ability to hold the fibers in place.

- A tackifier is typically applied at a rate of 140 kg/ha (125 lbs/ac). In windy conditions, the rates are typically 200 kg/ha (175 lbs/ac).

- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity. If the selected method is incorporation of straw mulch into the soil, then do as follows:

    - Applying and incorporating straw shall follow the requirements in MDT Standard Specifications.

    - On small areas, a spade or shovel can be used.

    - On slopes with soils, which are stable enough, and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife-blade roller or a straight bladed coulter, known commercially as a "crimper."

    - On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using wire staples, geotextile pins or wooden stakes (as described in BMP SS-7, "Geotextiles, Plastic Covers and Erosion Control Blankets/Mats").

Maintenance, Inspection, and Removals

- The key consideration in maintenance, inspection, and removal is that the straw needs to last long enough to achieve erosion control objectives.

- Reapplication of straw mulch and tackifier may be required by the Engineer to maintain effective soil stabilization over disturbed areas and slopes.

SYMBOL: ——————— ———SM———

STRAW MULCH SS-6:

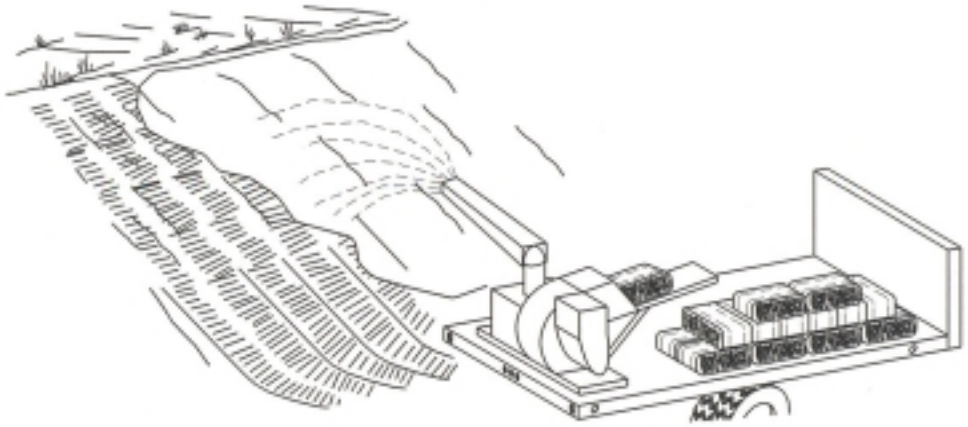
STRAW MULCH CONSISTS OF PLACING A UNIFORM LAYER OF STRAW AND ANCHORING IT INTO THE SOIL WITH A STUDDED ROLLER OR DISK OR BINDING THE STRAW TOGETHER WITH AN ENGINEER APPROVED TACKIFIER.

USE STRAW MULCH FOR SOIL STABILIZATION AS A TEMPORARY SURFACE COVER ON DISTURBED AREAS UNTIL SOILS CAN BE PREPARED OR RE-VEGETATION/PERMANENT VEGETATION IS ESTABLISHED. STRAW MULCH IS COMMONLY USED IN COMBINATION WITH TEMPORARY SEEDING, BMPs SS-4 & SS-15, AND/OR PERMANENT SEEDING TO ENHANCE PLANT ESTABLISHMENT.

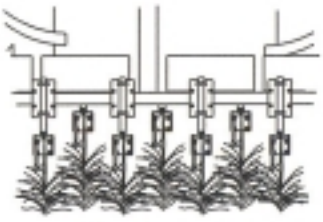
ALL STRAW MULCH IS REQUIRED TO BE CERTIFIED WEED FREE AND DERIVED FROM WHEAT, BARLEY OR RICE. ENGINEERS APPROVAL IS REQUIRED PRIOR TO ANY PLACEMENT OF STRAW MULCH.

STRAW MULCH CAN BE APPLIED BY HAND OR BLOWN UNDER LOW WIND CONDITIONS. OBTAIN ENGINEERS APPROVAL FOR PLACEMENT METHODS PRIOR TO PLACEMENT. EVENLY DISTRIBUTE STRAW MULCH AT A MINIMUM LOOSE RATE OF 4 490 kg/ha. IMMEDIATELY FOLLOWING PLACEMENT, CRIMP OR APPLY TACKIFIERS TO RETAIN MULCH. CRIMP USING DISKS OR A PUNCH-TYPE ROLLER. IF TACKIFIERS ARE USED, FOLLOW GUIDELINES PROVIDED IN BMP SS-5. WHEN EITHER TEMPORARY OR PERMANENT SEEDING IS COMBINED WITH THE STRAW MULCH BMP, COMPLETE SEEDING OPERATIONS PRIOR TO STRAW MULCH PLACEMENT. REFER TO BMPs SS-4 AND SS-15 FOR SEEDING GUIDELINES.

REAPPLICATION OF STRAW MULCH AND TACKIFIER MAY BE REQUIRED BY THE ENGINEER TO MAINTAIN EFFECTIVE SOIL STABILIZATION OVER DISTURBED AREAS AND SLOPES.



STRAW BLOWER

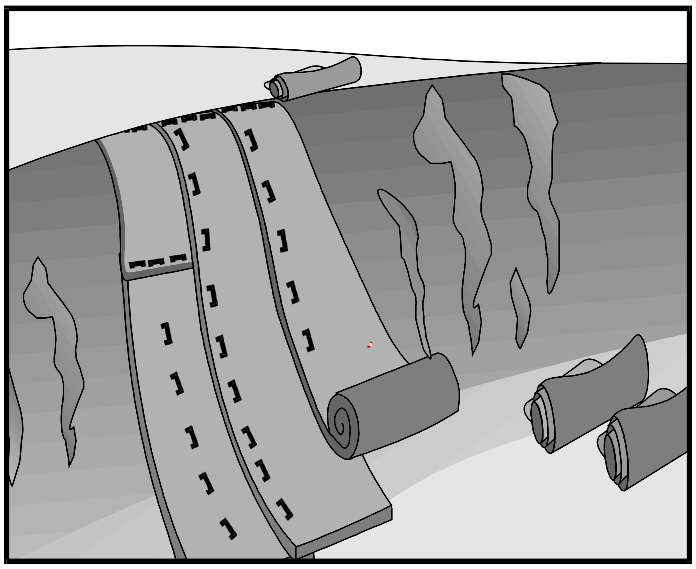


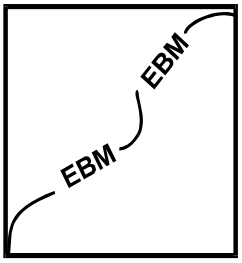
STRAW CRIMPING

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
STRAW MULCH (SS-6)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats SS-7





BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

This BMP involves the placement of geotextiles, plastic covers, or erosion control blankets/mats to stabilize disturbed soil areas and protect soils from erosion by wind or water.

Appropriate Applications

These measures are used when disturbed soils may be particularly difficult to stabilize, including the following situations:

- Steep slopes, generally steeper than 3:1.
- Slopes where the erosion hazard is high.
- Slopes and disturbed soils where mulch must be anchored.
- Disturbed areas where plants are slow to develop adequate protective cover.
- Channels with flows velocities exceeding 1.0 m/s (3 ft/s).
- Channels intended to be vegetated.
- Stockpiles.
- Slopes adjacent to water bodies.

Limitations

- Blankets and mats are more expensive than other erosion control measures, due to labor and material costs. This usually limits their application to areas inaccessible to hydraulic equipment, or where other measures are not applicable, such as channels.

- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers).

- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.

- Plastic sheeting is easily vandalized or torn. In addition plastic sheeting is susceptible to photodegradation and must be disposed of at a landfill.

- The use of plastic sheeting results in 100 percent runoff, which may cause serious erosion problems in the areas receiving the increased flow.

- The use of plastic shall be limited to covering stockpiles, or very small graded areas for short periods of time (such as through one damaging storm event), until alternative measures, such as seeding and mulching, may be installed.

Design Guidelines and Considerations

Material Selection

There are many types of erosion control blankets and mats, and selection of the appropriate type should be based on the specific type of application and site conditions. Selection(s) made by the Contractor must be approved by the Engineer prior to placement. The following criteria are helpful in the selection of the appropriate material:

- Cost
    - Material cost
    - Preparation cost
    - Installation cost
    - Add-ons
- Effectiveness
    - Reduction of erosion
    - Reduction of flow velocity
    - Reduction of runoff
- Acceptability
    - Environmental compatibility

- Institutional/regulatory acceptability
- Visual impact

- Vegetation Enhancement
  - Native plant compatibility
  - Moisture retention
  - Temperature modification
  - Open space/coverage

- Installation
  - Durability
  - Longevity
  - Ease of installation
  - Safety

- Operation and Maintenance
  - Maintenance frequency

Geotextiles

- Geotextile materials shall meet MDT Geosynthetics specifications.

- Geotextiles may be reused if, in the opinion of the Engineer, they are suitable for the use intended.

Plastic Covers

- Plastic cover material used for temporary soil stabilization shall be polyethylene sheeting and shall have a minimum thickness of 6 mils. Plastic covers shall be anchored by sandbags placed no more than 3 m (10 ft) apart and by keying into the tops of slopes to prevent infiltration of surface waters under the plastic. All seams shall be taped or weighted down their entire length, and there shall be at least a 300 mm to 600 mm (12 to 24 in) overlap of all seams.

- Plastic covers may be reused if, in the opinion of the Engineer, they are suitable for the use intended.

Erosion Control Blankets/Mats

- Erosion control blankets/mats shall meet MDT soil retention/erosion control blankets and mats specifications.

Geosynthetics Construction

- Follow MDT geosynthetics construction specifications, detail drawings, and the project special provisions.

Maintenance, Inspection, and Removal

- Areas treated with temporary soil stabilization shall be inspected and maintained to provide adequate erosion control. Temporary soil stabilization shall be reapplied or replaced on exposed soils when greater than 10 percent of the previously treated area becomes exposed or exhibits visible erosion.

- All blankets and mats shall be inspected periodically after installation.

- Installation shall be inspected after significant rainstorms to check for erosion and undermining. Any failures shall be repaired immediately.

- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.

- When no longer required for the work, temporary soil stabilization shall be properly disposed.

