

ACEC Erosion Control Design Training 2012



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Perimeter Devices

- ▶ Temporary Silt Fence (TSF)
- ▶ Special Sediment Control Fence (SSCF)
- ▶ Wattle Breaks (EW, CFW) 
- ▶ Wattle Barrier (EW, CFW) 
- ▶ Temporary Silt Ditch (TSD)

Temporary Silt Fence

Design - Utilized on Clearing & Grubbing and Final Grade Phases of Erosion Control Plans

Placement - Inside Buffer Zones and at the toe of fill slopes

Function - Silt Fence temporarily traps sheet flow from disturbed slopes allowing sediment to settle on the flow side

Silt Fence Tips

- ▶ Commonly Overused in EC design!
- ▶ Placement Locations on EC Plans:
 - Toe of Bridge Approach Fill Slopes
 - Toe of Fill Slopes in Wetlands
 - Toe of Fill Slopes in Urban Areas
 - Above Culvert Inlets and Outlets, esp. on Final Grade Phase
 - Perimeter of Streams and Fill Slopes inside Riparian Buffers

Silt Fence Guidelines

- ▶ Drainage Area is not greater than ¼ acre per 100 ft. of silt fence
- ▶ Maximum Slope Length behind Silt Fence

Slope	Slope Length (ft)	Maximum Area (ft ²)
<2%	100	10,000
2 to 5%	75	7,500
5 to 10%	50	5,000
10 to 20%	25	2,500
>20%	15	1,500

Table 6.62a, Erosion and Sediment Control Planning and Design Manual NCDENR

Silt Fence Breaks

- ▶ Special Sediment Control Fence



- ▶ Excelsior Wattle



- ▶ Coir Fiber Wattle



Special Sediment Control Fence

Design - Utilized on Clearing & Grubbing and Final Grade Phases of Erosion Control Plans

Placement – Short Sections between Silt Fence Segments

Function - Special Sediment Control Fence provides a drainage break for Silt Fence Sections in Low Areas

SSCF Tips

- ▶ Commonly Overused in EC design!
- ▶ Can be used in wetlands, but difficult to remove
- ▶ Placement Locations on EC Plans:
 - Drainage Breaks in Silt Fence (Max. Spacing of 200 ft.)
 - Adjacent to Stream Relocations
 - Some Permit Conditions require Special Sediment Control Fence at Toe of Bridge Approach Fills parallel to stream

Silt Fence Wattle Breaks



Design - Utilized on Clearing & Grubbing and Final Grade Phases of Erosion Control Plans

Placement – Between Silt Fence Segments

Function – Wattle provides a drainage break for Silt Fence Sections in Low Areas

Wattle Break Tips

- ▶ Design for Wattle of 10 ft. in length
- ▶ Can be used in wetlands, easy to remove (or not!)
- ▶ Maximum Spacing of 200 ft.
- ▶ Use Coir Fiber Wattles (CFW) for projects > 1 year

Wattle Barrier



Design - Utilized on Clearing & Grubbing and Final Grade Phases of Erosion Control Plans

Placement - At the toe of bridge approach fill slopes

Function - Wattle Barrier temporarily traps sheet flow from disturbed slopes allowing sediment to settle on the flow side

Wattle Barrier Tips

- ▶ Utilize where Silt Fence can't be installed
- ▶ Can be used in wetlands, easy to remove (or not!)
- ▶ Maximum Spacing of 20 ft. for breaks on slopes
- ▶ Use Coir Fiber Wattles (CFW) for projects > 1 year

Temporary Silt Ditch

Design - Utilized on Clearing & Grubbing and Final Grade Phases of Erosion Control Plans


Placement - Toe of fill slopes

Function - TSD directs sheet flow from fill slopes into sediment traps and basins

TSD Tips

- ▶ Extend TSD to inflow side of sediment basins without leaving any gaps
- ▶ Place velocity checks (either a Rock Silt Check or Wattle) with TSD
- ▶ Do not place inside slope stake lines in the footprint of the project!

Runoff Diversion Devices

▶ Temporary Diversion (TD) 

▶ Temporary Earth Berm 

▶ Clean Water Diversion (CWD) 

▶ Temporary Berms and Slope Drains



Temporary Diversion

Design - Utilized on Clearing & Grubbing Phase of Erosion Control Plans

Placement - Outside proposed cuts and across graded areas to reduce slope length

Function - TD diverts sheet flow from exposed slopes into rock dams, sediment traps and basins; used to reduce the size of drainage areas

Temporary Diversion Tips

- ▶ Place in small proposed ditches on Clearing & Grubbing phase so that ditch can be built early
- ▶ Place velocity checks (either a Rock Silt Check or Wattle) with TD
- ▶ Utilize TD to divert runoff inside footprint of project to perimeter sediment basins (Cuts)
- ▶ Can be used in Buffer Zones in proposed permitted ditches

