Section 6: Erosion and Sediment Control Design Information

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6.1 Guidelines for Sediment Basin Design

1. Where are sediment basins needed? A sediment basin is needed if there are 10 or more drainage acres going through a pipe, culvert, or other drainageway and 10 or more of those drainage acres are disturbed at once.

2. Eliminate the need for sediment basins. The best way to eliminate the need for sediment basins is to limit the amount of disturbed area at one time. This can be achieved through construction sequencing and the quick stabilization of disturbed areas. Another way to avoid using sediment basins is by using a series of sediment traps and/or best management practices. Our ultimate goal is to keep sediment on-site and out of waters of the state.

3. If I decide a sediment basin is necessary, how do I determine the required capacity? Ask the project grading engineer to calculate the amount of runoff from the drainage area. You may want to have the engineer do this even if you think a sediment basin is not needed to make sure that the alternate best management practices you have chosen to use will be sufficient for the estimated runoff.

4. How do I determine the area needed to build proposed sediment basins? The shape of the basin plays an important role in determining the effectiveness for removing sediment. Length to width ratios should be a minimum of 4:1 to maximize flow path length within the basin. Length is the distance between the inlet and outlet structures. Instead of being a perfect rectangular shape, it is advisable to have the basin wedge-shaped with the inlet at the narrow end. When physical site constraints prevent construction of basins with a length/width ratio of 4:1, silt fence baffles should be used to increase the flow path length within the basin.

In regards to sediment removal, surface area is more important than depth. Additional depth only adds more storage volume. The basin depth should be a minimum of 2 feet and no shallower than the length divided by 200. Basin dimensions can be determined using the following equations:

Basins with volumes less than 80,000 cubic feet	Basins with volumes more than 80,000 cubic feet
$Width = \sqrt{Volume/8}$	$Width = \sqrt[3]{12.5xVolume}$
Length = 4 x Width	*Length = 4 x Width*
Depth = 2 feet (a constant)	*Depth = Length/200*

5. Where should I locate the sediment basin? Refer to the ROW Section and Sections B and X to determine the best location. The sediment basin must:

- be outside the clear zone (30' from the edge of the driving lane) unless it is less than 2 feet deep.
- be within the ROW and proposed easements and above the water table
- have side slopes 3:1 or less (preferably vegetated before water enters the basin)
- be located a sufficient distance from property and waterbodies where a failure could cause catastrophic damage

6.2 Guidelines for Silt Fence Design as Perimeter Protection

Installation and removal of silt fence can increase disturbance—especially if installed incorrectly. Consider other BMP's before choosing to use silt fence. Other options may include:

- Stabilized topsoil berms with rock weepers
- Erosion Control Wattles
- Quick stabilization to reduce sediment runoff and reduce the need for sediment controls such as: temporary/permanent seeding, temporary mulching, or soil stabilizer.
- Temporary sediment barriers
- Floating Silt Curtain
- Temporary Water Barriers
- Triangular Silt Barriers

The guidelines for silt fence installation on slopes and as perimeter protection shown below have been adopted from the NRCS Colorado Fact Sheet.

Slope Steepness	Maximum Slope Length
2:1	50 feet
3:1	75 feet
4:1	125 feet
5:1	175 feet
<5:1	200 feet

- The area that contributes to runoff to be caught by the silt fence should not be greater than ½ an acre for 100 feet of fence.
- Silt fences should be installed on the contour of a slope.
- Limit the length of silt fence to allow the passage of wildlife.
- Installing silt fence in a J-hook pattern on slopes and near work limits allows wildlife to pass and is effective at catching sediment when placed on contour in an overlapping pattern.

6.3 Guidelines for Erosion Control Blanket Design

General

- Erosion Control Blankets are used where fiber or straw mulching is not sufficient to control erosion during vegetation establishment.
- Fiber Reinforced Matrices provide similar protection and may be easier to apply than blanket is to install, but should not be placed in ditch bottoms.
- Use the estimated time it will take to establish vegetation to determine the functional longevity needed. It typically takes longer to establish vegetation in the western portion of the state because of poorer soils and lower rainfall amounts (so Type 3 Erosion Control Blanket may be the best to use on that side of the state).