SYMBOL:

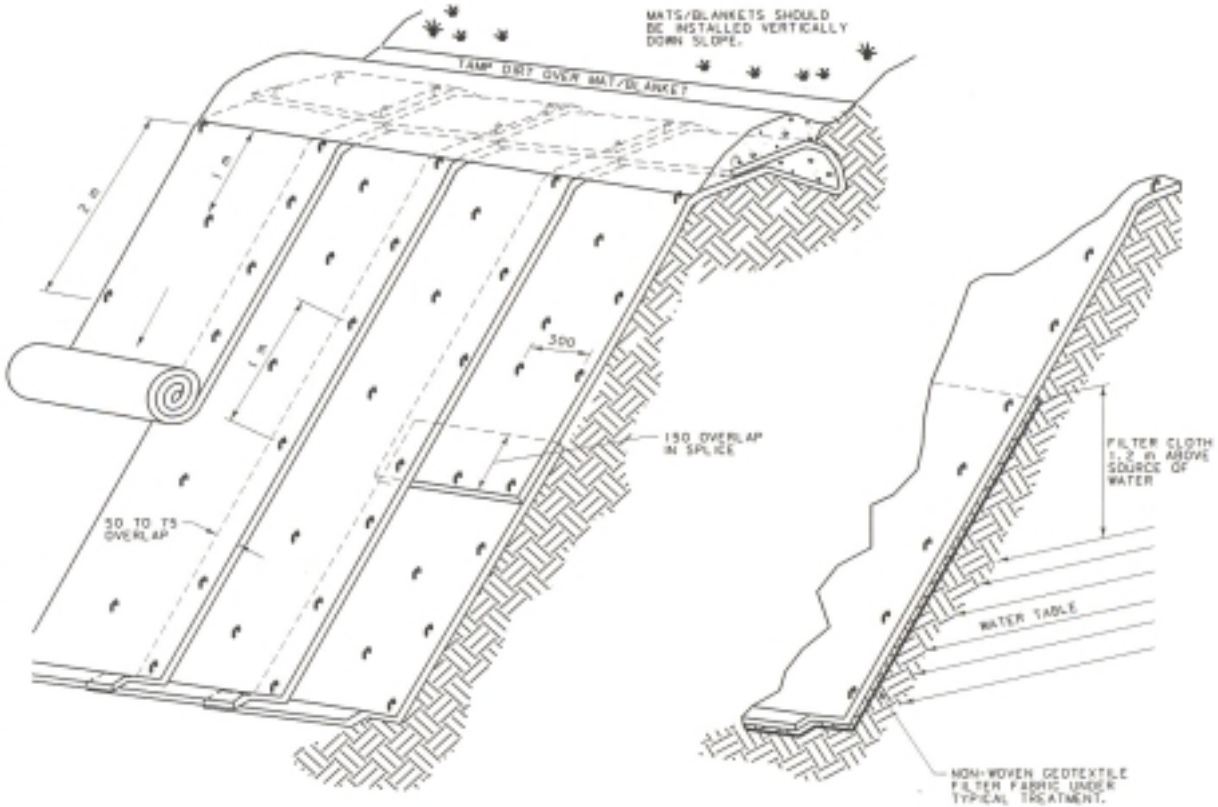
GEOTEXTILES, PLASTIC COVERS & EROSION CONTROL BLANKETS/MATS SS-7:

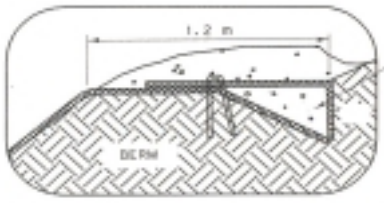
GEOTEXTILES, PLASTIC COVERS, AND EROSION CONTROL BLANKETS/MATS ARE USED TO STABILIZE DISTURBED SOIL AREAS AND PROTECT SOILS FROM EROSION BY WIND AND WATER. THESE PRODUCTS CAN BE USED ON STEEP SLOPES, SLOPES WITH HIGH EROSION HAZARDS, SLOPE WHERE MULCHES CAN NOT BE ANCHORED, UNPROTECTED CHANNELS AND HIGH FLOW CHANNELS.

INSTALL GEOTEXTILES AND EROSION CONTROL BLANKETS/MATS IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND MDT SECTION 622.

PROVIDE GEOTEXTILE MATERIALS MEETING MDT STANDARD SPECIFICATION T13.

LIMIT USE OF PLASTIC COVERS TO COVERING STOCKPILES, OR VERY SMALL GRADED AREAS FOR SHORT PERIODS OF TIME (SUCH AS THROUGH ONE IMMINENT STORM EVENT) UNTIL ALTERNATIVE MEASURES MAY BE INSTALLED. PLASTIC COVERS ARE REQUIRED TO BE POLYETHYLENE SHEETING HAVING A MINIMUM THICKNESS OF 6 mil. ANCHOR PLASTIC COVERS WITH SANDBAGS PLACED NO MORE THAN 3 m APART AND BY KEYING INTO THE TOP OF SLOPE TO PREVENT INFILTRATION OF SURFACE WATERS UNDER THE PLASTIC. TAPE OR WEIGHT DOWN THE ENTIRE LENGTH OF ALL SEAMS WITH AT LEAST 300 mm TO 600 mm OVERLAP.

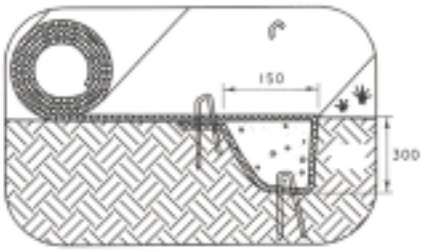




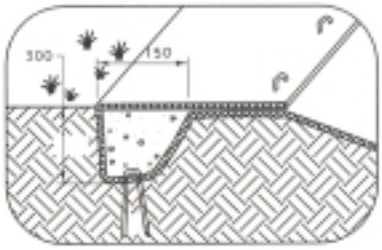
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

PRELIMINARY

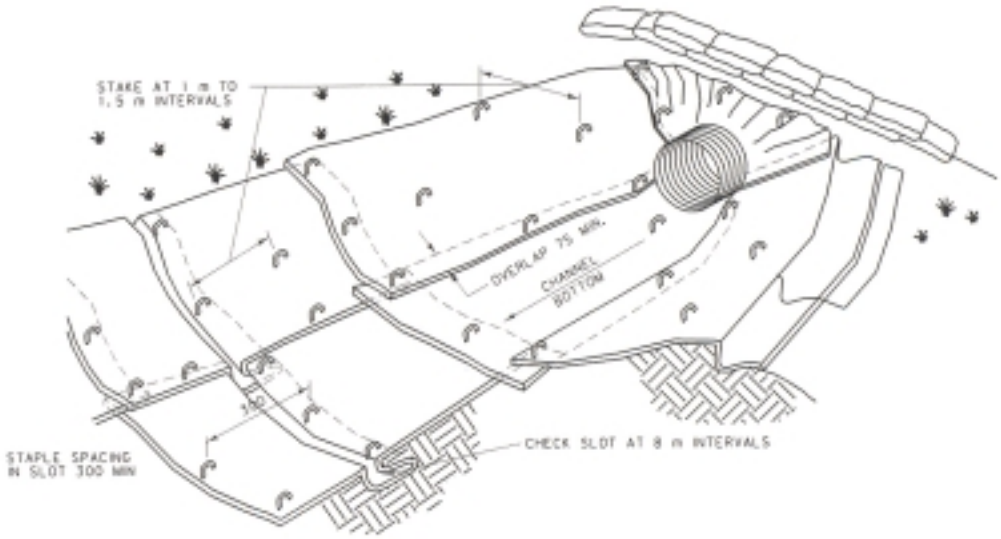
REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-30
GEOTEXTILES, PLASTIC COVERS & EROSION CONT. BLANKETS/ MATS (SS-7) (SHEET 1)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	



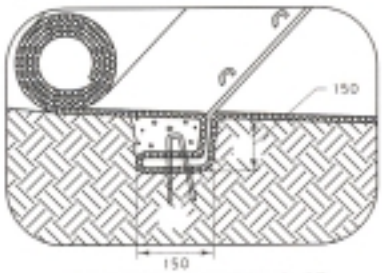
INITIAL CHANNEL ANCHOR TRENCH



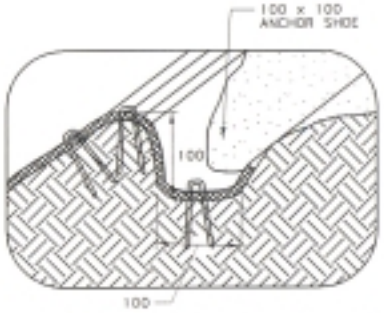
TERMINAL SLOPE & CHANNEL ANCHOR TRENCH



TYPICAL CHANNEL DETAIL - ISOMETRIC VIEW



INTERMITTENT CHECK SLOT



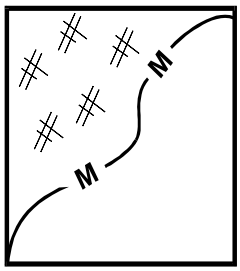
LONGITUDINAL ANCHOR TRENCH

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
GEOTEXTILES, PLASTIC COVERS & EROSION CONT. BLANKETS/ MATS (SS-T) (SHEET 2)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

Wood Mulching SS-8



BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Wood mulching consists of applying a mixture of shredded wood mulch, bark, or compost. Wood mulch is mostly applicable to landscape projects.

The primary function of wood mulching is to reduce erosion by protecting bare soil from rainfall impact, increasing infiltration, and reducing runoff.

Appropriate Applications

Wood mulching is considered a temporary soil stabilization alternative in the following situations:

- As a stand-alone temporary surface cover on disturbed areas until soils can be prepared for revegetation and permanent vegetative cover can be established.
- As short term, non-vegetative ground cover on slopes to reduce rainfall impact, decrease the velocity of sheet flow, settle out sediment, and reduce wind erosion.

Limitations

- Wood mulch may introduce unwanted plant species.
- Shredded wood does not withstand concentrated flows and is prone to sheet erosion.
- Green material has the potential for the presence of unwanted weeds and other plant materials.
- Delivery system is primarily by manual labor, although pneumatic application equipment is available.

Design Guidelines and Considerations

Mulch Selection

There are many types of mulches, and selection of the appropriate type shall be based on the type of application and site conditions. Engineers approval is required prior to use of wood mulches since some mulch use on construction projects may not be compatible with planned or future projects. Selection of wood mulches by the Contractor shall comply with MDT Standard Specifications and must be approved by the Engineer.

Application Procedures

After existing vegetation has been removed, roughen embankment and fill areas by rolling with a punching type roller or by track walking. Wood mulch can be applied once the surface has been prepared. The application procedures for wood mulches vary significantly depending upon the type of mulching method specified. Two (2) methods are highlighted here:

- Green Material: This type of mulch is produced by recycling of vegetation trimmings such as grass, shredded shrubs, and trees. Methods of application are generally by hand, although pneumatic methods are available. Mulch shall be composted to kill weed seeds.
  - It can be used as a temporary ground cover with or without seeding.
  - The green material shall be evenly distributed on site to a depth of 75 mm (3 in).
- Shredded Wood: Suitable for ground cover in ornamental or revegetated plantings.
  - Refer to limitations for conditions where shredded wood/bark is suitable.
  - Distribute wood/bark by hand, or approved pneumatic methods.
  - The mulch shall be evenly distributed across the soil surface to a depth of 75 mm (3 in).
- Avoid mulch placement onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- All material must be removed before resuming earthwork activities.