Temporary Earth Berm

Design - Utilized on Clearing & Grubbing and Final Grade Phases of EC Plans

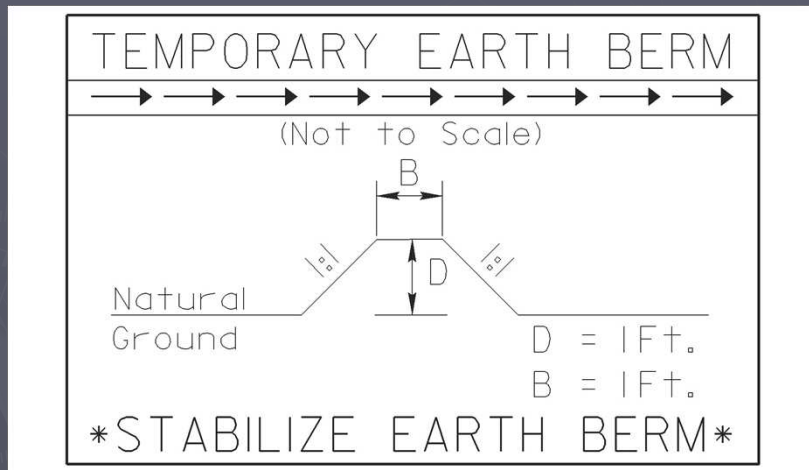
Placement - Outside cuts and fills and parallel to the ROW; across graded areas to reduce slope length (Fills)

Function - Earth Berms divert offsite runoff to minimize the runoff flowing to erosion control devices; used to reduce the size of drainage areas

Earth Berm Tips

- ▶ Include Earth Berm Detail on plan sheets where utilized
- ▶ Place velocity checks (either a Rock Silt Check or Wattle) with Earth Berms
- ▶ Place Earth Berms inside footprint of fill slopes to divert runoff to sediment basins

Temporary Earth Berm Detail



Clean Water Diversion



Design - Utilized on Clearing & Grubbing and Final Grade Phases of EC Plans

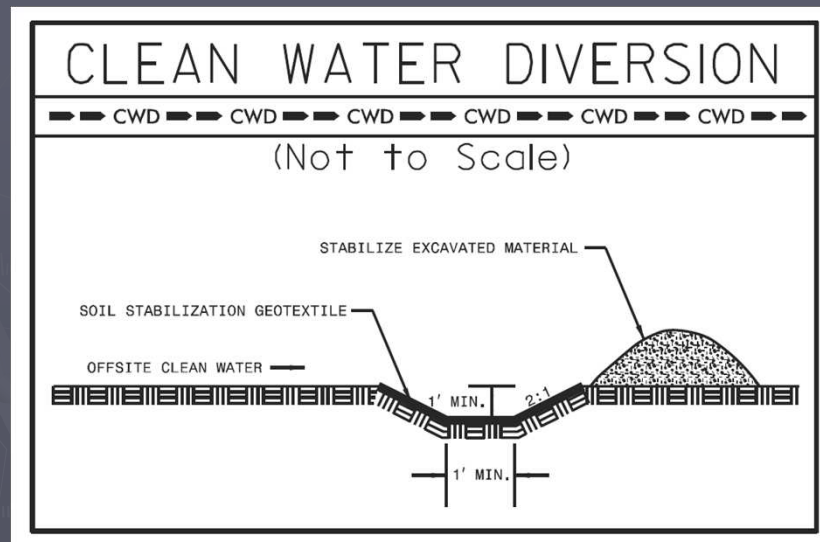
Placement - Outside cuts and fills and parallel to the ROW

Function – Clean Water Diversions divert offsite runoff to minimize the runoff flowing to erosion control devices; used to reduce the size of drainage areas

Clean Water Diversion Tips

- ▶ Include Clean Water Diversion Detail on plan sheets where utilized
- ▶ Place Type B Silt Checks for velocity control with Diversions at reduced spacing
- ▶ Place Type A Silt Checks at outlets
- ▶ Do not show wattles in Diversions

Clean Water Diversion Detail



Temporary Slope Drains

Design - Utilized on Clearing & Grubbing and Final Grade Phases of EC Plans

Placement – On large cuts and fills

Function – Convey concentrated runoff to bottom of slopes in a non-erosive manner

Slope Drains

- ▶ Utilize on fill slopes with 3:1 grade or steeper and fill slope height of:
 - 8 ft. and higher in Piedmont & Mountains
 - 5 ft. and higher in Sand hills & Coastal Plain
- ▶ Don't need on fills with 4:1 or flatter slope
- ▶ Make sure slope drain outlets to a basin, trap, check dam or stone energy dissipater
- ▶ Use maximum spacing of 200 ft.