Type 1 Erosion Control Blanket

- Typical 3 to 6 month functional longevity
- Channels: Calculated Shear Stresses of 0 psf to 1.5 psf
- Slopes: typically used on street boulevards to help establish vegetation
- Channels: typically used on street boulevards to help establish vegetation
- This type is rarely used because most of places where they can be used are usually just mulched.

Type 2 Erosion Control Blanket

- Typical 6 to 12 month functional longevity
- Slopes: 4:1 (H:V) to 3:1 (H:V)
- Channels: Calculated Shear Stresses of 1.5 psf to 1.75 psf
- Ditch Grade of 2% to 4%

Type 3 Erosion Control Blanket

- Typical 12 to 24 month functional longevity
- Slopes: 3:1 (H:V) to 2:1 (H:V)
- Channels: Calculated Shear Stresses of 1.75 psf to 2 psf
- Ditch Grade of 4% to 6%
- One of the most used blankets and usually the least expensive.

Type 4 Erosion Control Blanket

- Typical 24 to 36 month functional longevity
- Slopes: 2:1 (H:V) to 1:1 (H:V)
- Channels: Calculated Shear Stresses of 2 psf to 2.25 psf
- Ditch Grade of 6% to 8%
- At shear stresses this high, it is best to use Turf Reinforcement Mat instead because permanent erosion control will be needed.
- Industry professionals have used this blanket sprinkled with powdered flocculants at sediment trap/basin inlets to increase sediment capture.

6.4 Guidelines for Turf Reinforcement Mat Design

General

- Turf Reinforcement Mats are for permanent stabilization of erodible areas.
- They are not necessarily the next step up from erosion control blankets because they are permanent and needed to prevent erosion even after vegetation has is fully established.
- The drainage manual says the vegetation in our ditches can withstand a shear stress of 2.10 psf when it is not mowed.
- To prevent erosion, it is best to use Turf Reinforcement Mats instead of Erosion Control Blanket in ditches with shear stresses near or above 2 psf. Turf Reinforcement Mat is only a little more expensive, but permanent.
- Talk to the designer about placing turf reinforcement mat under any rip rap adjacent to the planned TRM installation. It has been done in the Winner Area and ensures the mat is correctly anchored in rather than trying to trench it in along the rip rap. It may also provide additional erosion control by allowing vegetation growth in the rip rap.

Type 1 Turf Reinforcement Mat

- Channels: Calculated Shear Stresses of 2 psf to 4 psf

Type 2 Turf Reinforcement Mat

- Channels: Calculated Shear Stresses of 4 psf to 6 psf

Type 3 Turf Reinforcement Mat

- Channels: Calculated Shear Stresses of 6 psf to 8 psf
- Some Turf Reinforcement Mats can withstand Shear Stresses over 8 psf. To specify them they will need to be called out in the plan notes.

6.5 Seeding vs Sodding Design Decision

The following information can be used when the designer needs to choose between seeding and sodding on projects. Keep in mind that sodding can be used on some parts of the project and seeding can be used on other parts of the project depending on what the designer decides using the following information.

Design Information

- Aerial photos and site visits (Consider how well kept the existing lawn is.)
- Slope of the existing lawn as determined in cross sections and grading plans.
- Contact SDDOT field personnel for their input on whether to use seeding or to use sodding on a project.
- Consider requests from landowners for sodding on their property.
- Look at sodding and seeding Unit Prices on CDBS to consider cost differences. (Sodding is always more expensive than seeding.)

Seeding Considerations

- If seeding is used it must include the following:
    - Seeding plus Fiber Mulch (Commonly referred to as hydro turf)
    - Seeding plus Soil Stabilizer
    - Seeding plus Fiber Reinforced Matrix
    - Seeding plus Erosion Control Blanket

Advantages

- More grass types and varieties to choose from
- Less expensive than sodding
- Stronger root system development initially

Disadvantages

- Initial establishment is longer than sodding.
- For best results, time of seeding is limited mainly to late Summer and early Fall.
- Watering must be available because moisture is critical for the young seedlings.

