Slope Roughening, Terracing, and Rounding

Description

Methods of slope grading to reduce potential erosion by decreasing runoff velocities, trapping sediment, shortening slope length, and increasing infiltration into the soil.

Applications

- Areas where seeding, planting, and mulching erosion control measures may be enhanced by roughening of the soil surface. Graded areas with smooth, hard surfaces.
- Areas requiring terracing to shorten the slope length.
- Locations where vegetation is not adequate erosion protection and is affecting construction activity.

Installation and Implementation Requirements

CUT SLOPE ROUGHENING

- Cut slopes steeper than 3:1 (H:V) shall use stair-step grading or furrows.
- Use stair-step grading on soft soils that may be ripped by a bulldozer. Stair-step grading is particularly suitable for slopes consisting of soft rock with some subsoil.
- The vertical cut shall not exceed 2 feet in soft materials and 3 feet in rocky material.
- The vertical cut must be shorter than the horizontal cut. The typical stair width is 1 to 2 feet.

Slope Roughening, Terracing, and Rounding

Installation and Implementation Requirements *(continued)*

- Slope the horizontal cut towards the face of the slope, so storm water drains towards the slope and allows time for sediment to settle.
- Create ridges and depressions along the slope contours using machinery.

FILL SLOPE ROUGHENING

- Fill slopes steeper than 3:1 (H:V) shall be placed in lifts not exceeding 9 inches. Each lift shall be properly compacted.
- Slope faces shall consist of 4 to 6 inches of loose and uncompacted soil.
- Grooving or tracking shall be used to roughen slope faces as necessary.
- Apply seed, fertilizer, and mulch. Track or punch in the mulch. *See* section EC-14 Mulching and section EC-12 Seeding and Planting for additional information.
- The final slope face shall not be bladed or scraped.

CUTS, FILLS, AND GRADED AREAS

- Slopes that will be maintained by mowing shall be no steeper than 3:1 (H:V).
- Create shallow grooves by normal tilling, disking, harrowing, or use of a cultivator-seeder. Final pass of tillage shall be along the contour. Spacing between grooves shall be 10 inches or less. Groove depth shall be a minimum of 1 inch.

ROUGHENING WITH TRACKED MACHINERY

- Roughening with tracked machinery is only applicable to soils with a sandy texture. Other types of soil may be over-compacted by tracked machinery.
- Application is best for slope grades 3:1 (H:V) or flatter.
- Leave horizontal depressions in the soil by operating tracked machinery up and down the slope. During the final grading operation, do not back blade.
- Minimize the number of passes the tracked machinery makes to avoid over-compaction.
- Roughened areas shall be seeded and mulched for optimum seed germination and growth.

Machinery tracking must leave horizontal depressions on the slope soil. Horizontal depressions decrease runoff velocities, trap sediment, shorten slope length, and increase infiltration in the soil.

Slope Roughening, Terracing, and Rounding

Installation and Implementation Requirements *(continued)*

TERRACING

- Slope grades of 5:1 (H:V) shall include terraces or benches when slope heights exceed 30 feet. Steeper slope or highly erosive soil conditions may warrant terraces or benches for slope heights of 15 feet or higher.
- Runoff collected along terraces and benches shall be routed to lined diversion ditches. Install lined diversion ditches at the intersection of the terrace and slope.
- Vertical cut shall be between 1 and 2 feet. Horizontal cut must be longer than the vertical cut and slope inward towards the face of the slope. Benching width is usually made wide enough for mowing equipment.

ROUNDING

- All slopes shall be rounded with no sharp breaks in plan or profile.

Considerations

- Since terracing is permanent, design and approval shall be under the direction of a licensed, qualified engineer.
- Design of terraces shall provide adequate drainage and stabilized outlets.
- Roughening may result in increased grading costs and sloughing in soil.
- Stair-step grading are for cut slopes only and may not be applicable to sandy, steep, or shallow soils.
- During intense rainfall events, roughening may not be an effective temporary erosion control measure.

Terracing design and approval must be under the direction of a licensed, qualified engineer.

- Surface roughening must not be used to keep an area under the qualification of "actively working" to prolong the stabilization deadline.
- Slopes need to be regraded and reseeded if rills and gullies form, creating channels for runoff.
- Excessive compaction with tracking machinery can inhibit vegetation growth and cause higher runoff rates.

Slope Roughening, Terracing, and Rounding

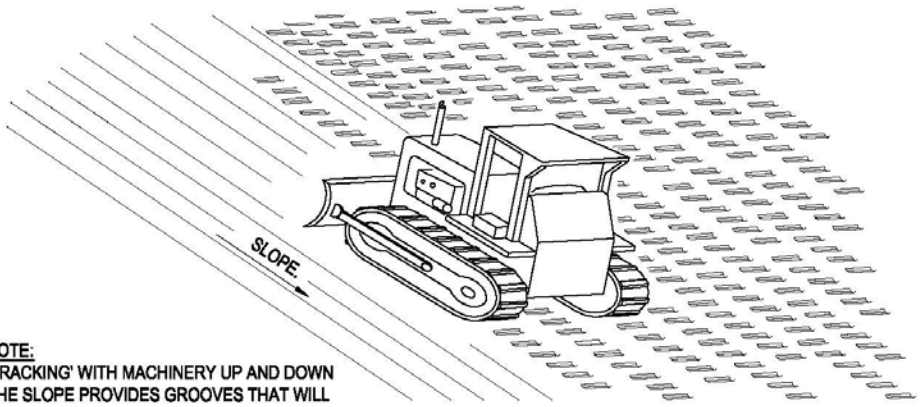
What to Inspect

- Is there evidence of rills and gullies on seeded and planted slopes?
- Does the slope have adequate vegetation coverage?
- Are proper cuts and methods being used to reduce erosion?

Maintenance

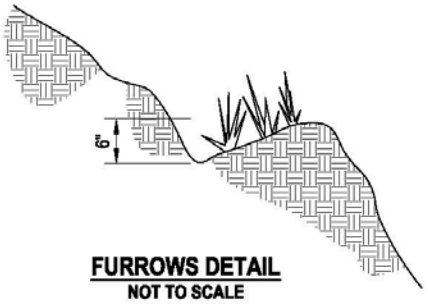
- Regrade and reseed areas where rills or gullies have formed.
- Revegetate bare areas on slope.

Slope Roughening, Terracing, and Rounding

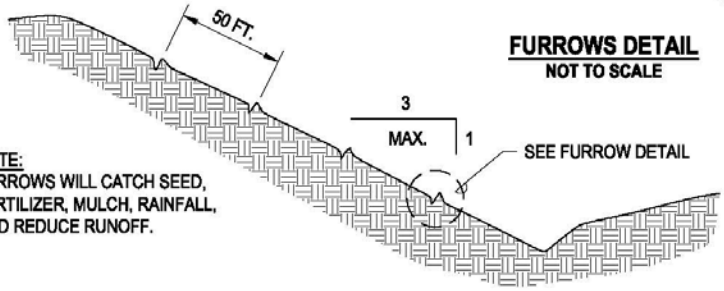


NOTE:
'TRACKING' WITH MACHINERY UP AND DOWN THE SLOPE PROVIDES GROOVES THAT WILL CATCH SEED, FERTILIZER, RAINFALL, AND REDUCE RUNOFF.