Maintenance, Inspection, and Removal

- Regardless of the mulching technique selected, the key consideration in maintenance and inspection is that the mulch needs to last long enough to achieve erosion-control objectives. If the mulch is applied as a stand-alone erosion control method over disturbed areas, it shall last the length of time the site will remain barren or until final re-grading and revegetation.
- When wood mulch is used as ornamental or landscaping application inspection and maintenance shall focus on longevity and integrity of the mulch.

SYMBOL: ——————— ———M———

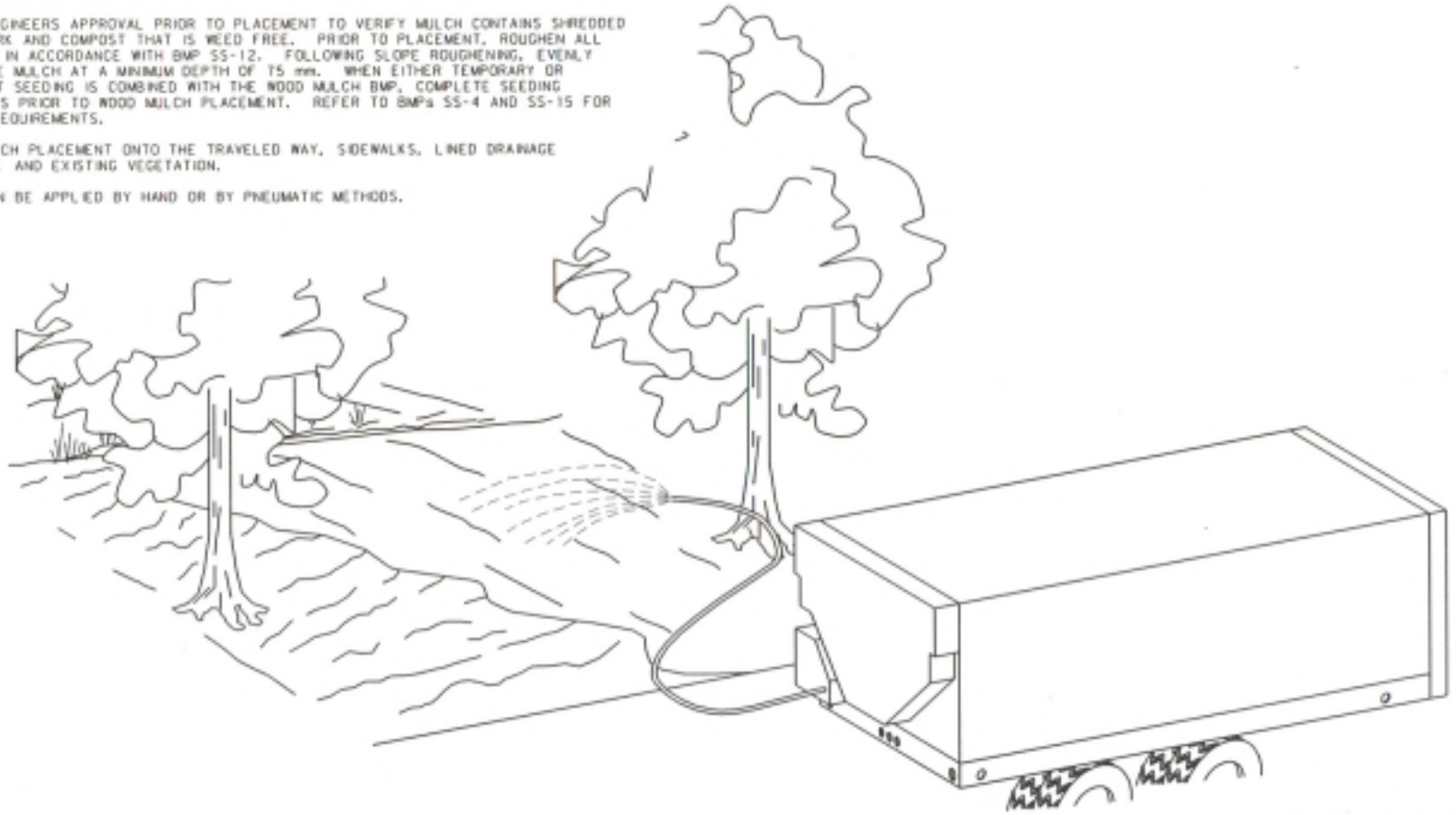
WOOD MULCH SS-8:

WOOD MULCHING CONSISTS OF APPLYING A MIXTURE OF SHREDDED WOOD MULCH, BARK, OR COMPOST. WOOD MULCH IS MOSTLY APPLICABLE TO LANDSCAPE PROJECTS. WOOD MULCHING REDUCES EROSION BY PROTECTING BARE SOIL RAINFALL IMPACT, INCREASING INFILTRATION, AND REDUCING RUNOFF. DO NOT USE WOOD MULCH WHERE CONCENTRATED RUNOFF FLOWS MAY EXIST.

OBTAIN ENGINEERS APPROVAL PRIOR TO PLACEMENT TO VERIFY MULCH CONTAINS SHREDDED WOOD, BARK AND COMPOST THAT IS WEED FREE. PRIOR TO PLACEMENT, ROUGHEN ALL SURFACES IN ACCORDANCE WITH BMP SS-12. FOLLOWING SLOPE ROUGHENING, EVENLY DISTRIBUTE MULCH AT A MINIMUM DEPTH OF 75 mm. WHEN EITHER TEMPORARY OR PERMANENT SEEDING IS COMBINED WITH THE WOOD MULCH BMP, COMPLETE SEEDING OPERATIONS PRIOR TO WOOD MULCH PLACEMENT. REFER TO BMPs SS-4 AND SS-15 FOR SEEDING REQUIREMENTS.

AVOID MULCH PLACEMENT ONTO THE TRAVELED WAY, SIDEWALKS, LINED DRAINAGE CHANNELS, AND EXISTING VEGETATION.

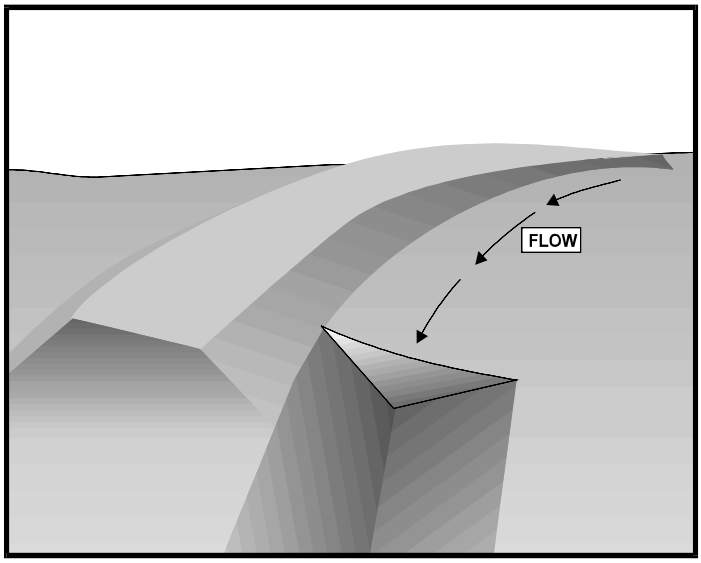
MULCH CAN BE APPLIED BY HAND OR BY PNEUMATIC METHODS.

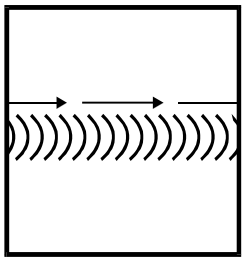


PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-22
WOOD MULCH (SS-8)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Earth Dikes/Drainage Swales and Lined Ditches SS-9





BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Earth dikes/drainage swales and lined ditches are structures that intercept, divert and convey surface run-on, generally sheet flow, to prevent erosion.

Appropriate Applications

- Earth dikes/drainage swales and lined ditches may be used to:
  - Convey surface runoff down sloping land.
  - Intercept and divert runoff to avoid sheet flow over sloped surfaces.
  - Divert and direct runoff towards a stabilized watercourse, drainage pipe, or channel.
  - Intercept runoff from paved surfaces.
- Earth dikes/drainage swales and lined ditches also may be used:
  - Below steep grades where runoff begins to concentrate.
  - Along roadways and facility improvements subject to flood drainage.
  - At the top of slopes to divert run-on from adjacent or undisturbed slopes.
  - At bottom and mid-slope locations to intercept sheet flow and convey concentrated flows.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Engineer.

Limitations

- Earth dikes/drainage swales and lined ditches are not suitable as sediment trapping devices.
- May be necessary to use other soil stabilization and sediment controls, such as check dams, plastics, and blankets to prevent scour and erosion in newly graded dikes, swales, and ditches.

Design Guidelines and Considerations

- Care must be applied to correctly size and locate earth dikes, drainage swales, and lined ditches. Excessively steep, unlined dikes and swales are subject to erosion and gully formation.
- Use a lined ditch for high flow velocities.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff from the right-of-way onto other property.
- When possible, install and utilize dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

Maintenance, Inspection, and Removals

- Inspect temporary measures prior to predicted storm events and as soon as possible after storm events, and regularly (approximately once per week) during the construction season.
- Inspect ditches and berms for washouts. Replace lost or damaged linings, or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment, and repair linings and embankments as needed or as directed by the Engineer.
- Temporary conveyances shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

SYMBOL: ——— CELL

EARTH DIKES/DRAINAGE SWALES & LINED DITCHES SS-9:

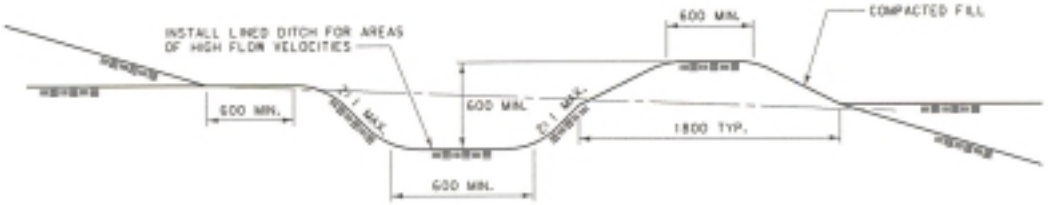
EARTH DIKES, DRAINAGE SWALES AND LINED DITCHES ARE STRUCTURES THAT INTERCEPT, DIVERT, AND CONVEY SURFACE RUN-ON, GENERALLY SHEET FLOW, TO PREVENT EROSION. THESE DEVICES MAY BE IMPLEMENTED ON A PROJECT-BY-PROJECT BASIS WITH OTHER BMPs WHEN DETERMINED NECESSARY AND FEASIBLE BY THE ENGINEER. DIKES, SWALES AND DITCHES ARE CONVEYANCE MEASURES AND ARE NOT INTENDED TO TRAP SEDIMENT. SEDIMENT CONTROL BMPs CAN BE USED IN CONJUNCTION WITH THESE CONVEYANCE DEVICES.