Sodding Considerations

- If there is an underground lawn sprinkler system in place, sodding may be a better choice because of ease of watering and less chance for erosion.
- The SDDOT typically considers the use of sodding only on urban projects.
- Some sod farms offer more drought tolerant species in their sod than in the past

Advantages

- Immediate protection from erosion thus helping to meet erosion and sediment control and storm water quality stabilization requirements sooner
- Can be used as a buffer strip
- Rapid establishment and relatively weed-free in the beginning
- Good for slopes or areas prone to erosion
- Can be laid any time during the growing season as long as watering is available

Disadvantages

- Somewhat expensive
- Less selection as far as species and varieties of grasses
- Availability depending on the time of year

6.6 Erosion and Sediment Control Design Checklist

Date:_____
Project #:_____
County and PCN:_____

Plans, letters, and notes needed to design most projects:

☐Scope Summary in HC65 C2C
☐Section B Grading Plans and Profiles (Road Design Grading Squad)
☐Section X Cross-sections (Road Design Grading Squad)
☐Section Z Pipe Section Sheets (Road Design Grading Squad)
☐Non-Section Plans (Road Design Grading Squad)
☐Right-of-Way Photos (ROW Section of Road Design)
☐Borrow Pit Agreements and Borrow Pit Layouts (Region Materials Engineer)
☐Soils Letter (Geotechnical Office)

- May have erosion control suggestions
- Will likely note rocky areas or slopes
- Will include topsoil depth and/or soil types for SWPPP checklist

☐Landowner (LO) Meeting Notes (Road Design Grading Squad)

- May have special requests for seeding or sodding
- May request colored concrete/landscape rock replacement instead of grass

☐Pavement Removal Plans (Road Design Grading Squad)

- Will help with calculating topsoil, seed, fertilizer, and mulch quantities.

☐Sequence of Operations (Section C from Area Office)

- May help in deciding where more interim erosion and sediment controls are needed

☐Drainage Memo (Hydraulics Office)

- Will show drainage areas at culverts
- Will identify “Waters of the US”. More erosion and sediment controls may be needed.

☐Section A Environmental Commitments (Environmental Office)

- Tree and shrub replacement
- Topeka Shiner
- Fishery Waters
- Wetlands

Other useful design information:

☐Look at Average Unit Prices in CDBS when selecting Erosion and Sediment Control BMPs.
☐USDA Plants Database: to determine plants native to each county for seed mix development
☐Rocky or Rock Slopes
☐Contours (use InRoads to import into gfile).
☐Websoil Survey (USGS) for soils information on projects without Soils Letters
☐ArcGIS: Pipe Surveys and other information
☐Stream Relocation (A consultant may be hired to do the stream relocation plans.)
☐Wetland Mitigation (Usually done in-house if right along a project)
☐Google Maps (to get a better idea of what is shown in the topo and ROW photos)
☐HR49 Roadway Inventory (similar to Google Maps)
☐Environmental folders (if Section A isn’t complete before review)

Tasks for the Erosion and Sediment Control Designer:

☐Keep electronic correspondence and other information in the project directory.
☐Keep good documentation.
☐Look through Electronic Project Files for pertinent information.
☐Look through the entire “Grading Design Project File” in file drawer for pertinent information.
☐Communicate with the Grading Designer thoughout the project.
☐Look at the completed set of grading plans before they go out for review to make sure nothing was missed in regard to Erosion and Sediment Control.

6.7 Erosion and Sediment Control Design Information

PLACING TOPSOIL

Topsoil is salvaged from all areas where grading is to occur under the bid item "Unclassified Excavation" in Section B. It is replaced when grading is finished under the bid item "Placing Topsoil" in Section D. Refer to Section D Standard Notes.

Example Placing Topsoil Calculation for Rural Projects*	
Area of Work Limits measured in Microstation -see U:\rd\Doc\CADD Procedures Manual, E-Erosion Control - determine a quantity for each plan sheet	284,548 SqFt
Length of Roadway -calculated using the stationing on each plan sheet	30+00 to 60+00 = 3,000 Ft
Area of Roadway -calculated by multiplying the length of the roadway by the width found in Section B Typical Sections. Width may vary along a measured section—use best judgment for estimating area.	3,000 Ft x 52 Ft = 156,000 SqFt
Area of Work Limits minus area of Roadway	284,548 SqFt – 156,000 SqFt = 128,548 SqFt
+3% for slopes	128,548 SqFt x 1.03 = 132,404 SqFt
4 inches of topsoil inside Right-of-Way -if the Soils Recommendations Letter from the Geotechnical Office states that more is available, consider using that quantity instead. -if the Soils Letter states that less than 4 inches is available, "Contractor Furnished Topsoil" may have to be added.	132,404 SqFt x 0.33 Ft (4") = 43,693 CuFt
6 inches on Temporary Easements* (outside Right-of-Way) -multiply the sum of temporary easement areas shown on each plan sheet by an additional 2"	43,693 SqFt x 0.17 Ft (2") = 7,428 CuFt
Total CuFt	43,693 CuFt + 7428 CuFt = 51,121 CuFt
Convert to CuYd -place this number in the table after the appropriate stationing	1,893 CuYd