TRACKING
NOT TO SCALE



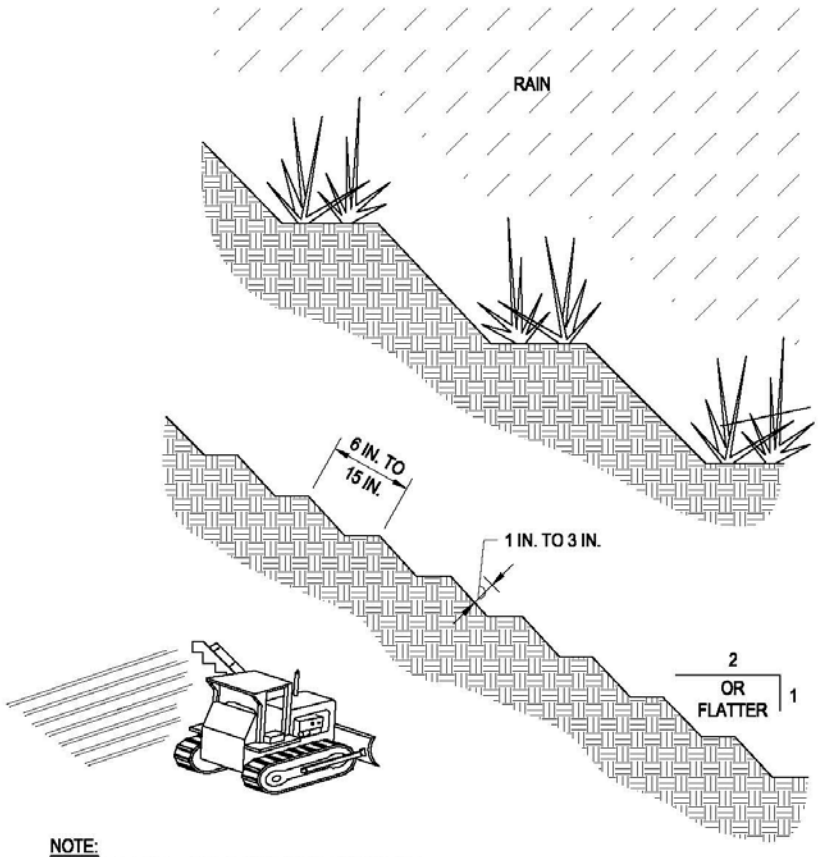
FURROWS DETAIL
NOT TO SCALE



NOTE:
FURROWS WILL CATCH SEED, FERTILIZER, MULCH, RAINFALL, AND REDUCE RUNOFF.

CONTOUR FURROWS
NOT TO SCALE

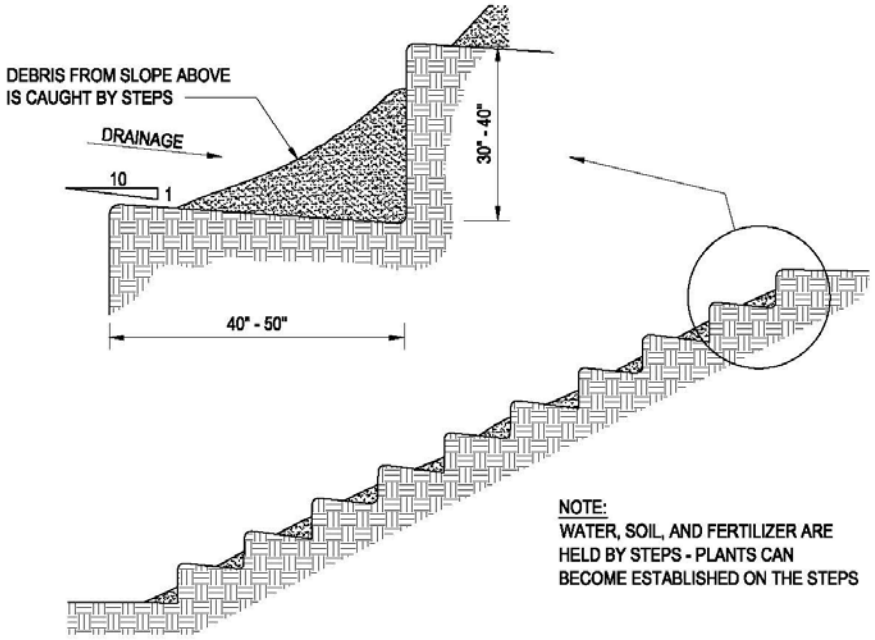
Slope Roughening, Terracing, and Rounding



NOTE:
GROOVE BY CUTTING SERRATIONS ALONG THE CONTOUR. IRREGULARITIES IN THE SOIL SURFACE CATCH RAINWATER, SEED, MULCH, AND FERTILIZER.

SERRATED SLOPE
NOT TO SCALE

Slope Roughening, Terracing, and Rounding



STAIR STEPPING CUT SLOPES
NOT TO SCALE

Slope Drains and Subsurface Drains

Description

Pipes to prevent erosion along slopes by intercepting and conveying runoff or groundwater from the top of the slope to a stabilized discharge point located at the bottom of the slope. Slope drains are primarily used to convey runoff down cut or fill slopes. Subsurface drains are primarily used to remove water from the soil in sloped areas.

Applications

- Use of slope drains is applicable to the following:
  - Drainage of concentrated runoff from within swales or behind dikes located at the top of slopes.
  - Drainage of surface runoff to prevent erosion along the slope.
- Emergency spillways for sediment basins.
- Use of subsurface drains is applicable to areas where water must be removed from the soil to lower the groundwater table or to prevent excessive soil saturation.

Installation and Implementation Requirements

SLOPE DRAIN DESIGN CONSIDERATIONS

- Consult with a hydrogeologist or qualified engineer regarding design flows.
- Limit drainage area discharging to slope drain to 5 acres.
- Direct surface runoff into slope drain using interceptor dikes at the top of slope. *See* section EC-5 Earth Dikes, Swales, and Ditches for more information.

Slope Drains and Subsurface Drains

Installation and Implementation Requirements *(continued)*

- Pipe slope drains exceeding 12 inches in diameter require a standard flared end section or headwall constructed at the inlet and outlet.
- Common materials used for slope drains is plastic lining, fiber matting, flexible plastic pipe, metal pipe, rigid pipe, and half round pipe.
- Install lining such as vegetation or geotextile filter fabric to protect area around inlet.
- Install rip-rap or other energy dissipation device at outlets.
- Place rip-rap so it extends to the maximum flow depth, or to a point where vegetation will be satisfactory to control erosion.

High flow velocities at the pipe outlet require the implementation of velocity dissipation devices to prevent downstream erosion.

- Compact soil under and around inlet, outlet, and along the pipe.
- Slope drain must be installed on a slope gradient of 3% or greater.
- Slope drains may be installed above-ground or buried beneath the slope surface.
- Drains that are buried beneath the slope surface must have an earth dike, a minimum of 12 inches, on top of the pipe at the top of slope.
- Above-ground installation shall utilize pipe anchors to secure pipe to ground and be spaced a maximum of 10 feet apart.
- Align slope drain perpendicular to contours of slope. Generally, limit maximum slope to 2:1 (H:V). For slopes exceeding 2:1 (H:V), velocity dissipation is required at the pipe outlet.
- A half round pipe, fiber matting or plastic lining can be installed for shorter slopes that have a gradient flatter than 2:1 (H:V).
- Berms must remain relatively low and vegetated. Limit berm height to no more than 24 inches in height.
- The pipe should have a minimum diameter of 12 inches and should be equal over the entire length. Maximum pipe diameter is 24 inches due to height limitations of berms.
- Direct sediment-laden storm water to a sediment trap or sediment basin.

Slope drains may be installed above-ground or buried beneath the slope surface.

Slope Drains and Subsurface Drains

Considerations

- Drainage area discharging to slope drains shall not exceed 5 acres. For larger areas, use multiple pipes, paved chute, or rock lined channel.
- Clogged slope drains direct runoff around pipe which may result in erosion along the slope.
- High flow velocities at the pipe outlet require implementation of velocity dissipation devices to prevent downstream erosion. *See* section EC-8 Outlet Protection and Velocity Dissipation Devices for more information.
- High flows may wash away velocity dissipation devices at the outlet, which leaves the area susceptible to erosion.
- Severe flooding and erosion may result from failure of slope drains and storm water overtopping the berm.

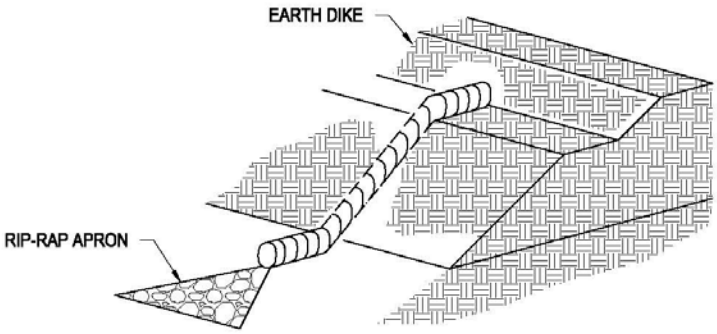
What to Inspect

- Are slope drains accumulating debris and sediment?
- Is there evidence of scour or erosion at the outlet?
- Is the pipe damaged or leaking?
- Are the pipe connections watertight?
- Is the pipe anchored to the slope?
- Is ponding occuring in active traffic lanes or material storage areas?