WHEN POSSIBLE, INSTALL AND UTILIZE DIKES, SWALES AND DITCHES EARLY IN THE CONSTRUCTION PHASE. CONSTRUCT SWALES ALONG THE TOP AND BOTTOM OF CUT AND FILL SLOPES, AS SPECIFIED IN THE PLANS OR AS DESIGNATED BY THE ENGINEER. "V" BOTTOM DITCHES CAN BE USED FOR SWALE CONSTRUCTION FOLLOWING ENGINEERS APPROVAL. USE SEDIMENT CONTROL DEVICES FOR RUNOFF THAT IS DIVERTED FROM DISTURBED AREAS. CONVEY FLOWS FROM UNDISTURBED AREAS INTO A STABILIZED AREA AT NON-EROSIVE VELOCITIES. DO NOT PLACE DIKES, SWALES, AND DITCHES IN A MANNER THAT ALLOWS HIGHWAY RUNOFF TO ENTER ONTO OTHER PROPERTY'S RIGHT-OF-WAY.

USE LINED DITCHES FOR AREAS OF HIGH FLOW VELOCITIES FOLLOWING THE GUIDELINES SPECIFIED IN SS-7 (GEOTEXTILES, PLASTIC COVERS & EROSION CONTROL BLANKETS/MATS) AND/OR SS-11 (SLOPE DRAINS). SEED ALL UNLINED PORTIONS OF DITCHES, DIKES AND SWALES THAT WILL BE IN USE FOR MORE THEN 14 DAYS IN ACCORDANCE WITH SS-15 (EROSION SEEDING).

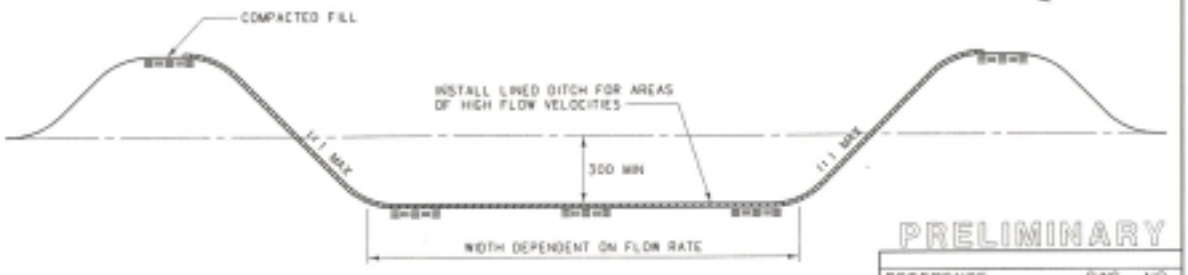
INSPECT DIKES, SWALES, AND DITCHES AFTER RAINFALL EVENTS. REMOVE DEBRIS AND SEDIMENT, AND REPAIR LININGS AND EMBANKMENTS AS NEEDED OR AS SPECIFIED BY THE ENGINEER.

REMOVAL ALL DIKES, SWALES AND LINED DITCHES FROM THE CLEAR ZONES EXPEDIENTLY UPON COMPLETION OF CONSTRUCTION ACTIVITIES.



TYPICAL DRAINAGE SWALE

TYPICAL EARTH DIKE



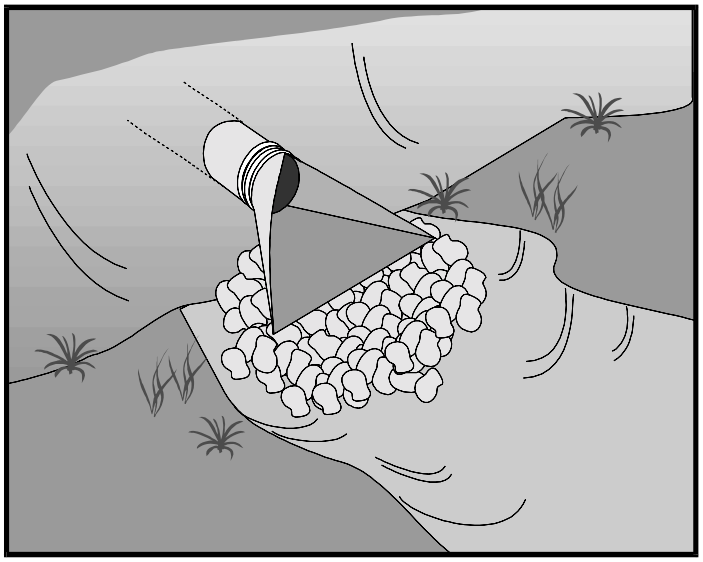
TYPICAL TRAPEZOIDAL DITCH

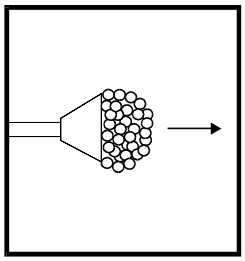
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-??
EARTH DIKES/DRAINAGE SWALES & LINED DITCHES (SS-9)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Outlet Protection/Velocity Dissipation Devices SS-10





BMP Objectives

- ● Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

These devices are temporarily placed at pipe outlets to prevent scour and reduce the velocity and/or energy of exiting storm water flows. The devices shall be used for temporary pipe placement and temporary stabilization until the final work is completed. MDT Hydraulics Section designs permanent outlet protection and velocity dissipation devices.

Appropriate Applications

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Engineer.

Limitations

- Loose rock may be washed away during high flows.
- Grouted riprap may break up in areas of freeze and thaw.

- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.

Design Guidelines and Considerations

- There are many types of energy dissipater's, with rock being the one that is represented in the attached Detail Drawings. This is only one example and the Engineer may approve any other type of device proposed by the Contractor.

- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction.

- Carefully place riprap to avoid damaging the filter fabric.

- For proper operation of apron:

    - Align apron with receiving stream such that a straight line is created. If a curve is needed to fit site conditions, place it in upper section of apron.

    - If size of apron riprap is large, protect underlying filter fabric with a gravel blanket.

- Outlets on slopes steeper than 10 percent shall have additional protection.

Maintenance, Inspection, and Removal

- Inspect temporary measures prior to predicted storm events, and as soon as possible after storm events, and regularly (approximately once per week) during the construction season.

- Inspect apron for displacement of dissipation devices and/or damage to the underlying fabric and repair as needed.

- Inspect for scour beneath the dissipation devices and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

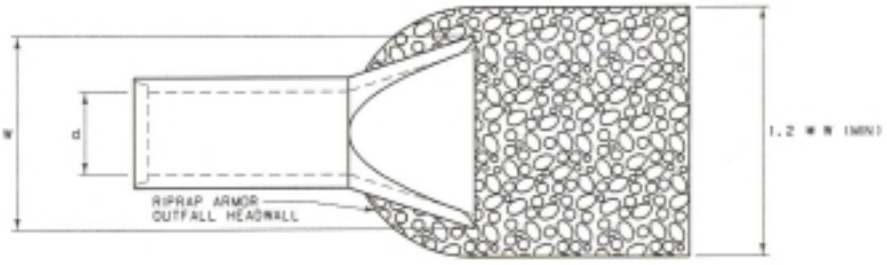
- Temporary devices shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

SYMBOL: ——————— CELL

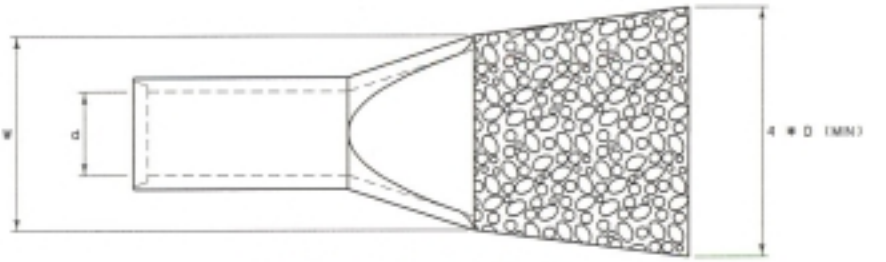
OUTLET PROTECTION/VELOCITY DISSIPATION DEVICES SS-10

OUTLET PROTECTION AND VELOCITY DISSIPATION DEVICES ARE PLACED AT PIPE OUTLETS TO PREVENT SCOUR AND REDUCE THE VELOCITY AND/OR ENERGY OF EXITING STORM WATER FLOWS. THESE DEVICES CAN BE USED AT THE OUTLETS OF PIPES, DRAINS, CULVERTS, SLOPE DRAINS, DIVERSION DITCHES, SWALES, CONDUITS OR CHANNELS AND SHOULD BE IMPLEMENTED ON A PROJECT-BY-PROJECT BASIS WITH OTHER BMPs WHEN DETERMINED NECESSARY BY THE ENGINEER.

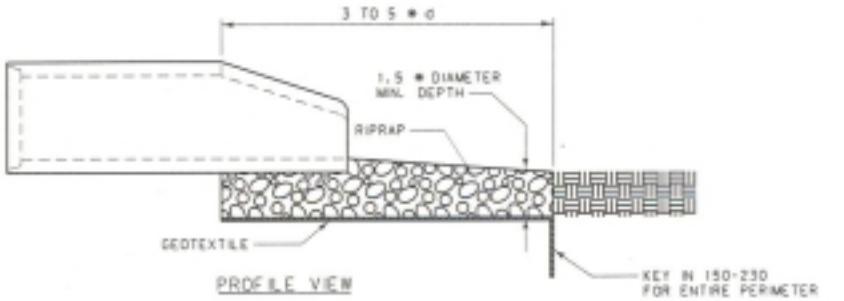
FOLLOW GUIDELINES BELOW FOR SIZING OUTLET PROTECTION AND VELOCITY DISSIPATION DEVICES. FOLLOWING ENGINEER'S APPROVAL, OTHER MATERIALS MAY BE SUBSTITUTED FOR RIPRAP. GEOTEXTILE PLACEMENT MAY BE ELIMINATED FOLLOWING ENGINEERS APPROVAL. PLACE TYPE I OR TYPE 2 BANK PROTECTION AT PIPE OUTLET. FOR PIPE DIAMETERS LARGER THAN 600 mm AND/OR HIGH FLOWS, THE APPLICATION IS NOT CONSIDERED TEMPORARY AND A MONTANA REGISTERED ENGINEER'S DESIGN IS REQUIRED.