*It has been determined that projects in urban areas only need 4" on temporary easements. Also, urban grading jobs have many paved surfaces, so areas for topsoil placement, seeding, fertilizing, and mulching may need to be measured in Microstation using the curb and gutter file and topog rather than just subtracting the roadway.

CONTRACTOR FURNISHED TOPSOIL

If the Soil Recommendations Letter notes that less than 4" of topsoil is available on grading projects, subtract the quantity available from the 4" to get the amount for Contractor Furnished Topsoil. The quantity available will be listed under the "Placing Topsoil" bid item with the quantity needed listed under the "Contractor Furnished Topsoil" bid item. Contractor Furnished Topsoil may also be needed for landscaping projects in areas such as planting beds and medians with the thickness and quantity determined by the Landscape Architect.

REMOVE AND REPLACE TOPSOIL

The topsoil is bladed down the inslopes prior to resurfacing, then bladed back up the inslope after resurfacing is complete. Refer to Standard Notes for more info.

EXAMPLE REMOVE AND REPLACE TOPSOIL COMPUTATION	
Length of the Project -typically shown on Section F title sheet	4,017 Ft
One side of a 4-Lane Highway -multiply length of the project by 28' (11' wide strip on inside lane inslope, 16' wide strip on outside lane inslope) **2-Lane Highway** -multiply length of the project by 32' (16' wide strip on each inslope)	4,017 Ft x 32' = 128,458 SqFt
+3% for slopes	128,548 SqFt x 1.03 = 132,404 SqFt
4 inches of topsoil inside Right-of-Way	132,404 SqFt x 0.33 Ft (4") = 43,693 CuFt
Total CuFt	43,693 CuFt + 7428 CuFt = 51,121 CuFt
Convert to CuYd -Create a "Remove and Replace Topsoil" note in the plans by stating how many feet each inslope will be bladed back and how many total CuYd are estimated to be removed and replaced (in this case 1,893 CuYd).	1,893 CuYd

SURFACE ROUGHENING

Surface Roughening is a method of temporary stabilization the may be completed on slopes 3:1 or steeper, in ditch channels greater than 2%, or in areas deemed necessary by the engineer. Surface Roughening is measured to the nearest tenth of an acre.

STABLIZED CONSTRUCTION ENTRANCES

Add a Stabilized Construction Entrance on every grading project. During review, the Region and/or Area Engineer will advise to how many they think are actually necessary.

OPTION BORROW PITS AND BORROW PITS

All borrow pit information comes from the Region Materials Offices. Borrow Pit Information Sheets will be available from the Project Engineer if borrow pits are utilized on the project. These sheets show the estimated volume of topsoil and the estimated area disturbed. Add the estimated volume of topsoil to the Option Borrow Pit section of the "Placing Topsoil" table. Use the estimated area disturbed to calculate seed and mulch quantities.

Borrow Pit Agreements indicate what type of seed the landowner requested. Landowner requests are usually honored. If the borrow pit area will be restored for use as cropland, permanent seed and mulch will not be needed. If Borrow Pit Agreements are not available, assume the pit will be seeded with the same seed mixture as the rest of the project and mulched unless otherwise informed.

If the project utilizes Contractor Furnished Borrow, quantities for Placing Topsoil, Permanent Seeding, and Mulching will not need to be included in the Section D Estimate of Quantities because these are taken care of by the Contractor.

COVER CROP SEEDING

The area to be seeded with Cover Crop Seeding is typically computed as 25% of the total area to be Permanent Seeded. The application rate is 2 Bu/Acre. Cover Crop Seeding may not be necessary on projects that use Type F or G Permanent Seed Mixture as these already have a cover crop included.