Standard Sediment Basins

- ▶ Silt Basin Type B
- ▶ Temporary Rock Sediment Dam Type B
- ▶ Infiltration Basin

Sediment Basin FYI

- ▶ Optimal Length:Width Ratio is 3:1, with 2:1 minimum and 6:1 maximum
- ▶ NCDOT Sediment Basins have 1.5:1 side slopes
- ▶ Don't place basins in following locations:
 - Riparian Buffer Zones (unless permitted)
 - Wetlands (unless permitted)
 - Close to Homes or Businesses
 - In live streams

Silt Basin Type B

- ▶ Surface Area Requirement
 - 435 ft² per cfs of $Q_{10 \text{ or } 25}$ peak inflow
 - 325 ft² per cfs of $Q_{10 \text{ or } 25}$ peak inflow at drainage inlet structures (i.e. DI's, CB's, etc.)
- ▶ Sediment Storage Requirement
 - 3600 ft³ per disturbed acre
 - 1800 ft³ per disturbed acre at drainage inlet structures (i.e. DI's, CB's, etc.)

Silt Basin Type B Tips

- ▶ Utilize in medians at drainage inlets
- ▶ Utilize adjacent to Rock Pipe Inlet Sediment Traps (PIST-A, PIST-B)
 - Surface Area = 435 ft² per cfs of Q_{10 or 25}
 - Sediment Storage = 3600 ft³ per disturbed acre
- ▶ Use Silt Basin B's for additional sediment storage upgrade of drainage outlet

Sediment Dam Type B

- ▶ Surface Area Requirement
 - 435 ft² per cfs of Q_{10 or 25} peak inflow
- ▶ Sediment Storage Requirement
 - 3600 ft³ per disturbed acre
- ▶ Minimum Weir Length is 4 ft.
- ▶ Maximum Drainage Area is 1 Acre (NCG-01)

Sediment Dam Type B Tips

- ▶ Place Temporary Rock Sediment Dams Type B (TRSD-B) at drainage outlets that do not drain directly to a jurisdictional water body
- ▶ Place TRSD-B's inside footprint of project on Clearing & Grubbing EC Plans
- ▶ TRSD-B's are relatively inexpensive, but have largest basin footprint

Infiltration Basin



- ▶ Surface Area Requirement
 - 325 ft² per cfs of $Q_{10 \text{ or } 25}$ peak inflow
- ▶ Sediment Storage Requirement
 - 1800 ft³ per disturbed acre
- ▶ Minimum Weir Length is 4 ft.
- ▶ Maximum Dewatering Time is 3 days

Infiltration Basin Tips

- ▶ Infiltration Basins can be placed at drainage outlets that drain directly to jurisdictional water bodies and Riparian Buffer Zones
- ▶ Utilize Infiltration Basins at toe of fill slopes; **do not use in proposed ditches**
- ▶ Recommend knowing ground water elevation for berm height construction
- ▶ Do not place in "Soils Prone to Flooding"

Break!

Skimmer Devices

- ▶ Skimmer Basin
- ▶ Tiered Skimmer Basin
- ▶ Earthen Dam with Skimmer 
- ▶ Stormwater Basin with Skimmer 

Skimmer Basin Design Criteria

- ▶ Surface Area Requirement
 - 325 ft² per cfs of $Q_{10 \text{ or } 25}$ peak inflow
- ▶ Sediment Storage Requirement
 - 1800 ft³ per disturbed acre
- ▶ Minimum Weir Length is 4 ft.
- ▶ Minimum Dewatering Time is 24 hours

Skimmer Basin Tips

- ▶ Place Skimmer Basins at drainage outlets that drain directly to jurisdictional water bodies and Riparian Buffer Zones
- ▶ Skimmer Orifice is sized to dewater basin in 2 to 3 days in Basin Design spreadsheet
- ▶ Skimmer Basins are more expensive than TRSD-B's, but have smaller footprint

Tiered Skimmer Basin Tips

- ▶ Place Tiered Skimmer Basins at drainage outlets that drain directly to jurisdictional water bodies and Riparian Buffer Zones
- ▶ Utilize Tiered Skimmer Basin when elevation difference is greater than 6 ft. from inflow to outflow ends of basin
- ▶ Label length, width and weir dimensions of upper basin (Modified Silt Basin Type B) and lower basin

Earthen Dam with Skimmer Design Criteria

- ▶ Surface Area Requirement
 - 325 ft² per cfs of Q_{10 or 25} peak inflow
- ▶ Sediment Storage Requirement
 - 1800 ft³ per disturbed acre
- ▶ Minimum Weir Length is 4 ft.
- ▶ Minimum Dewatering Time is 24 hours