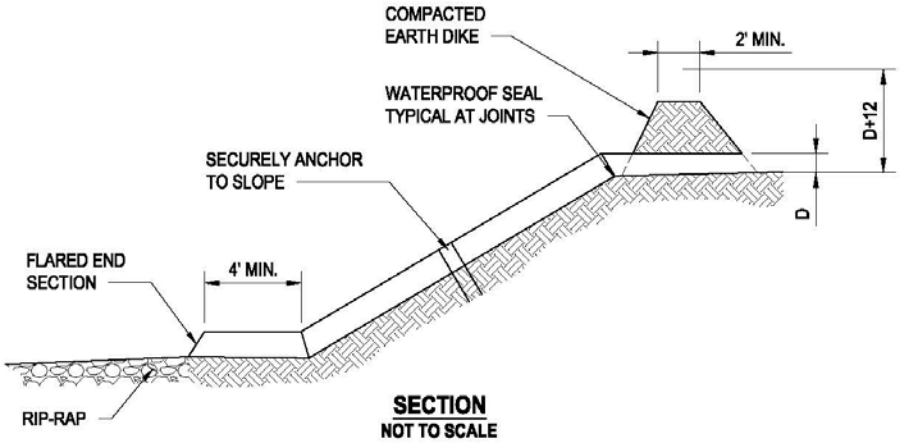
Maintenance

- Repair damage caused by erosion and scour, and install energy dissipation devices as necessary.
- Remove sediment and debris from entrances, outlet, and within drains to maintain flows.
- Repair/replace pipe if it is leaking or damaged.

Slope Drains and Subsurface Drains



PERSPECTIVE
NOT TO SCALE



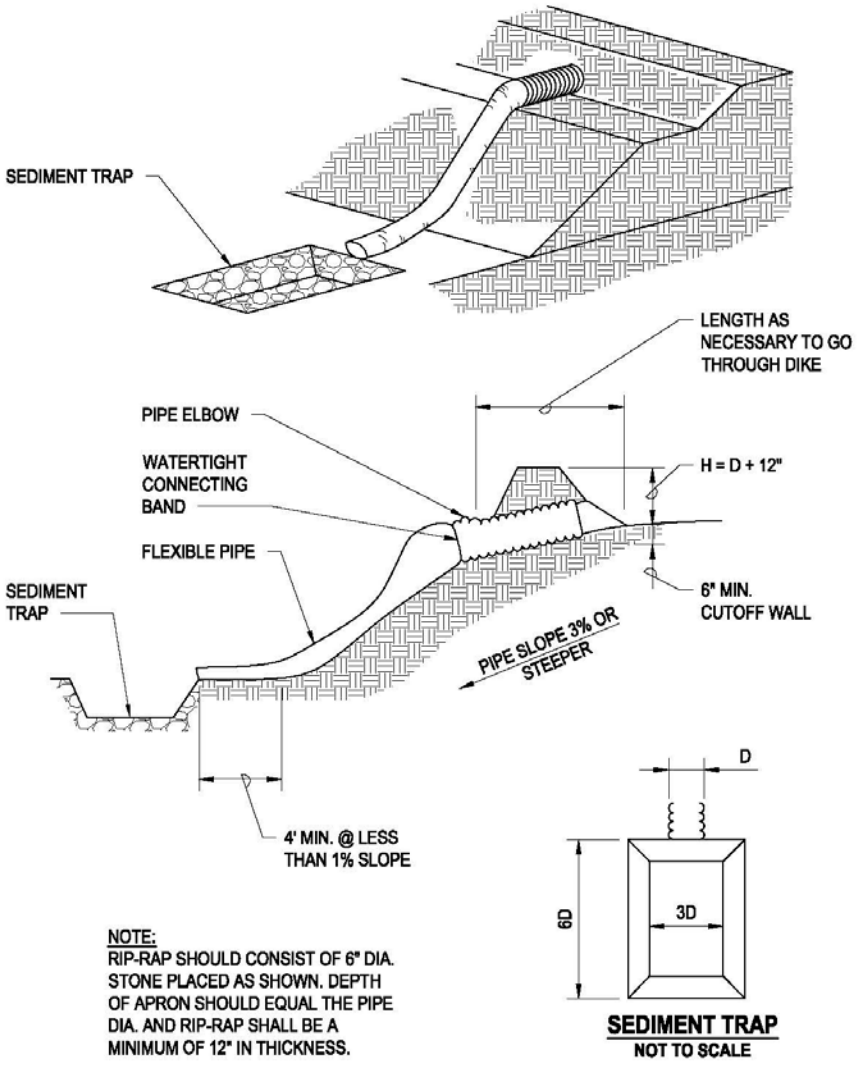
SECTION
NOT TO SCALE

NOTES:

1. INSTALL SLOPE DRAINS PERPENDICULAR TO SLOPE CONTOURS.
2. SLOPE DRAINS CAN BE PLACED ON OR BURIED UNDERNEATH THE SLOPE SURFACE.
3. COMPACT SOIL AROUND AND UNDER ENTRANCE, OUTLET, AND ALONG LENGTH OF PIPE.
4. SECURELY ANCHOR AND STABILIZE PIPE AND APPURTENANCES INTO SOIL.
5. CHECK TO ENSURE THAT PIPE CONNECTIONS ARE WATERTIGHT.
6. PROTECT AREA AROUND INLET WITH FILTER CLOTH.
7. TOP OF INTERCEPTOR DIKES SHOULD BE LIMITED TO 12" HIGHER THAN THE TOP OF THE SLOPE DRAIN.
8. MAXIMUM SLOPE IS GENERALLY LIMITED TO 2:1 (H:V).
9. DIRECT SURFACE RUNOFF TO SLOPE DRAINS WITH INTERCEPTOR DIKES.
10. PROTECT OUTLET OF SLOPE DRAINS USING FLARED END SECTION WHEN OUTLET DISCHARGES TO A FLEXIBLE ENERGY DISSIPATION DEVICE. THE FLARED SECTION SHOULD SLOPE TOWARDS THE PIPE INLET.

PIPE SLOPE DRAIN (RIGID)

Slope Drains and Subsurface Drains



PIPE SLOPE DRAIN (FLEXIBLE)
NOT TO SCALE

Slope Interceptor or Diversion Ditches/Berms

Description

Methods to minimize sheet flow over slopes and reduce erosion by intercepting and conveying runoff to sediment removing structures or a protected drainage system.

Applications

- Protecting slopes from sheet flow runoff.
- Areas which must be protected from runoff flowing down slopes.
- Installed horizontally across disturbed slopes to reduce runoff velocity.
- Slopes where runoff must be intercepted at bottom of slope.
- Terraced areas on large/long slopes.
- Remove runoff to treatment area.
- A built-in ditch/swale at the base or top of the disturbed slope to divert storm water to an area where erosion control is prevalent.

Installation and Implementation Requirements

- Design flows and safety factors shall be determined by an evaluation of risks associated with erosion and overtopping, flow backups, or structure washouts. Consult with the District Maintenance Engineer or Highways Division's Hydraulic Section to determine these values.
- Ditches with high flow velocities shall be lined or stabilized. Consider use of rock check dams to slow flow.

Slope Interceptor or Diversion Ditches/Berms

Installation and Implementation Requirements *(continued)*

- Direct flows at top of slopes to slope drains or a sediment trap. *See* sections EC-7 Slope Drains and Subsurface Drains and SC-4 Sediment Trap for more information.
- A BMP device (dike, berm, compost filter sock) should be installed at the top of disturbed slopes until the slope is revegetated or temporary erosion control is installed on the face of the slope.
- Protect outlets from erosion.
- Place slope interceptors as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 feet.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber rolls should be placed at a maximum interval of 15 feet.
  - Slope inclination 2:1 (H:V) or greater: Fiber rolls should be placed at a maximum interval of 10 feet; a closer spacing is more effective.
- Stakes should be installed to secure compost filter berms. Drive stakes at least 12 inches into the ground. *See* section SC-6 Compost Filter Berm/Sock for more information.

Compost filter berms must be staked into the slope to secure them into the ground.

Considerations

- Additional sediment trapping BMP devices may be necessary for sediment-laden runoff.
- Slope interceptors on steeper slopes will need to be spaced closer due to faster flows.
- Slopes made up of a higher percentage of clay will increase the velocity of sheet flow.

Avoid using silt fences on slopes. However, if silt fence is placed on a slope, the fence post may need additional embedment.