PLAN VIEW - CHANNELIZED FLOW
(OUTFALL TO CHANNEL OR DITCH)



PLAN VIEW - UNCHANNELIZED FLOW
(OUTFALL TO UNCONFINED SURFACE-OVERLAND FLOW)



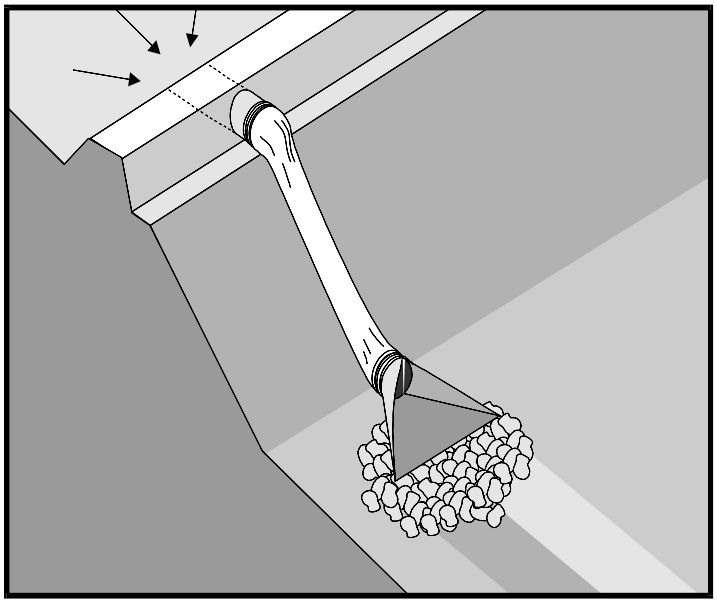
PROFILE VIEW

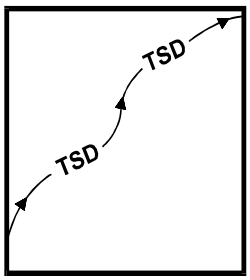
PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
OUTLET PROTECTION/VELOCITY DISSIPATION DEVICES (SS-10)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

Slope Drains SS-11





BMP Objectives
- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

A slope drain is a temporary pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device or stabilized area. Slope drains are often used with lined ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes.

Appropriate Applications

- Slope drains may be used at construction sites where slopes may be eroded by surface runoff.
- This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Engineer.

Limitations

- Severe erosion may result when slope drains fail by over topping, piping, or pipe separation.

Design Guidelines and Considerations

- When using slope drains, limit drainage area to 4 ha (10 acre) per pipe. For larger areas, use a rock-lined channel or a series of pipes.
- Maximum slopes are generally limited to 2:1 as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to and from slope drains with interceptor dikes. See BMP SS-8, "Earth Dikes/Drainage Swales, and Lined Ditches."
- Slope drains can be placed above or buried underneath the slope surface.

- Slope drain materials, including pipes, riprap, synthetic liners, and concrete, need to comply with MDT Standard Specifications or project special conditions.

- When installing slope drains:

  - Install slope drains perpendicular to slope contours.

  - Compact soil around and under entrance, outlet, and along length of pipe.

  - Securely anchor and stabilize pipe and appurtenances into soil.

  - Check to ensure that pipe connections are watertight.

  - Protect area around inlet with geosynthetic liner meeting MDT Standard Specifications. Protect outlet with riprap or other energy dissipation device. For high-energy discharges, reinforce riprap with concrete or use reinforced concrete device.

  - Protect inlet and outlet of slope drains: use standard flared end sections at entrances and exists for pipes 300 mm (12 in) and larger in diameter.

Maintenance, Inspection, and Removal

- Inspect before and after each rainstorm, and weekly until the tributary drainage area has been stabilized. Follow routine inspection procedures for inlets thereafter.

- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.

- Inspect slope drainage for accumulations of debris and sediment.

- Remove built-up sediment from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.

- Make sure water is not ponding onto inappropriate areas (e.g., active traffic lanes, material storage areas, etc.).

- Remove temporary slope drains when permament drains are completed.

SYMBOL: ———————— ———TSD———

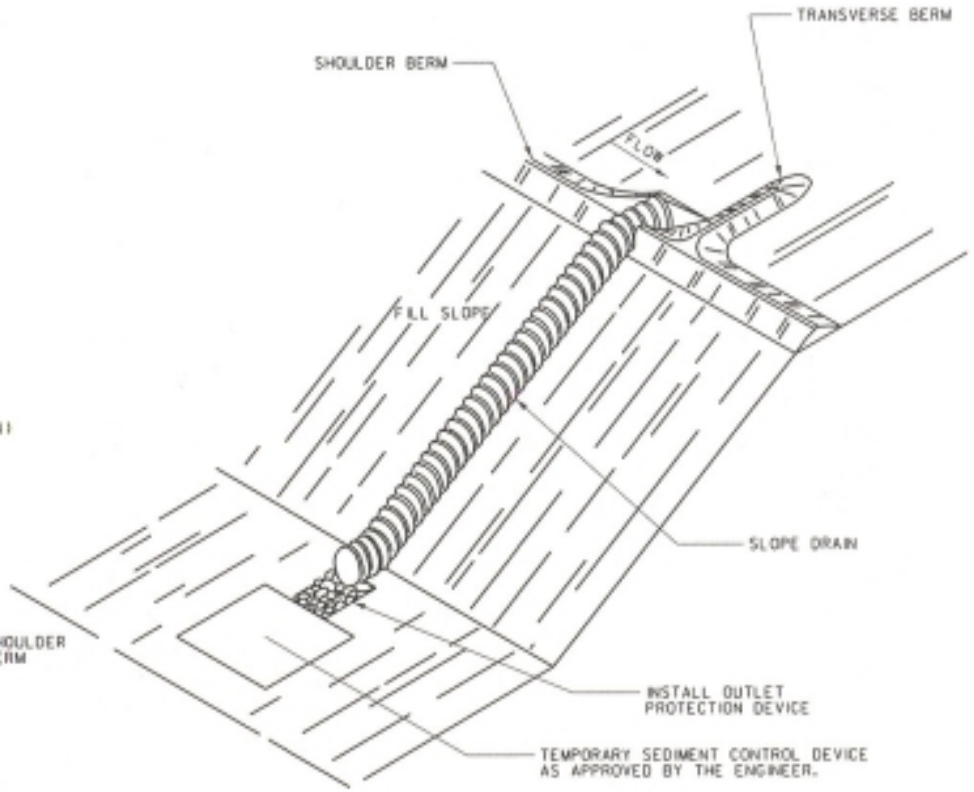
SLOPE DRAINS SS-11

A SLOPE DRAIN IS A PIPE OR LINED CHANNEL USED TO INTERCEPT AND CONVEY SURFACE RUNOFF OR GROUNDWATER INTO A STABILIZED WATERCOURSE, TRAPPING DEVICE, OR STABILIZED AREA. THIS DEVICE MAY BE USED AT CONSTRUCTION SITES WHERE SLOPES MAY BE ERODED BY SURFACE RUNOFF.

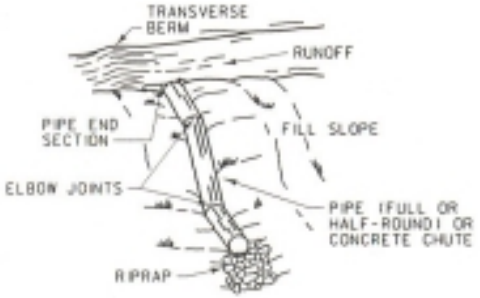
DO NOT EXCEED A DRAINAGE AREA OF 4 ha PER SLOPE DRAIN PIPE. FOR AREAS LARGER THAN 4 ha USE ROCK LINED CHANNELS. DO NOT PLACE SLOPE DRAINS ON SLOPES THAT EXCEED 2:1 SLOPES. INCORPORATE BMP SS-9 (EARTH DIKES/DRAINAGE SWALES & LINED DITCHES) TO AID IN FLOW DIVERSION.

INSTALL SLOPE DRAINS AS FOLLOWS:
- INSTALL DRAINS PERPENDICULAR TO SLOPE
- COMPACT SOIL AROUND INLET, OUTLET AND LENGTH OF STRUCTURE
- SECURELY ANCHOR SLOPE DRAINS INTO SOIL
- ENSURE CONNECTIONS ARE WATER TIGHT
- PROTECT INLET AND OUTLET WITH BMP SS-10 (OUTLET PROTECTION & VELOCITY DISSIPATION)

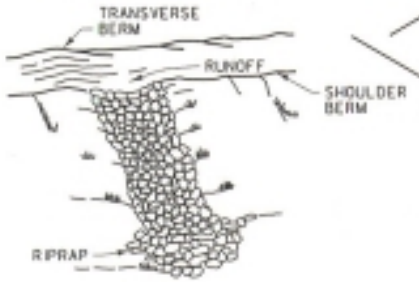
ALL MATERIALS REQUIRE ENGINEER'S APPROVAL PRIOR TO PLACEMENT.



PIPE SLOPE DRAIN

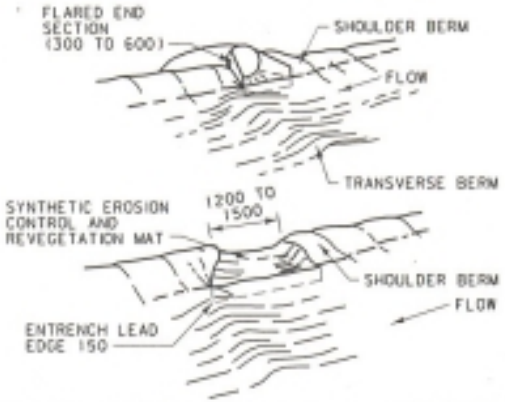


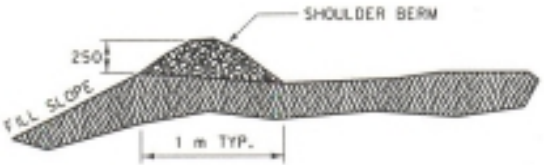
RIPRAP SLOPE DRAIN



DITCH LINER: SYNTHETIC EROSION CONTROL AND REVEGETATION MAT

SLOPE DRAIN INLETS





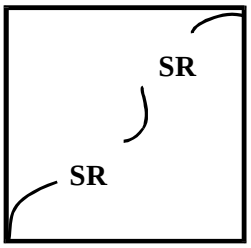
ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-72
SLOPE DRAINS (SS-11)	
EFFECTIVE:	

CDM Camp Dresser & McKee Inc.