PERMANENT SEEDING

The area to be Permanent Seeded is the sum of the disturbed areas after adding 3% for slopes in the Topsoil Calculations (shown on page 52). Other areas that also need to be Permanent Seeded include the following:

- Temporary Easements
- Borrow Pits and Haul Roads
- Waste Disposal Sites (if Waste Disposal Sites are not furnished by the Contractor)
- Areas of Old Road Obliteration
- Other areas that vary by project

HYDROSEEDING

The Hydroseeding bid item may be used at the discretion of the Landscape Architect. The equipment used for hydroseeding shall be a mechanical agitation hydroseeding machine. All costs for hydroseeding including equipment, labor, and materials shall be incidental to the contract unit price per square yard for "Hydroseeding." Although Permanent Seed and Fertilizer are part of Hydroseeding, they are separate bid items.

SODDING
Sod is measured to the nearest square yard. Water for Vegetation should also be included in the Estimate of Quantities (refer to Sodding in Spec. Book).

FERTILIZING
Refer to the Section D Standard Notes for rates. Fertilizing is done on most projects using only organic slow-release fertilizers. Chemical fertilizers are discouraged because they benefit weeds and invasive species more than the native species we plant. Chemical fertilizers are also more likely to leach into surface waters and create water quality issues.

GRASS HAY OR STRAW MULCH
Grass Hay or Straw Mulch is applied at a rate of 2 Ton/Acre to areas to be permanent seeded on rural projects. An additional 25% is added for temporary stabilization. Steep slopes may require 3-4 Ton/Acre.

FIBER MULCHING
Fiber Mulching is typically applied at a rate of 2000 Lb/Acre to areas to be permanent seeded. Quantities may be added for temporary stabilization. Fiber Mulching is applied in a separate application after seeding. It is 50% effective during storm events lasting 60 minutes with 5" of total precipitation.

SOIL STABILIZER
Soil Stabilizer is applied at various rates depending on the slope and product. Soil Stabilizer can be used interchangeably with Fiber Mulching. One benefit of Soil Stabilizer is that it can be broadcasted (applied as dry pellets) or hydraulically blown. Soil stabilizer can also be used to temporarily protect exposed soil and topsoil stockpiles and prevent them from eroding and creating dust (if applied in the liquid form).

BONDED FIBER MATRIX
Use Bonded Fiber Matrix on permanently seeded areas on urban projects. Apply in a separate operation after seeding. Bonded Fiber Matrix is also used on steep slopes and bridge berms where conventional equipment such as a drill and straw crimper cannot be operated. The rate of application for Bonded Fiber Matrix will vary according to the Manufacturer's recommendations. It is usually calculated at 3,900 Lb/Acre. It is 95% effective during storm events lasting 60 minutes with 5" of total precipitation.

FIBER REINFORCED MATRIX
Use on critical slopes or near sensitive areas to provide immediate stabilization and faster revegetation. It requires no curing time and should not be placed in channels without being sprayed into the manufacturer recommended turf reinforcement mat. It is 99% effective during storm events lasting 60 minutes with 5" of total precipitation.

ROCK CHECK DAMS AND RIPRAP
Use in ditches with shear stresses over 8 psf with Turf Reinforcement Mat.

SILT FENCE
Do not use silt fence in streams or channels. Use sandbags/snake bags in places where soil is too rocky to be dug so that the silt fence material can be held to the ground for proper functioning.

HIGH FLOW SILT FENCE
Use high flow silt fence where there is concentrated water such as at pipe inlets. 25% of total may be added for additional temporary sediment control. Refer to Standard Plate 734.05 for more information.

APPROACH PIPES
Pipe 24" or less use 18 Ft in a U shape
Pipe larger than 24" use 30 Ft across ditch

MAINLINE PIPES
Pipe 24" or less use 18 Ft in a U shape
Pipe larger than 24" use 30 Ft across ditch
Pipe with drainage area 50-100 acres use 60 Ft at each end of pipe
Pipe with drainage area 100+ acres use 100 Ft at each end of pipe

LOW FLOW SILT FENCE
Use low flow silt fence to keep sediment from entering wetlands, streams, box culverts, and adjacent properties. 25% of total may be added for additional temporary sediment control. Refer to Standard Plate 734.04 for more information.

BOX CULVERTS
End without Detour 200 Ft
End with Detour 400 Ft

BRIDGES
Berms 300 Ft

REPAIR SILT FENCE
Only 25% of the total length of high and low flow silt fence installed is used based on a review of past projects and the quantity actually repaired.

REMOVE SILT FENCE
Only 25% of the total length of high and low flow silt fence installed is used based on a review of past projects and the quantity actually removed.