Slope Interceptor or Diversion Ditches/Berms

What to Inspect

- Are washouts evident in ditches or berms?
- Are structures accumulating sediment and/or debris?
- Is there evidence of rill or gully erosion?
- Is sediment discharging into outlets?
- Are berms correctly trenched and staked?
- Are berms properly spaced on slope?
- Is a BMP device installed at the top of the disturbed slope?
- Are additional BMPs required to prevent erosion and undermining?

Compost filter berms that do not maintain direct contact with soil allows erosion and undermining to occur.

Maintenance

- Repair or replace rip-rap as needed.
- Repair damaged lining as needed.
- Use soil stabilizers.
- Compact fill berms and revegetate.
- Compact and revegetate ditches as needed.
- Remove accumulated sediment when it reaches one-half the height of the berm.
- Repair/replace compost filter berms that have rips and tears.

Geotextiles and Mats

Description

Natural or synthetic mats are roll-type materials used for temporary or permanent soil stabilization and protection from rain/wind erosion.

Applications

- Stabilize drainage ditches, channels, and stream banks.
- Stabilize steep slopes with high potential for erosion.
- Stabilize slope until vegetation is established.
- Hold water near surface to assist in vegetation growth.
- Protect stockpiles from wind erosion.
- Suppress weed growth.
- Provide temporary cover for bare areas that are idle.

Installation and Implementation Requirements

- Apply matting to disturbed soils and areas where vegetation has been removed.
- Install matting immediately after the area is seeded and fertilized.
- Minimize disturbance of slopes greater than 15% in grade.
- Phase disturbances and use stabilization techniques designed for steep grades if disturbance of steep slopes is unavoidable.

Geotextiles and Mats

Installation and Implementation Requirements *(continued)*

- Grade and shape disturbed slopes prior to installing geotextiles and/or erosion control matting.
- Prepare area by removing rocks, vegetation and other obstructions that will inhibit direct contact with soil.
- Entrench or anchor material at the top and bottom of the slope in a 6-inch × 6-inch trench or per manufacturer's specifications, whichever is more stringent. The trench should be placed a minimum of 12 inches from the top of the slope.
- Intermittent check slots can also be installed for large or long lengths of matted areas to increase stability of the area.

Check with manufacturer's specifications for erosion control matting anchorage requirements.

- Do not stretch matting. Maximize mat contact with soil by loosely laying blankets and securing to slope with stakes.
- Ensure matting maintains direct contact with soil to prevent rills, gullies, and undermining.
- Follow manufacturer's specifications on overlapping and stake spacing requirements. Steep slopes may require additional staking requirements.
- If geotextile matting is to be installed on steep slopes greater than 15%, space stakes every 2 feet.
- Organic matting provides temporary protection until permanent vegetation has been established or construction activities recommence. Organic matting materials include the following:
  - Jute matting
  - Straw matting
- Synthetic matting provides temporary or post-construction soil stabilization in both vegetated and non-vegetated areas. Synthetic matting materials include the following:
  - Excelsior™ matting
  - Glass fiber matting
  - Stakes
  - Mulch netting
  - Plastic sheeting/covering

Phase disturbances and use stabilization techniques designed for steep grades if disturbance of steep slopes is unavoidable.

Geotextiles and Mats

Installation and Implementation Requirements *(continued)*

- Key in temporary plastic sheeting at top of slope and weigh down by gravel bags no more than 6 feet apart.
- Install erosion control measures or devices at the top and toe of the slope to filter sediment-laden runoff and decrease storm water velocity.
- Other proprietary devices may be used and shall be installed per manufacturer's recommendations.
- The contractor shall immediately initiate soil stabilization measures when earth-disturbing construction activities on exposed areas have been completed or will be temporarily inactive for 14 or more calendar days.

Considerations

- Minimize use of matting to areas where other erosion control measures are not applicable such as channels or steep slopes since matting is costly compared to other erosion control measures.
- Seed germination may be delayed due to decreased soil temperature.
- Extensive soil preparation is needed before installation for adequate contact with slope.
- Mats made of natural material have a limited life and low shear strength.
- High material cost and extensive manpower needed.
- Generally, the slope needs to be smooth and free of large rocks.
- Plastic sheeting results in 100% runoff and is easily torn/damaged.

What to Inspect

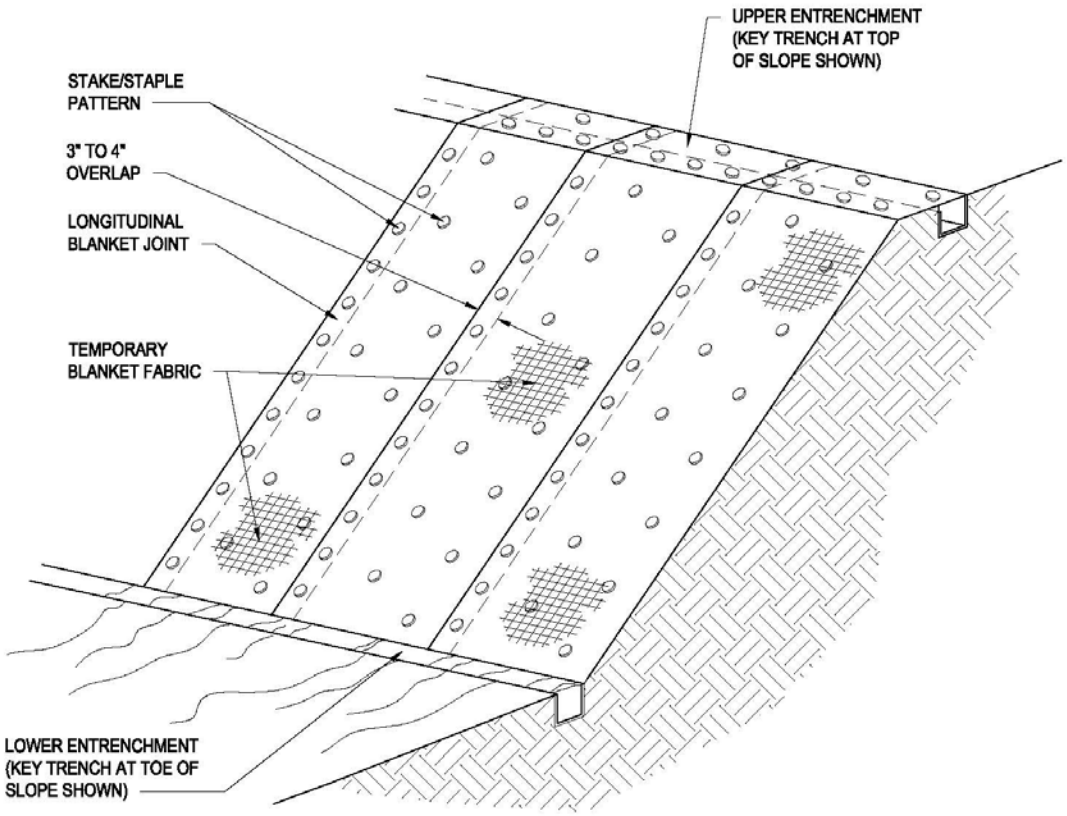
- Is there evidence of undercutting at the top of slope?
- Is the slope eroding beneath the blanket?
- Are blankets firmly anchored and trenched in at top and bottom of slope?
- Are blanket segments properly overlapped?
- Are stakes properly spaced and driven into the soil to prevent the blanket from lifting away from soil?
- Is matting free from any defects or tears?
- Are there areas not adequately growing vegetation?

Matting must maintain direct contact with soil to prevent rills, gullies, and undermining.

Maintenance

- Repair undermining or erosion.
- Repair/replace damaged blankets.
- Replace stakes and sandbags as needed.
- Reseed and fertilize areas not adequately growing vegetation.