Slope Roughening SS-12



BMP Objectives

- ● Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Soil roughening is a temporary erosion control practice often used in conjunction with grading. Soil roughening involves increasing the relief of a bare soil surface with horizontal grooves or tracking using construction equipment. Slopes that are not fine graded and that are left in a roughened condition can also reduce erosion. Soil roughening reduces runoff velocity, increases infiltration, reduces erosion, traps sediment, and prepares the soil for seeding and planting.

Appropriate Applications

Soil roughening works well on slopes steeper than 3:1, on piles of excavated soil, and in areas with highly erodible soils. This technique is especially appropriate for soils that are frequently moved or disturbed because roughening is relatively easy to accomplish. To slow erosion, roughening should be done as soon as possible after the vegetation has been removed. Roughening can be used with both seeding and temporary mulching to stabilize an area. For steeper slopes and slopes that will be left roughened for longer periods of time, a combination of surface roughening and vegetation is appropriate. Roughening should be performed immediately after grading activities have ceased (temporarily or permanently) in an area.

Limitations

Soil roughening is not appropriate for rocky slopes. Soil compaction might occur when roughening with tracked machinery. Soil roughening is of limited effectiveness in anything more than a gentle or shallow depth rain. If roughening is washed away in a heavy storm, the surface shall be re-roughened.

Design Guidelines and Considerations

Graded areas with smooth, hard surfaces increase erosion potential by decreasing the amount of storm water infiltration. A rough soil surface allows surface ponding and slows storm water velocities. Grooves in the soil are cooler and provide more favorable moisture conditions than hard, smooth surfaces. These conditions promote seed germination and vegetative growth. It is important to avoid excessive compacting of the soil surface, especially when tracking,

because soil compaction inhibits vegetation growth and causes higher runoff velocity. Therefore, it is best to limit roughening with tracked machinery to sandy soils that do not compact easily and to avoid tracking on heavy clay soils, particularly when wet. Bare soil areas should be seeded immediately following slope roughening. Proper dust control procedures also should be followed when soil roughening.

There are different methods for achieving a roughened soil surface on a slope. The selection of an appropriate method depends on the type of slope and the available equipment. Roughening methods include grooving and tracking. Factors to consider when choosing a method are slope steepness, mowing requirements, whether the slope is formed by cutting or filling, and available equipment. The following methods can be used for surface roughening.

Grooving. This technique uses machinery to create a series of ridges and depressions that run across the slope along the contour. Grooves should be made using an appropriate implement that can be safely operated on the slope, such as disks, tillers, spring harrows, or the teeth on a front-end loader bucket. The grooves should be made more than 75 mm (3 in) deep and less than 380 mm (15 in) apart.

Tracked. Roughening with tracked machinery should be limited to sandy soils to avoid undue compaction of the soil surface. Tracked machinery should be operated perpendicular to the slope to leave horizontal depressions in the soil. Tracking is generally not as effective as other roughening methods.

Fill slope roughening for areas that will not be mowed. Fill slopes with a gradient steeper than 3:1 should be placed in lifts and compacted per MDT Standard Specifications. To obtain a roughened slope, the face of the slope should consist of loose, non-compacted, 100-150 mm lifts (4 in- 6 in). Grooving or tracking should be used to roughen the face of the slopes. The final slope face should not be bladed or scraped.

Cuts, fills, and graded areas that will be mowed. Mowed slopes should be made no steeper than 3:1. These areas should be roughened with shallow grooves less than 25 mm (1 in) deep and more than 250 mm (10 in) apart using normal tilling, disking, or harrowing equipment (a cultipacker-seeder can also be used). Excessive roughness is undesirable where mowing is planned.

Maintenance, Inspection, and Removal

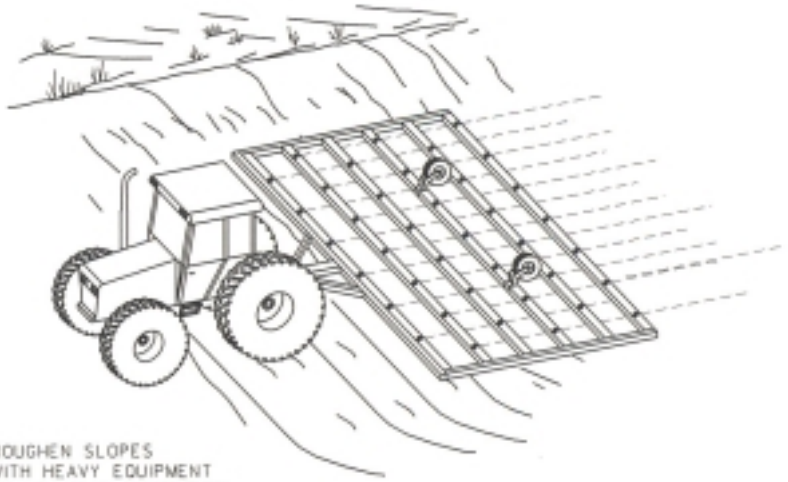
Areas need to be inspected after storms, since roughening might need to be repeated. Weekly inspection of roughened slopes will indicate where additional erosion and sediment control measures are needed. If rills appear, they should be filled, graded again, and reseeded immediately. Proper dust control methods should be used.

SYMBOL: ——————— ———SR———

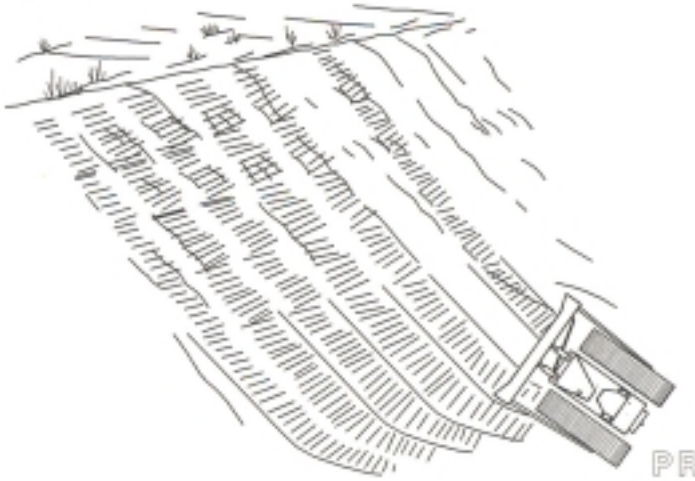
SLOPE ROUGHENING SS-12:

SLOPE ROUGHENING IS A VERY ROUGH SOIL SURFACE ON SLOPES RESULTING FROM CONSTRUCTION ACTIVITIES OR THE SYSTEMATIC ROUGHENING USING HEAVY EQUIPMENT TO CREATE RIDGES OR FURROWS PERPENDICULAR TO THE SLOPE. THE RIDGES OR FURROWS ARE TO BE EQUAL TO OR GREATER THAN 50 mm IN HEIGHT AND NO FURTHER THAN TWICE THE HEIGHT OF THE RIDGE OR FURROW APART. SLOPE ROUGHENING IS A GOOD FIRST LINE OF DEFENSE TO CONTROL EROSION AND SEDIMENT RUNOFF. DEGREE OF SLOPE ROUGHENING IS DEPENDENT ON THE GRADES AND PROXIMITY TO WATER RESOURCES.

ALL SLOPES STEEPER THAN 3:1 AND GREATER THAN 1500 VERTICAL MILLIMETERS REQUIRE SLOPE ROUGHENING. EXCLUDING ROCK SLOPES THAT CANNOT BE EXCAVATED BY RIPPING. ROUGHEN DISTURBED SLOPES OR LEAVE IN A ROUGHENED CONDITION. APPROPRIATE SUPPLEMENTS INCLUDE SOIL STABILIZATION BMPs SUCH AS TEMPORARY SEEDING OR EROSION SEEDING. WHEN FILL SLOPES ARE WITHIN 15 m OF SURFACE WATER, EARTH DIKES/DRAINAGE SWALES & LINED DITCHES (SS-9) AND/OR A SEDIMENT CONTROL BMP ARE REQUIRED.



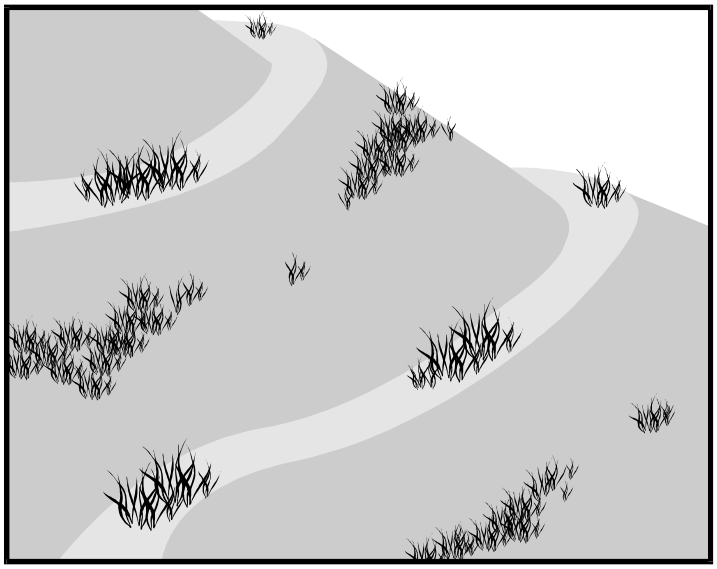
ROUGHEN SLOPES
WITH HEAVY EQUIPMENT
OR LEAVE IN ROUGHENED
CONDITION

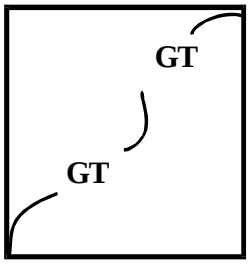


PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-27
SLOPE ROUGHENING (SS-12)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Gradient Terraces SS-13





BMP Objectives

- ● Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Gradient terraces are made of either earthen embankments or ridge and channel systems. They reduce damage from erosion by collecting and redistributing surface runoff to stable outlets at slower speeds and by increasing the distance of overland runoff flow. They also surpass smooth slopes in holding moisture and help to minimize sediment loading of surface runoff.

Appropriate Applications

Gradient terraces are most suitable for un-vegetative slopes that have existing or expected water erosion problem and they are only effective when there are suitable runoff outlets provided. They are usually limited to use on long, steep slopes.