MUCKING SILT FENCE
Only 25% of the total length of high and low flow silt fence installed is used based on a review of past projects and the quantity actually mucked.

EROSION BALES

Erosion Bales have been replaced by Erosion Control Wattles. Erosion Bales may be better suited as a substitute for Silt Fence as perimeter protection near sloughs and wetlands. Refer to Standard Plate 734.02 for more information.

EROSION CONTROL WATTLES

Use Erosion Control Wattles perpendicular to the highway in ditch channels to decrease the velocity of flowing water and to trap sediment. Erosion Control Wattles also work well on slopes, for perimeter protection, and with Erosion Control Blanket. Look at cross sections and ditch grades to determine placement. Wattles come in 6", 9", 12" and 20" diameters. Refer to Standard Plate 734.06 for more information. The following guidelines are for 12" diameter wattles:

DITCH INSTALLATION SPACING	
2%	150 Ft
3%	100 Ft
4%	Use erosion control blanket.

SLOPE INSTALLATION SPACING	
1:1	10 Ft
2:1	20 Ft
3:1	30 Ft
4:1	40 Ft

EROSION CONTROL BLANKET

Use in areas where Straw Mulch, Fiber Mulch, or Erosion Control Wattles are not sufficient for holding soil in place. Erosion Control Blanket is typically placed 16 or 20 Ft wide in highway ditch channels. See recommendations on page 49. Refer to Standard Plate 734.01 for more information.

SHAPING FOR EROSION CONTROL BLANKET

Shaping for Erosion Control Blanket is calculated when Erosion Control Blankets are used in ditch channels. Shaping equals the length in feet of ditch channel that the blanket covers at 16 or 20 Ft wide.

TURF REINFORCEMENT MAT

Use in areas where established vegetation alone will not hold soil in place—usually above 2 psf. Turf Reinforcement Mat is typically placed 16 or 20 Ft wide in highway ditch channels. See recommendations on page 50.

6.8 Erosion and Sediment Control Design Computation Worksheets

An excel spreadsheet can be used as an alternative to the following sheets. Save the spreadsheet under the documents folder in the project folder of the project you are working on as SectionD.xls.

Date:__________
Project #:__________
County and PCN:__________

PLACING TOPSOIL (calculation method for rural areas)

Area of Roadway
Using the typical sections, find the area of the roadway throughout the project.

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

Sta__________to Sta__________=__________Ft
__________Ft (Length) x __________Ft (Roadway Width) =__________SqFt
or__________Acres

=__________Acres Total Area of Roadway

PROJECT TOPSOIL COMPUTATION WORKSHEET	
to (Begin)	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd

to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd

to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd

to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd
to	to
SqFt	SqFt
Ft x Ft = SqFt	Ft x Ft = SqFt
SqFt - SqFt = SqFt	SqFt - SqFt = SqFt
SqFt x 1.03 = SqFt	SqFt x 1.03 = SqFt
SqFt x 0.33Ft (4”) = CuFt	SqFt x 0.33Ft (4”) = CuFt
SqFt x 0.17Ft (2”) = CuFt	SqFt x 0.17Ft (2”) = CuFt
CuFt + CuFt = CuFt	CuFt + CuFt = CuFt
CuYd	CuYd

PERMANENT SEEDING

OTHER AREAS THAT NEED TO BE PERMANENT SEEDED

	(Acres)
Area of Option Borrow Pits and Haul Roads	
Area of Temporary Easements (from Section B Plan Sheets)	
Area of Waste Disposal Site (if Waste Disposal Site is not furnished by the Contractor)	
Areas of Old Road Obliteration	
Other areas that need to be permanent seeded that vary by project	
Total Area to be Permanent Seeded:	

PERMANENT SEEDING ON GRADING PROJECTS

_____Acres (area within Work Limits minus area of Roadway) plus _____Acres (other areas that need to be Permanent Seeded) =_____Acres (total acres that are to be Permanent Seeded)

_____Acres x _____ Lb/Acre (Permanent Seeding Rate) =_____Lb

PERMANENT SEEDING ON SURFACING PROJECTS

_____Acres (area where topsoil is to be stripped) plus _____Acres (other areas that need to be Permanent Seeded)
=_____Acres (total acres that are to be Permanent Seeded)

_____Acres x _____Lb/Acre (Permanent Seeding Rate) = _____Lb

COVER CROP SEEDING

The area to be seeded with Cover Crop Seed is typically computed as 25% of the total area to be Permanent Seeded.