Geotextiles and Mats



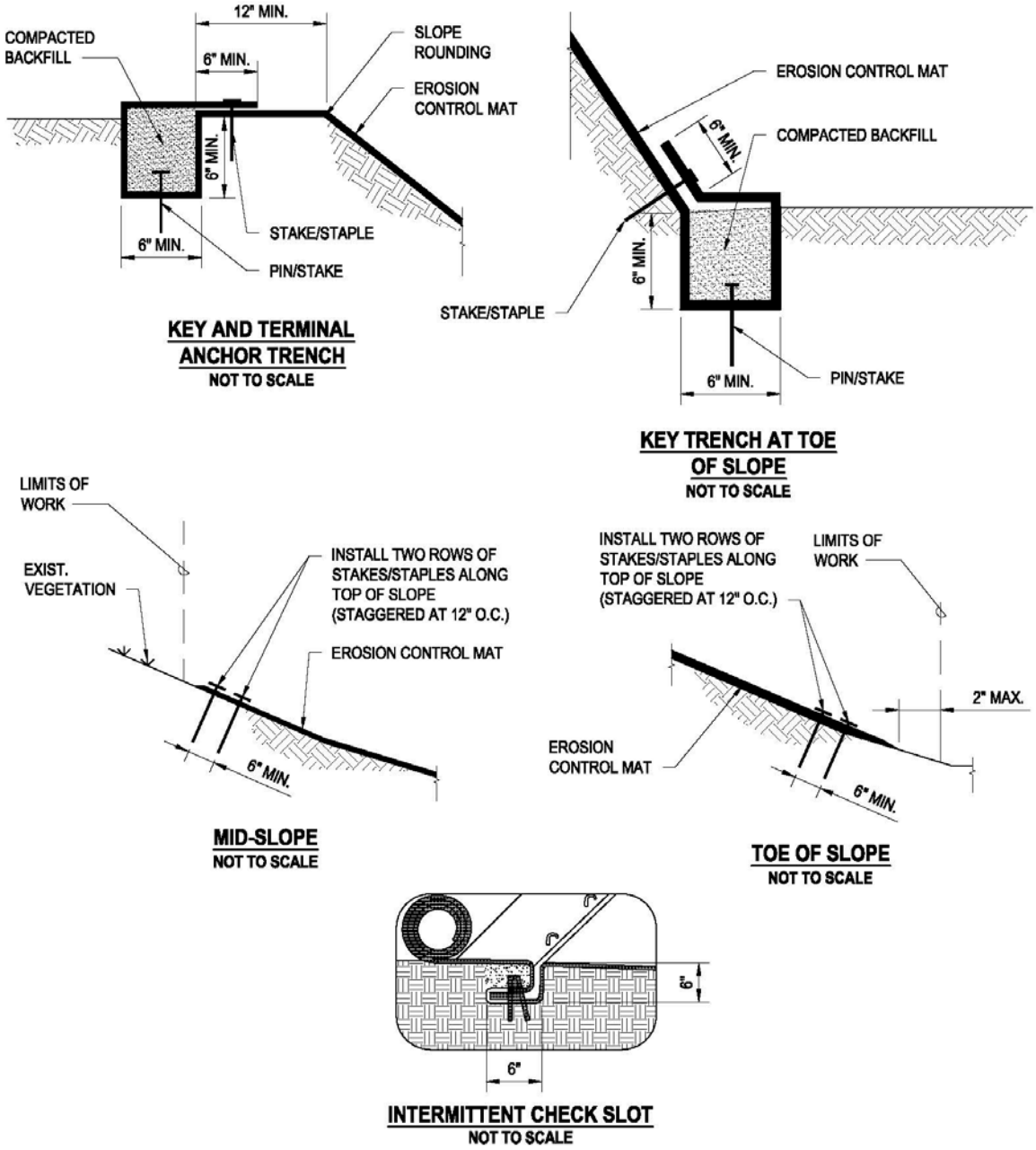
TEMPORARY EROSION CONTROL BLANKET ON SLOPE
NOT TO SCALE

NOTES:
1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS, AND GRASS. SOIL CONTACT SHALL BE MAXIMIZED.

2. LAY BLANKETS LOOSELY AND STAKE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.

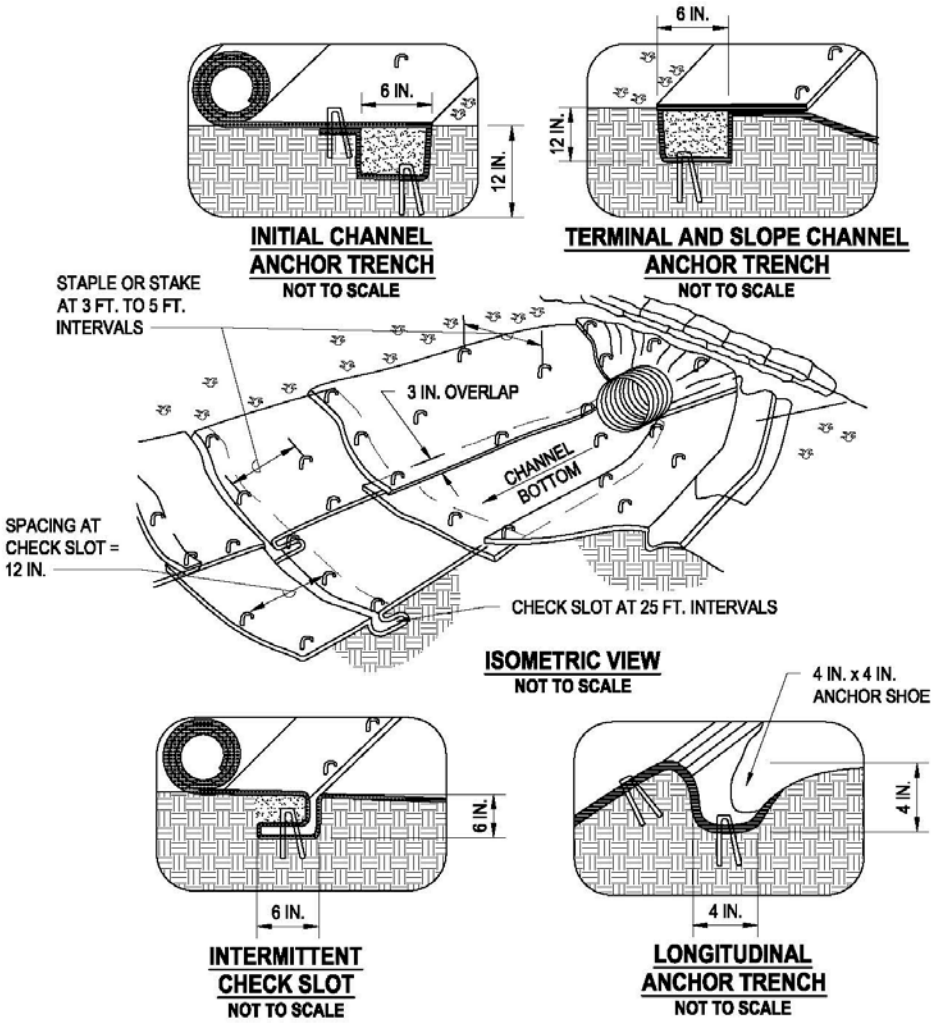
3. INSTALLATION MAY VARY ACCORDING TO MANUFACTURER'S RECOMMENDATIONS. APPLY THE MORE STRINGENT REQUIREMENT.

Geotextiles and Mats



GEOTEXTILES AND MATS INSTALLATION DETAIL FOR SLOPES

Geotextiles and Mats



GEOTEXTILES AND MATS DETAIL FOR CHANNELS

NOTES:
1. CHECK SLOTS TO BE CONSTRUCTED PER MANUFACTURER'S SPECIFICATIONS.

2. STAKING OR STAPLING LAYOUT PER MANUFACTURER'S SPECIFICATIONS.

Seeding and Planting

Description

Practices and procedures to provide ground cover for temporary or permanent stabilization of soil.

Applications

Soil stabilization during or after the construction phase applies to the following site conditions:

- Graded/cleared areas upon temporary or permanent cessation of earth-disturbing activities
- Open space and fill areas
- Steep slopes
- Spoil piles or temporary stockpile of fill material
- Vegetated swales
- Landscape corridors
- Stream banks

Installation and Implementation Requirements

- Coordinate temporary vegetative stabilization with permanent vegetative stabilization.
- Restrict vehicle/equipment use in areas where vegetative stabilization will be used to avoid soil compaction.

Installation and Implementation Requirements *(continued)*

- A licensed landscape architect should review the proposed vegetation to be used for the project.
- Condition the soil to promote vegetative growth prior to planting in areas where vehicle/equipment use cannot be avoided.
- Contractor shall keep records of application dates, type(s), amount of fertilizer used, and the areas covered.
- Plant vegetation immediately after Engineer approval.
- Minimize the amount of exposed soil during construction activity by phasing disturbances.
- Preserve native topsoil and vegetation where practicable.
- Use of invasive species is prohibited.