Limitations

Gradient terraces are not appropriate for use on sandy, or shallow soils. Sloughing could occur if too much water permeates the soil in a terrace system and cut and fill costs could increase substantially. Terraces should not be constructed on slopes containing rocky or sandy soil.

Design Guidelines and Considerations

Gradient terraces should be designed with adequate and appropriate outlets and should be installed according to a well-developed plan. Acceptable outlets include grassed waterways, vegetated areas, or tile outlets. Any outlet that is used should be able to redirect surface runoff away from the terraces and toward an area that is not susceptible to erosion or other damage.

Design considerations include:

- Whenever possible, vegetative cover should be used in the outlet.
- The terrace's water surface design elevation should be no lower than the outlet's water surface design elevation when both are performing at design flow.

- During construction of the terrace system, dust control procedures should be followed.
- Proper vegetation/stabilization practices should be followed while constructing these graded terraces.

Maintenance, Inspection, and Removal

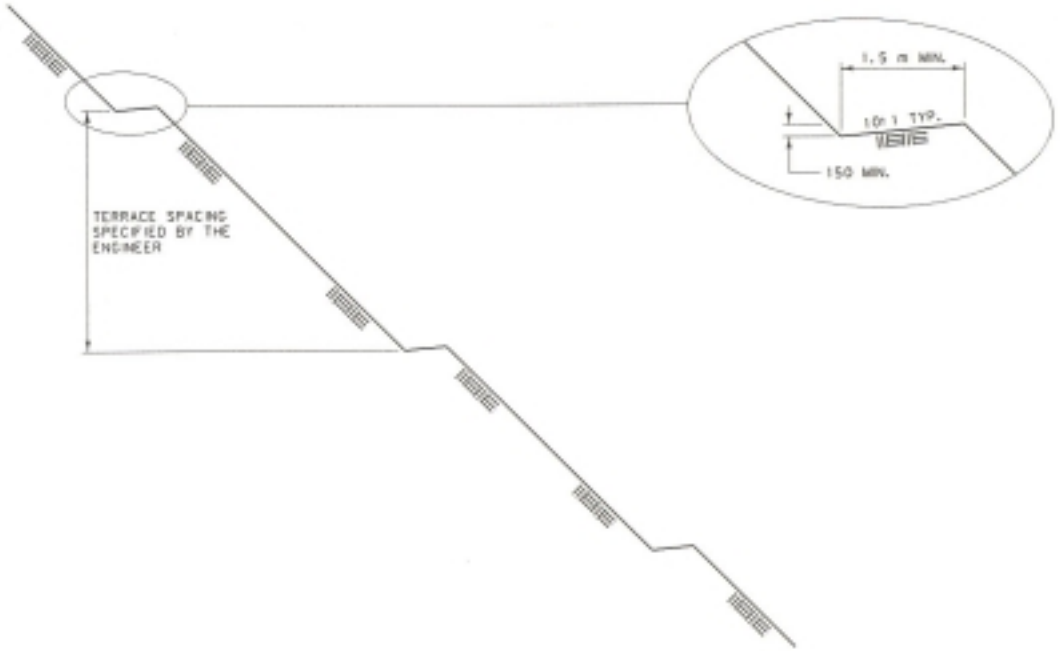
- Regular inspections of the terraces should occur after any major storms and during the weekly BMP inspections to ensure that the terraces are structurally sound and have not been subject to erosion.

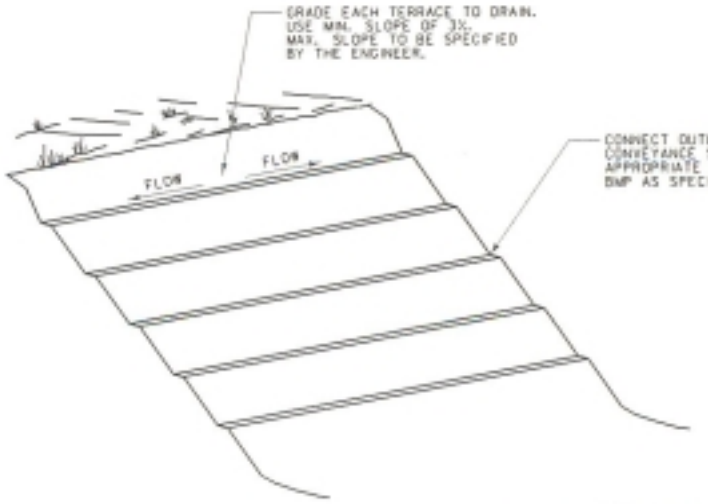
SYMBOL: ———— ——TS——

TERRACED SLOPES SS-13

TERRACED SLOPES ARE MADE OF EITHER EARTHEN EMBANKMENTS OR RIDGE AND CHANNEL SYSTEMS THAT ARE PROPORTIONALLY SPACED AND ARE CONSTRUCTED WITH AN ADEQUATE GRADE. TERRACES REDUCE DAMAGE FROM EROSION BY COLLECTING AND REDISTRIBUTING SURFACE RUNOFF TO STABLE OUTLETS AT SLOWER VELOCITIES AND BY INCREASING THE DISTANCE OF OVERLAND RUNOFF FLOW. THIS BMP IS USUALLY LIMITED TO USE ON LONG STEEP SLOPES WITH A WATER EROSION PROBLEM, OR WHERE IT IS ANTICIPATED THAT WATER EROSION WILL BE A PROBLEM. TERRACED SLOPES ARE NOT APPROPRIATE FOR USE ON SANDY, STONY, OR SHALLOW SOILS.

DESIGN TERRACED SLOPES WITH ADEQUATE AND APPROPRIATE OUTLETS. ENGINEER'S APPROVAL IS REQUIRED PRIOR TO MODIFICATIONS OF SPECIFIED TERRACED SLOPES.



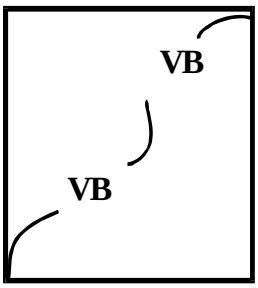


ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
TERRACED SLOPES (SS-13)	
EFFECTIVE:	
CDM Camp Dresser & McKee Inc.	

Vegetated Buffer SS-14



BMP Objectives

- ● Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Vegetated buffers are areas of either natural or established vegetation that are maintained to protect the water quality of neighboring areas. Buffer zones reduce the velocity of storm water runoff, provide an area for the runoff to permeate the soil, contribute to ground water recharge, and act as filters to catch sediment.

Appropriate Applications

Vegetated buffers can be used in most areas that are able to support vegetation, but they are most effective and beneficial on floodplains, near wetlands, along stream banks, and on steep, unstable slopes. They are also effective in separating land use areas that are not compatible and protecting wetlands or water bodies from construction activities that might be potential sources of non-point source pollution.

Limitations

Vegetated buffers require plant growth before they can be effective, and land on which to plant the vegetation must be available. If the cost of the land is very high, buffer zones might not be cost-effective. Although vegetated buffers help to protect water quality, they usually do not effectively counteract concentrated storm water flows to neighboring or downstream wetlands. Vegetative buffer zones require additional sediment control BMPs when slopes have significant lengths or steepness.

Design Guidelines and Considerations

To establish an effective vegetative buffer, the following guidelines should be followed:

- ■ Soils should not be compacted.

- Slopes should be less than 20:1.
- Buffer widths should be determined after careful consideration of slope, vegetation, soils, depth to impermeable layers, runoff sediment characteristics, type and quantity of storm water pollutants, and annual rainfall.
- Buffer widths should increase as slope increases.
- Zones of vegetation including grasses, deciduous and evergreen shrubs, and understory and overstory trees, should be intermixed.
- In areas where flows are concentrated and velocities are high, buffer zones should be combined with other structural or nonstructural BMPs as a pretreatment.

Maintenance, Inspection, and Removal

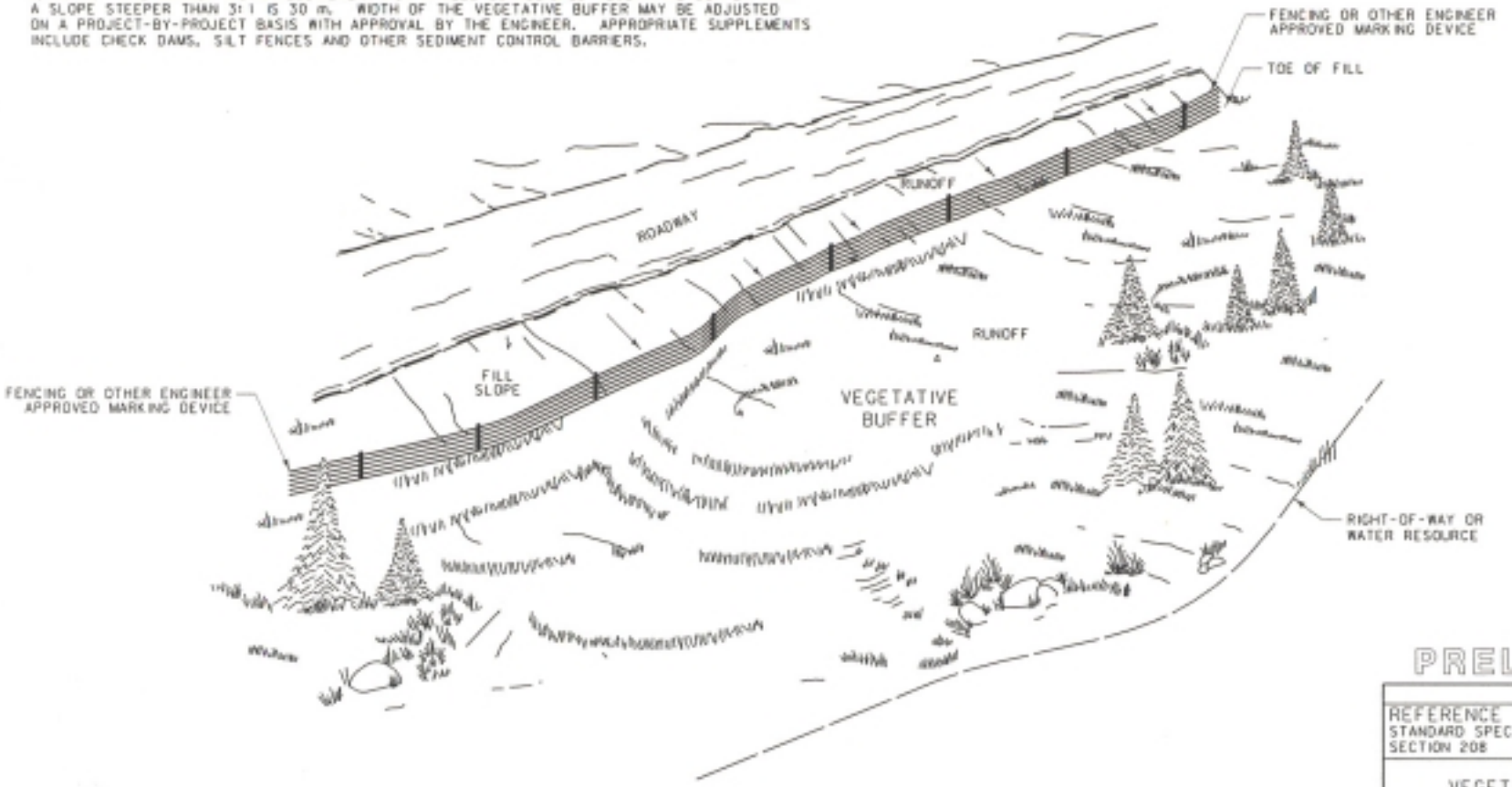
- Keeping vegetation healthy in vegetated buffers requires routine maintenance, which can include weed and pest control, mowing, fertilizing, liming, irrigating, and pruning. Inspection and maintenance are most important when buffer areas are first installed. Once established, vegetated buffers do not require much maintenance beyond the routine procedures listed earlier and periodic inspections of the areas, especially after any heavy rainfall and at least once a year. Inspections should focus on encroachment, gully erosion, density of vegetation, evidence of concentrated flows through the areas, and any damage from foot or vehicular traffic. Remove any sediment that has encroached onto the vegetative buffer and has a depth greater than 150 mm (6 in).