_____Acres x 0.25 (25%) = _____Acres

_____Acres x 2 Bu/Acre = _____Bu

EROSION BALES (rarely used since erosion control wattles have been developed)

_____Locations x 12 Erosion Bales/Location = _____

FERTILIZING

Rural Area Calculation (Refer to Seciton D Standard Notes for the rates)

_____Acres x _____ Lb/Acre = _____ Lb or _____Ton

Urban Area Calculation (Refer to Section D Standard Notes for the rates)

(_____SqFt/1,000SqFt) x _____Lb/1000 SqFt = _____Lb or_____Ton

GRASS HAY OR STRAW MULCH (for rural areas and ditch sections in urban areas)

_____Acres (Acres that were Permanent Seeded) x 2 Ton/Acre = _____Ton
+_____Ton (25% of the total acres that were Permanent Seeded) for Temporary Erosion Control= _____Ton

In addition a quantity of Grass Hay or Straw Mulch is computed based on 25% of the total acres to be Permanent Seeded and added to the Estimate of Quantities for Temporary Erosion Control.

Note: Some areas of a project (such as steep slopes) may have 4 Ton/Acre of Grass Hay or Straw Mulch applied.

FIBER MULCHING (≈ 50% effective during a 5 inch, 60 minute rain event)

_____Acres x 2000* Lb/Acre = _____Ton

BONDED FIBER MATRIX (≈ 95% effective during a 5 inch, 60 minute rain event)

_____Acres x 3900* Lb/Acre = _____Ton
*The rate of application for Bonded Fiber Matrix will vary according to the Manufacturer's recommendations.

ROCK CHECK DAMS

Use 6-8" Crushed Rock. Approximate Volume = 55 Cubic Yards at each location.

REPAIR SILT FENCE

Only 25% of the total is used based on a review of past projects and how much quantity was actually used.

_____Ft (Total Length of Silt Fence on the project including both Low Flow Silt Fence and High Flow Silt fence) x 0.25 (25%) =_____Ft

REMOVE SILT FENCE

Only 25% of the total is used based on a review of past projects and how much quantity was actually used.

_____Ft (Total Length of Silt Fence on the project including both Low Flow Silt Fence and High Flow Silt fence) x 0.25 (25%) =_____Ft

MUCKING SILT FENCE

Note: Mucking Silt Fence is calculated as the volume in the shape in the shape of a triangular prism that accumulates behind the silt fence. Only 25% of the total is used based on a review of past projects and how much quantity was actually used.

_____Ft (Total length of Silt Fence on the project including both Low Flow Silt Fence and High Flow Silt Fence)x 1/2 x 1Ft x 15 Ft divided by 27 = _____CuYd x 0.25 (25%) = _____CuYd

EROSION CONTROL BLANKET

Sta_____to Sta_____

_____ Ft (Length) x _____ Ft (Width) (typically 16 Ft or 20 Ft Width in Highway Ditch Channel) = _____SqYd

TURF REINFORCEMENT MAT

Sta_____to Sta_____

_____ Ft (Length) x _____ Ft (Width) (typically 16 Ft or 20 Ft Width in Highway Ditch Channel) = _____SqYd

CONSTRUCTION ENTRANCE (information only, paid per construction entrance)

PIT RUN MATERIAL
15 Ft x 50 Ft x 1 Ft = 750 CuFt or 28 CuYd
½(10 x10) = 50 SqFt, 50 SqFt x 1 Ft = 50 CuFt or 1.9 CuYd
1.9 CuYd x 2 = 3.8 CuYd
28 CuYd + 3.8 CuYd = 31.8 CuYd
31.8 CuYd x 1.89 Ton/CuYd (Conversion Factor) = 60 Ton

GRANULAR MATERIAL FOR CONSTRUCTION ENTRANCE
31.8 CuYd x 1.89 Ton/CuYd (Conversion Factor) = 60 Ton

MSE GEOTEXTILE FABRIC
Ft x 50 Ft =750 SqFt
½(10 x10) = 50 SqFt, 50 SqFt x 2 = 100 SqFt
750 SqFt + 100 SqFt = 850 SqFt or 94 SqYd use 95 SqYd for Estimate of Quantities