SEEDING AND PLANTING APPLICATION CONSIDERATIONS

- Type of vegetation
- Site and seedbed preparation
- Seasonal planting times
- Fertilizers
- Water

GRASSES

- Ground preparation requires fertilization, scarification, and mechanical stabilization of the soil.
- Can tolerate short-term temperature extremes and waterlogged soil conditions.
- Appropriate soil conditions include a shallow soil base, good drainage, and 2:1 (H:V) or flatter slope.
- Quickly develops from seeds.
- Vigorous grass growth depended on mowing, irrigating, and fertilizing.
- Immediately after seeding or planting the area to be vegetatively stabilized, to the extent necessary to prevent erosion on the seeded or planted area, install non-vegetative erosion controls that provide cover (e.g., mulch, rolled erosion control products) to the area while vegetation is becoming established.

TREES AND SHRUBS

- Selection dependent on vigor, species, size, shape, and potential wildlife food source.
- Consider wind/exposure and irrigation requirements.
- Plant indigenous species where possible.

Installation and Implementation Requirements *(continued)*

VINES AND GROUND COVER

- Lime and fertilizer required for ground preparation.
- Use appropriate seeding rates.
- Consider requirements for drainage, acidity, and ground slope.
- Plant indigenous species where possible.
- Avoid species that require irrigation.

FERTILIZER USE

- Do not apply fertilizers or pesticides during or just before a rain event.
- Do not apply to storm water conveyance channels with flowing water.
- Comply with fertilizer and pesticide manufacturer's recommended usage and disposal instructions. Do not over apply.
- Apply fertilizers at the appropriate time of year for the location, and preferably as closely as possible to the period of maximum vegetation uptake and growth.
- Where possible, till fertilizer into soil rather than surface spreading or spraying on steep slopes.
- Minimize discharges of fertilizers containing nitrogen or phosphorus.
- Store fertilizer in original container with proper labeling, sealed, and under cover or covered with secondary containment.
- Follow federal, state, and local laws regarding fertilizer application.

WATERING

- Quantity and frequency of watering may vary depending on type of vegetation, type of soil, location, frequency of rainfall, and slope.
- Regulate quantity of water to prevent erosion and formation of gullies.
- Temporary irrigation may be required for initial establishment of vegetation and sustained growth.
- Permanent water supply source may be required for certain types of vegetation.

Temporary irrigation may be required for initial establishment of vegetation and sustained growth.

STABILIZATION

- Initiate soil stabilization measures immediately whenever earth-disturbing activities have permanently or will/has temporarily ceased for 14 or more calendar days on any portion of the site to prevent erosion.

Installation and Implementation Requirements *(continued)*

  - Types of activities that constitute initiation of stabilization include the following:
    - Prepping the soil for vegetative or non-vegetative stabilization.
    - Applying mulch or other non-vegetative product to the exposed area.
    - Seeding or planting the exposed area.
    - Starting any activities listed above on a portion of the area to be stabilized, but not on the entire area.
    - Finalizing arrangements to have stabilization product fully installed in compliance with the deadline for completing initial stabilization activities.
- Stabilization activities must be completed as soon as practicable, but no later than 14 days after the initiation of soil stabilization measures. If area drains to impaired waters, stabilization activities must be completed as soon as practicable, but no later than 7 days after the initiation of soil stabilization measures. Refer to the Hawaii Administrative Rules (HAR) Title 11, Chapter 55, Appendix C for more information.
  - Types of activities that constitute completion of initial stabilization activities include the following:
    - For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized.
    - For non-vegetative stabilization, the installation or application of all such non-vegetative measures.
- Vegetative coverage must be perennial.
- Establish uniform vegetation, which provides 70% of coverage that was provided by vegetation prior to commencing earth-disturbing activities.
- The contractor should take pictures of the area being used prior to installing BMPs. This will provide evidence of the amount of vegetation in the area prior to commencing earth-disturbing activities.
- Immediately after seeding the area the contractor shall install non-vegetative erosion controls, to the extent necessary, to provide cover to the area while vegetation is becoming established.
- Install perimeter controls around exposed areas where vegetation is becoming established to prevent sediment-laden runoff from entering storm drain systems and open waterbodies.
- Remove non-vegetative erosion controls once the area is deemed stabilized by the Engineer.

Install non-vegetative erosion controls, to the extent necessary, to provide cover to areas where vegetation is becoming established.

Seeding and Planting

Considerations

- During dry periods without irrigation, permanent and temporary vegetation may not grow.
- Improper application of fertilizer may contribute to storm water pollution.
- Vegetative coverage must be perennial for final stabilization.
- Lack of dedicated water supply may require a temporary water source.
- Rainwater can wash away seeds and fertilizer from areas being restabilized.
- It is common for topsoil to be lost from grading, which causes the soil to lack nutrients for seeds to germinate.
- Disturbed areas may be difficult to stabilize if soil has been compacted.

What to Inspect

- Is vegetation growing?
- Is there evidence of erosion?
- Are fertilizers being properly stored and handled?
- Are fertilizers being over applied or applied in an improper area?
- Is there at least 70% vegetative coverage?
- Are temporary non-vegetative stabilization devices installed?
- Has soil been conditioned?
- Are native plants being used?
- Has the contractor initiated vegetative stabilization within the required timeframe?

Maintenance

- Water, fertilize, mow, weed, and/or prune the grasses/plants as needed.
- Repair broken or leaking water lines, sprinklers, or valves used for irrigation.
- Mow temporary plantings as needed to prevent signage/site obstructions, fire hazards, or nuisances to the public.
- Replace plants that fail to develop healthy growth, become injured, or die.
- Remove invasive species.
- Reseed areas where the grass did not grow and/or any areas affected by erosion.

Mulching

Description

Application of loose bulk material to stabilize disturbed soil by protecting bare soil, increasing infiltration, and reducing runoff. Materials suitable for mulching include green material, vegetable fibers (hay or straw), and wood/bark chips.

Applications

- Temporary ground cover until permanent vegetation has been established.
- Method may be used in combination with temporary or permanent seeding to enhance plant growth.
- Areas requiring soil moisture retention to prevent cracking of the soil.
- Ground cover for exposed soil between trees or shrubs.
- Mulch should be used in conjunction with other BMPs for optimal erosion control, especially on slopes.

Installation and Implementation Requirements

VEGETABLE FIBERS (HAY OR STRAW)

- Loose hay or straw which may be used in combination with seeding. Mulching usually follows seeding and the process is described in the following:
  - Apply seed and fertilizer to bare soil.
  - Apply loose hay or straw over top of seed and fertilizer prior to seed germination. Apply at a rate of 2,000 pounds per acre by machine or hand distribution.
  - Evenly distribute mulch on the soil surface to cover 80% to 90% of the ground.

Hydroseeding

Description

Application of a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydromulch equipment to temporarily protect exposed soils from wind and water erosion.

Applications

- Temporary ground cover until permanent vegetation has been established.
- Suitable for disturbed areas that will be redisturbed following an extended period of inactivity.

Installation and Implementation Requirements

- Seed type must be carefully selected based upon anticipated soil type and future irrigation. All seeds must be in conformance with the State of Hawaii Department of Agriculture (HDOA). For information on appropriate seed mixes, visit the Hawaii office of the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) website.
- Avoid use of hydroseeding in areas where future earthwork activities will commence.

Apply hydroseed to moderate soil moisture and temperature until seeds germinate and grow.

Hydroseeding

Installation and Implementation Requirements *(continued)*

- Roughen the slope, fill area, or area to be seeded with the furrow trending along the contours prior to application of hydroseed. Rolling with a crimping or punching type roller or track walking is required on all slopes prior to hydroseeding. *See* EC-4 Slope Roughening, Terracing, and Rounding for more information.
- Apply mulch to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- Avoid spraying hydroseed onto sidewalks, lined drainage channels, roads, and existing vegetation.

EVALUATION OF SITE CONDITIONS CONSIDERATIONS TO SELECT APPROPRIATE HYDROSEEDING MIXTURES

- Soil conditions
- Site topography
- Season and climate
- Vegetation types
- Maintenance requirements
- Sensitive adjacent areas
- Water availability
- Plans for permanent vegetation

Considerations

- Steep slopes are difficult to protect with temporary seeding.
- Hydroseeding shall only be used when there is sufficient time to ensure adequate vegetation establishment and provide adequate erosion control.
- Temporary seeding may not be appropriate without supplemental irrigation.
- Temporary vegetation may have to be removed before permanent vegetation is applied.
- Hydroseeding shall not be used in areas subject to heavy traffic.
- To ensure complete coverage over roughen terrain, hydroseeding may have to be applied from multiple angles and sides.