SYMBOL: ———————— ————VB————

VEGETATIVE BUFFER SS-14:

VEGETATIVE BUFFER IS AN UNDISTURBED AREA OR STRIP OF ESTABLISHED VEGETATION. A VEGETATIVE BUFFER PROVIDES A LIVING SEDIMENT FILTER TO REDUCE RUNOFF VELOCITIES AND ALLOW CAPTURE AND SETTLING OF COARSE-GRAINED SEDIMENT. VEGETATIVE BUFFERS REDUCE OR PREVENT SEDIMENTATION FROM LEAVING THE RIGHT-OF-WAY.

IDENTIFY EXISTING VEGETATIVE BUFFERS BEFORE CONSTRUCTION OCCURS AND MARK AREA PER SS-2 (PRESERVATION OF EXISTING VEGETATION) OR WITH SC-1 (SILT FENCE). ESTABLISHED VEGETATIVE BUFFERS SHOULD INCLUDE GRASSES AND SHRUBS. IRRIGATION, FERTILIZATION AND WEED AND PEST CONTROL MAY BE REQUIRED IN ORDER TO ESTABLISH AND MAINTAIN AN EFFECTIVE VEGETATIVE BUFFER. KEEP EQUIPMENT AND FILL MATERIAL OFF OF VEGETATIVE BUFFERS. ALWAYS CONSIDER VEGETATIVE BUFFER BUFFERS WHEN WATER RESOURCES ARE ADJACENT TO OR NEAR DISTURBANCES AND REQUIRE PROTECTION. THE MINIMUM WIDTH REQUIREMENT FOR A WELL-ESTABLISHED VEGETATIVE BUFFER WITH A SLOPE OF 3:1 OR FLATTER IS 15 m. THE MINIMUM WIDTH REQUIREMENT FOR A WELL-ESTABLISHED VEGETATIVE BUFFER WITH A SLOPE STEEPER THAN 3:1 IS 30 m. WIDTH OF THE VEGETATIVE BUFFER MAY BE ADJUSTED ON A PROJECT-BY-PROJECT BASIS WITH APPROVAL BY THE ENGINEER. APPROPRIATE SUPPLEMENTS INCLUDE CHECK DAMS, SILT FENCES AND OTHER SEDIMENT CONTROL BARRIERS.

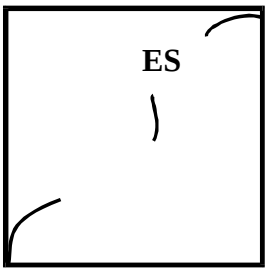


PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208	DWG. NO. 208-77
VEGETATED BUFFER (SS-14)	
EFFECTIVE:	

CDM Camp Dresser & McKee Inc.

Erosion Seeding SS-15



BMP Objectives

- ● Soil Stabilization
- ○ Sediment Control
- ○ Tracking Control
- ● Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

Well-established vegetative cover is one of the best erosion control measures available. Erosion seeding is the immediate seeding of freshly exposed slopes. Use erosion seeding on cut and fill slopes steeper than 3:1 that will not undergo further disturbance. Erosion seeding is not the same as temporary seeding. Temporary seeding (as shown in SS-4) is the establishment of a temporary vegetative cover on areas with a slope of 3:1 or flatter that will be exposed for longer than 14 days and that will undergo further disturbance. Erosion seeding uses a mixture of seed.

Appropriate Applications

Erosion seeding is used on freshly exposed slopes requiring temporary protection until permanent vegetation is established. Erosion seeding provides erosion protection on disturbed areas and traps sediments, promotes infiltration, and improves the appearance of the site. Erosion seeding is a relatively inexpensive erosion control measure.

Limitations

- Rock slopes that cannot be excavated by ripping are not seeded.
- Erosion seeding may not be appropriate in dry areas or periods without supplemental irrigation.
- Erosion seeding vegetation may have to be removed before permanent vegetation is applied.

Design Guidelines and Considerations

- The erosion seed mix and rate of application are found in the MDT Erosion Seeding (SS-15) Detail Drawing.

- Freshly exposed slopes are to be seeded daily, regardless of the time of year.
- Accomplish seeding by manual broadcasting with a shoulder-harnessed spreader seeder or its equivalent.
- Store the recommended mix on-site prior to initiation of slope excavation.
- If one or more species is unavailable, contact the MDT Agronomist, through the Engineer, for the substitute. Substitutions shall be approved in writing by the Engineer during the construction phase.
- The following considerations should be addressed if a hydroseeder is approved by the MDT Agronomist, through the Engineer, instead of manual broadcasting with a shoulder-harnessed spreader:
  - Hydroseeding typically consists of applying a mixture of fiber, seed, fertilizer, and stabilizing emulsion with hydro-mulch equipment, which temporarily protects exposed soils from erosion by water and wind. In order to select appropriate hydroseeding mixtures, an evaluation of site conditions shall be performed with respect to soil conditions, maintenance requirements, site topography, sensitive adjacent areas, season and climate, water availability, vegetation types, and plans for permanent vegetation.
  - Selection of hydroseeding mixtures shall be approved through the Engineer by the MDT Agronomist.
  - The following steps shall be followed for implementation:
  - Seed mix shall comply with MDT Erosion Seeding (SS-15) Detail Drawing and the project's special provisions.
  - Hydroseeding can be accomplished using a multiple-step or one-step process. The multiple-step process ensures maximum direct contact of the seeds to soil. When the one-step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seeds not having direct contact with the soil.
  - Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. The container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. All legume seed shall be pellet-inoculated. Inoculant sources shall be species specific and shall be applied at a rate of 2 kg (4.5 lbs) of inoculant per 100 kg (220 lbs) of seed.
  - Follow-up applications shall be made as needed to cover weak spots and to maintain adequate soil protection.
  - Avoid over-spray onto the travel way, sidewalks, lined drainage channels, and existing vegetation.

Maintenance, Inspection, and Removal

- All seeded areas shall be inspected for failures and re-seeded within the planting season following guidance from the MDT Agronomist. Any temporary revegetation efforts that do not provide adequate cover must be revegetated as required by the Engineer.

- After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

SYMBOL: ———————— ——ES——

EROSION SEEDING BMP SS-15:

EROSION SEEDING IS THE IMMEDIATE SEEDING OF FRESHLY EXPOSED SLOPES. USE EROSION SEEDING ON CUT AND FILL SLOPES STEEPER THAN 3:1 THAT ARE NOT SUBJECT TO FURTHER DISTURBANCE. EVALUATE ROCK AREAS THAT CANNOT BE RIPPED ON A PROJECT-BY-PROJECT BASIS FOR THE NEED OF EROSION SEEDING. THESE AREAS WILL RECEIVE EROSION SEEDING FOLLOWING THE ENGINEER'S APPROVAL. SEEDING DOES NOT REPLACE OR SUBSTITUTE FOR FINAL SEEDING ACTIVITIES SPECIFIED IN THE SEEDING SPECIAL PROVISION.

SEED COMPLETED SECTIONS DAILY, REGARDLESS OF THE TIME OF YEAR. ACCOMPLISH SEEDING BY MANUAL BROADCASTING WITH A SHOULDER-HARNESSED SPREADER SEEDER WITH NO MULCH OR FERTILIZER APPLIED. TRACK AREAS FOLLOWING SEEDING IN ACCORDANCE TO BMP SS-12, SLOPE ROUGHENING. HYDROSEEDING MAY ONLY BE USED AS APPROVED BY THE MDT AGRONOMIST, THROUGH THE ENGINEER. STORE THE RECOMMENDED SEED MIX ON-SITE PRIOR TO INITIATION OF SLOPE EXCAVATION. IF ONE OR MORE SPECIES IS UNAVAILABLE, CONTACT THE MDT AGRONOMIST, THROUGH THE ENGINEER, FOR THE SUBSTITUTE. THE SEED MIX AND RATE OF APPLICATION ARE AS FOLLOWS:

DISTRICT	SPECIES	kg/ha PLS
1 (MISSOULA)	CANADA WILDRYE	3.5
	SECAR BLUEBUNCH WHEATGRASS	5.5
	CRITANA THICKSPIKE WHEATGRASS	5.5
	COVAR SHEEP FESCUE	2.0
	CEREAL BARLEY	5.5
2, 3, 5 (BUTTE, GREAT FALLS, BILLINGS)	CANADA WILDRYE	3.5
	SECAR BLUEBUNCH WHEATGRASS	5.5
	SODAR STREAMBANK WHEATGRASS	5.5
	COVAR SHEEP FESCUE	2.0
	CEREAL BARLEY	5.5
4 (GLENDIVE)	CANADA WILDRYE	3.5
	SECAR BLUEBUNCH WHEATGRASS	5.5
	ROSANA WESTERN WHEATGRASS	5.5
	LODORM GREEN NEEDLEGRASS	3.5
	CEREAL BARLEY	5.5

SLOPES STEEPER THAN 3:1

PRELIMINARY

REFERENCE STANDARD SPEC. SECTION 208

DWG. NO. 208-??

EROSION SEEDING (SS-15)

EFFECTIVE:

CDM Camp Dresser & McKee Inc.