Hydroseeding

What to Inspect

- Is there evidence of erosion?
- Are there bare areas that need to be reseeded?
- Is an irrigation system installed?
- Does the irrigation system apply complete coverage to the desired areas?
- Is the irrigation system working?
- Are there any areas of exposed soil showing?

Maintenance

- Mulches applied to seeded areas may be disturbed due to wind or runoff. Recover exposed areas until permanent vegetation has been established.
- Replace ornamental and landscape mulches of bark or wood chips if soil is visible in more than 75% of the designated area.
- Follow-up applications must be made as needed to cover weak spots and to maintain adequate soil protection.
- If erosion has occurred, additional mulch may be required. Eroded areas need to be repaired prior to additional mulch being added.

Additional mulch may be needed if erosion of hydroseeded area has occurred.

Mulching

Installation and Implementation Requirements *(continued)*

- Maintain maximum fiber length. Average fiber length shall be greater than 6 inches.
- Use a tackifier, netting, or mechanical "punching" method to anchor mulch. "Punching" refers to the act of crimping or compressing to anchor to the ground. Methods depends on slope steepness, accessibility, soil conditions, and longevity.
- Punching straw or hay to anchor the mulch to the ground is the preferred method of anchoring mulch for the following conditions:
  - Use a spade or shovel on small areas.
  - Use a knife-blade roller or straight bladed coulter ("crimper") on slopes with soil, which can support construction equipment without undesirable compaction or instability.
  - Use plastic netting or jute on small areas and/or steep slopes. Geotextile pins, wooden stakes, or 11-gauge wire staples shall secure netting in place. This condition warrants consideration of the use of matting rather than mulch.
  - Use tackifiers on steep slopes unable to support construction equipment or large application areas where use of nettings, straw, or hay is not cost-effective. Tackifiers glue vegetable fibers together and to the soil surface until the establishment of permanent vegetation.

Use a tackifier, netting, or mechanical "punching" method to anchor mulch. Method depends on slope steepness, accessibility, soil conditions, and longevity.

GREEN MATERIAL

- Consists of recycled vegetation trimming such as grass and shredded shrubs and trees.
- Generally applied manually.
- Temporary ground cover with or without seedings.
- Evenly distribute green material on soil surface. Depth shall not exceed 4 inches.
- Anchor with a tackifier or netting on steep slopes or for areas with anticipated overland sheet flow. The condition warrants consideration of the use of matting rather than mulch.

WOOD/BARK CHIPS

- Suitable for areas which will not be mowed such as around trees, shrubs, and landscape plantings.

Evenly distribute wood/bark chips on soil surface and maintain a 2-inch mulch depth to tree basins and a 4-inch mulch depth to shrub beds.

Mulching

Installation and Implementation Requirements *(continued)*

- Test soils prior to application. Add a minimum of 12 pounds of nitrogen per ton of mulch to counteract the effect of decomposing wood-based materials, which extract nitrogen from soil. Use a balanced, slow-release fertilizer or an organic source such as compost.
- Apply mulch manually.
- Evenly distribute wood/bark chips on soil surface and maintain a 2-inch mulch depth to tree basins and a 4-inch mulch depth to shrub beds.

Considerations

VEGETABLE FIBERS (HAY OR STRAW)

- Requires 3-step machinery.
- Labor intensive installation.
- For applications using straw blowers, the applicable area must be located within 150 feet of a road or surface capable of supporting loads from large vehicles. Use of straw is preferred, in lieu of hay, if available.
- Avoid applying fibers prior to an anticipated rain event.

GREEN MATERIAL

- Limited commercial availability.
- Variable quality.
- Application primarily uses manual labor.
- Unpredictable effectiveness as an erosion control measure. Requires overspray with a tackifying agent to increase effectiveness.
- Application of fertilizer may be required.
- Limit use to non-critical steep slopes and areas where alternative erosion control measures may be readily applied. A critical slope surface exists when a combination of soil and slope factors create a high potential for slope face failure and subsequent erosion, such as a slope greater than 2:1 (H:V) on freshly graded or disturbed slopes. Refer to *Slope Face Stabilization for Critical Slope Surfaces* at website – www.ccriindia.org/pdf/Object335PDFEnglish.pdf for more information on critical slopes.

WOOD/BARK CHIPS

- Poor erosion control effectiveness.

Mulching

Considerations *(continued)*

- Anchoring of chips onto sleep slopes is difficult due to potential movement from high winds.
- Subject to displacement from concentrated flows.
- Use of fertilizer with a high nitrogen content is required. This is to prevent nutrient deficiency in plants due to the decomposing wood-based materials, which extract nitrogen from soil. Improper fertilizer use may contribute to water quality pollution.
- Limit use to non-critical steep slopes and areas where alternative erosion control measures may be readily applied.

What to Inspect

- Is mulch applied to areas which will be regraded and/or revegetated?
- Is there uniform coverage of mulch?
- Was the application rate sufficient for the area?
- Is there evidence of rills or gullies?

Maintenance

- Mulches applied to seeded areas may be disturbed due to wind or runoff. Recover exposed areas until permanent vegetation has been established.
- Replace ornamental and landscape mulches of bark or wood chips if soil is visible in more than 75% of the designated area.
- If erosion has occurred, additional mulch may be required.

Hydromulching

Description

Application of loose bulk material to stabilize disturbed soil by protecting bare soil, increasing infiltration, and reducing runoff. Materials used for mulching include hydraulic matrices, hydraulic mulches of recycled paper or wood fiber.

Applications

- Temporary ground cover until permanent vegetation has been established.
- Method used in combination with temporary or permanent seeding to enhance plant growth.
- Areas requiring soil moisture retention to prevent cracking of the soil.
- Ground cover for exposed soil between trees or shrubs.
- Mulch should be used in conjunction with other BMPs for optimal erosion control, especially on slopes.

Installation and Implementation Requirements

HYDRAULIC MULCHES OF RECYCLED PAPER

- Consists of recycled newsprint, magazines, and other wastepaper sources.
- May be applied with or without tackifiers.
- Hydraulic mulch materials shall conform to *2005 Hawaii Standard Specifications for Road and Bridge Construction*, Standard Specifications & Special Provisions Sections 209, 619 & 641, as in effect.

Hydromulching

Installation and Implementation Requirements *(continued)*

- Mix mulch in a hydraulic application machine (hydroseeder) and apply as a liquid slurry.
- May be sprayed from a cannon up to 200 feet or from a hose up to 1,500 feet away from the application area.
- Mix mulch with seed and fertilizer as specified by the manufacturer. Apply mulch at the manufacturer's recommended rate to ensure uniform and effective coverage.
- Mulch used as temporary ground cover shall be reapplied to bare areas until permanent vegetation has been established.
  - Avoid spraying mulch onto sidewalks, lined drainage channels (i.e., concrete swales and concrete culverts), travelway areas, and existing vegetation.

Mulches must be applied at the manufacturer's recommended rate to ensure uniform and effective coverage.

HYDRAULIC MULCHES OF WOOD FIBER:

- Consists of wood waste from lumber mills or urban sources.
- May be manufactured with or without a tackifier.
- Hydraulic mulch shall conform to *2005 Hawaii Standard Specifications for Road and Bridge Construction*, Standard Specifications & Special Provisions Sections 209, 619, & 641, as in effect. Mix mulch in a hydraulic application machine (hydroseeder) and apply as a liquid slurry.
- Mix mulch with seed and fertilizer as specified by the manufacturer.
- Apply mulch at the manufacturer's recommended rate to ensure uniform and complete coverage.

HYDRAULIC MATRICES

- Hydraulic slurries consisting of wood fiber, paper fiber, or a combination of wood and paper fiber mixed with a binder system.
- Exceeds erosion control performance of blankets due to close contact with soil.
- Apply as an aqueous slurry (with seed) using standard hydroseeding equipment.
- Applications rates vary for different combinations of conditions and products.

Properly applied hydraulic mulches stabilize disturbed soil by protecting bare soil, increasing infiltration, and decreasing runoff.

Hydromulching

Installation and Implementation Requirements *(continued)*

BONDED FIBER MATRIX (BFM) CONSISTING OF PREMIXED FIBER AND BINDERS

- After application and upon drying, BFM shall adhere to soil and form a 100% cover. The cover shall be biodegradable, promote vegetation, and prevent soil erosion.
- Are composed of long strand, thermally produced wood fibers (>88% of total volume by weight), held together by organic tackifiers (10%) and mineral bonding agents (<2%), which become insoluble and non-dispersible upon drying. Composition of BFM varies based on supplier.
- Perform a free liquid quality control test on the liquid slurry.
- Binder shall not dissolve or disperse upon watering.
- Upon applications to the soil, holes in the matrix shall not exceed 0.04 inches in size.
- There shall not be any gaps between the matrix and the soil.
- Minimum water holding capacity of the matrix shall be 1.2 gallons per pound matrix.
- The matrix shall be free of germination of growth inhibiting factors and shall not form a water-resistant crust.
- Materials used for the matrix shall be 100% biodegradable and 100% beneficial to plant growth.
- Testing and evaluation of the matrix by an independent research laboratory shall have been conducted to verify reported erosion control performance.
- A trained and manufacturer certified applicator with knowledge of proper mixing and product application shall install the BFM.

- Typical BFM application rates range from 3,000 to 8,000 pounds per acre per recommendations from various manufacturers.
- BFM shall not be applied 24 hours before an anticipated rain event, during a rainfall event, or immediately after a rainfall event to ensure a drying time of 24 hours after installation.

Considerations

HYDRAULIC MULCHES OF RECYCLED PAPER

- Limited erosion control effectiveness due to short fiber length and absence of a tackifier.
- Limited moisture and soil temperature moderation.
- Residual inks within mulches may be undesirable in environmentally sensitive areas.
- Significant decrease in longevity compared with wood fiber mulch.
- Difficulty budgeting for this product due to volatile prices for recycled paper products.

Hydromulching

Considerations *(continued)*

HYDRAULIC MULCHES OF WOOD FIBER

- Limited erosion control effectiveness.
- Short-term use of 1 growing season.

HYDRAULIC MATRICES

- Avoid applying mulch 24 hours before an anticipated rainfall event, during a rainfall event, or immediately after a rainfall event.
- Hydromulch requires a drying time of 24 hours.
- To ensure complete coverage over roughen terrain, hydromulch may have to be applied from multiple angles and sides.

What to Inspect

- Is mulch applied to areas which will be regraded and/or revegetated?
- Is there uniform and complete coverage?
- Was the application rate sufficient for the disturbed area?
- Is there evidence of rill or gullies?

Maintenance

- Mulches applied to seeded areas may be disturbed due to wind or runoff. Recover exposed areas until permanent vegetation has been established.
- Replace ornamental and landscape mulches of bark or wood chips if soil is visible in more than 75% of the designated area.
- If erosion has occurred, additional mulch may be required.

Soil Binders

Description

Application of soil binders to exposed soil to temporarily prevent water- and wind-induced erosion.

Applications

- Disturbed areas requiring short-term temporary protection.
- Good alternative to mulches in areas where grading activities will soon resume.
- Suitable for use on stockpiles.
- Applied in conjunction with mulching or seeding applications.

Installation and Implementation Requirements

- Soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and must not stain paved or painted surfaces. Soil binders must not pollute storm water. Prior to application, submit the manufacturer's material product data sheets to the Engineer for review and approval.
- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid overspray onto roads, sidewalks, lined drainage channels (i.e., concrete swales and concrete culverts), existing vegetation, etc.

Soil Binders

Installation and Implementation Requirements *(continued)*

SELECTING A SOIL BINDER

- Properties of common soil binders used for erosion control are provided in Table EC-16.3. Use the Table to select an appropriate soil binder.
- Consult with the Engineer if soil binders are an appropriate option for temporary stabilization.
- 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 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, 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 cleanup.

PLANT-MATERIAL BASED (SHORT-LIVED) BINDERS

- Guar: Guar is a non-toxic, biodegradable, natural galactomannan (or plant carbohydrates/sugars) based hydrocolloid treated with dispersant agents for easy field mixing. It must be mixed with water at the rate of 11 to 15 pounds per 1,000 gallons. Recommended minimum application rates are as provided in table EC-16.1.
- Psyllium: Psyllium is composed of the finely ground mucilloid coating of seeds (from Plantago plant) that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12- to 18-hours drying time. Application rates must be 80 to 200 pounds/acre, with enough water in solution to allow for a uniform slurry flow.
- Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 pounds/acre. Approximate drying time is 9 to 12 hours.

Table EC-16.1 Application rates for Guar soil stabilization.

Slope Gradient (H:V)	Pounds/Acre
• Flat	• 40
• 4:1	• 45
• 3:1	• 50
• 2:1	• 60
• 1:1	• 70

Installation and Implementation Requirements *(continued)*

PLANT-MATERIAL BASED (LONG-LIVED) BINDERS

- Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin must be a minimum of 26% of the total solids content. The soil stabilizer must be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and must be applied as follows:
  - For clayey soil: 5-parts water to 1-part emulsion.
  - For sandy soil: 1-part water to 1-part emulsion.
- Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

POLYMERIC EMULSION BLEND BINDERS

- Acrylic Copolymers and Polymers: Polymeric soil stabilizers must consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound must be handled and mixed in a manner that will not cause foaming or must contain an anti-foaming agent. The polymeric emulsion must not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer must be readily miscible in water, non-injurious to seed or animal life, non-flammable, must provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and must not reemulsify when cured. The applied compound should air cure within a maximum of 36 to 48 hours. Liquid copolymer must be diluted at a rate of 10-parts water to 1-part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Soil Binders

Installation and Implementation Requirements *(continued)*

- Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants, or silicates. For soil stabilization applications, it is diluted with water in accordance with manufacturer's recommendations and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after applications.
- Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient, as described in Table EC-16.2.
- Polyacrylamide and Copolymer of Acrylamide: Linear copolymer polyacrylamide is packaged as a dry flowable solid. When used as a standalone stabilizer, it is diluted at a rate of 11 pounds/1,000 gallons of water and applied at the rate of 5 pounds/acre.
- Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable polyacrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 pounds/acre. Drying time is 0 to 4 hours.

Table EC-16.2 Application rates for copolymers of sodium acrylates and acrylamides.

Slope Gradient (H:V)	Pounds/Acre
• Flat to 5:1	• 3 – 5
• 5:1 to 3:1	• 5 – 10
• 2:1 to 1:1	• 10 – 20

CEMENTITIOUS-BASED BINDERS

- Gypsum: This is a formulated gypsum-based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates of 4,000 to 12,000 pounds/acre. Drying time is 4 to 8 hours.

Soil Binders

Installation and Implementation Requirements *(continued)*

APPLYING SOIL BINDERS

Soil binders can be used on large stockpiles to prevent erosion from wind and rain.

- After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. The following steps shall be followed:
  - Follow manufacturer's specifications for application rates, pre-wetting of application area, and cleaning of equipment after use.
  - Prior to application, roughen embankment and fill areas.
  - Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders shall not be applied during or immediately before rainfall.
  - Avoid overspray onto roads, sidewalks, drainage channels (i.e., concrete swales and concrete culverts), sound walls, existing vegetation, etc. Soil binders shall not be applied to areas with standing water, under rainy conditions, or when the temperature is below 40° Fahrenheit during the curing period.
  - More than 1 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 instructions for specific cure time.
  - For liquid agents:
    - Crown or slope ground to avoid ponding.
    - Uniformly pre-wet ground at 0.03 to 0.3 gallons/yard^2 or according to manufacturer's recommendations.
    - Apply solution under pressure. Overlap solution 6 to 12 inches.
    - All 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 humidity, reactivate chemicals by rewetting with water at 0.1 to 0.2 gallons/yard^2.

Soil Binders

Considerations

- Soil binders are temporary in nature and may need reapplication.
- Some soil binders may not be compatible with existing vegetation.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer.
- Soil binders may need reapplication after a rain event.
- 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.
- A sampling and analysis plan should be incorporated into the *Storm Water Pollution Prevention Plan (SWPPP),* as soil binders could be a source of non-visible pollutants.

What to Inspect

- Has soil binder broken down due to natural elements?
- Is there evidence of erosion?
- Does the soil binder need to be reapplied?
- Are the soil binders an effective BMP for the area?

Maintenance

- Repair areas where erosion is evident and reapply BMPs as soon as possible. Care must be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

Soil Binders

Table EC-16.3 Properties of soil binders used for erosion control.

Evaluation Criteria	Binder Type			
	Plant Material Based (Short-lived)	Plant Material Based (Long-lived)	Polymeric Emulsion Blends	Cementitious-Based Binders
Relative Cost	Low	Low	Low	Low
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time Before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/ Powder	Powder	Liquid	Liquid/powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies	Varies	Varies	4,000 to 12,000 pounds/acre