Skimmer Dam Tips

- ▶ Place Earthen Dam with Skimmer in ditches with Large Cross Section (i.e. Base Ditch)
- ▶ Utilize when ditch grade is less than 2%
- ▶ Label weir length and height of designed dam
- ▶ Economic and Construction Benefits if feasible

Stormwater Basin with Skimmer Design Criteria

- ▶ Surface Area Requirement
 - 435 ft² per cfs of $Q_{10 \text{ or } 25}$ peak inflow
- ▶ Sediment Storage Requirement
 - 1800 ft³ per disturbed acre
- ▶ Primary Spillway (Riser) to Convey 2-yr Storm
- ▶ Minimum Dewatering Time is 24 hours

Stormwater Basin Tips

- ▶ Size Skimmer and Orifice Diameter for provided Stormwater Basin volume
- ▶ Use volume for 1 ft. off the bottom of basin
- ▶ Show Skimmer attached to Riser with label
- ▶ Include Note to use Stormwater Basin during construction

Stormwater Basin Construction Concerns

- ▶ Rock Layer or Water Table Too Close to Surface
- ▶ Unsuitable Material for Berms
- ▶ Inadequate Compaction in Berms

Stormwater Basin Construction Specs

- ▶ Minimum of 3 Baffles with Equal Spacing
- ▶ Anti-Seep Collars
<ftp://ftp-fc.sc.egov.usda.gov//IL/engineer/supplements/6-36.1.pdf>
- ▶ Berm Material
 - Compact Embankment to at least 90% of AASHTO T 99 Test
- ▶ Specify Matting and Permanent Seed Mix for Slopes

When surface area and/or sediment storage requirement for a basin cannot be achieved:

- ▶ Design sediment basin or sediment trap to the maximum practical length and width dimensions
- ▶ Utilize Polyacrylamide (PAM) devices (Wattle, Silt Check A with Matting) upgrade of the sediment basin/trap

PAM Devices

- ▶ Excelsior Wattle
- ▶ Coir Fiber Wattle
- ▶ Silt Check Type A with Matting

Excelsior Wattle

- ▶ Can be used with or without PAM
- ▶ When utilized, place wattles every 50 ft. in temporary and/or permanent ditches
- ▶ Use Excelsior Wattles on short term projects (one year project duration or less)

Coir Fiber Wattle

- ▶ Can be used with or without PAM
- ▶ When utilized, place coir wattles every 50 ft. in temporary and/or permanent ditches
- ▶ Use Coir Fiber Wattles on long term projects (project duration of more than a year)

Silt Check Type A with Matting

- ▶ When utilized, place Silt Check Type A (TRSC-A) with Matting and PAM in temporary and/or permanent ditches
- ▶ When utilized, place TRSC-A's with Matting and PAM every 50 ft. in temporary and permanent ditches
- ▶ Use TRSC-A's with Matting and PAM on short and long term projects where ditch grade $> 2.5\%$ (?)

Environmentally Sensitive Areas

- ▶ 50 ft. zone from top of streambank (TOB)
 - 50 ft. from water's edge if TOB is not delineated on plans
- ▶ Shown inside and to ROW/Easement; **do not hatch the water surface!**
- ▶ Match ESA hatch spacing to ESA plan sheet note

ESA Locations

- ▶ DWQ High Quality Waters
 - WS-I, WS-II, HQW, ORW, SA
- ▶ DWQ and WRC Trout Streams
- ▶ Streams with Riparian Buffers
- ▶ Relocated Streams
- ▶ 303(d) Streams for Sediment or Turbidity Impairment
- ▶ Design Standards in Sensitive Watersheds Commitment

EC in Riparian Buffers

- ▶ No excavated erosion control devices inside Riparian Buffer, unless permitted by DWQ!
- ▶ Runoff treated separately inside and outside Buffer
- ▶ Protect Buffer and Stream with Perimeter EC Devices

Allowed EC Devices in Buffers

- ▶ Temporary Silt Fence
- ▶ Special Sediment Control Fence
- ▶ Rock Silt Checks
- ▶ Wattles
- ▶ Stone Inlet Protection
- ▶ Special Stilling Basins

NCG-01 Construction Permit

- ▶ Effective August 3, 2011
- ▶ Outlet devices must withdraw from basin surface unless drainage area is < 1 acre
- ▶ Ground Stabilization Time Frames of 7 or 14 days

NCDOT and NCG-01 Permit

- ▶ Effective for all 2012 Standards projects
- ▶ Some design flexibility with surface dewatering devices for areas > 1 acre
- ▶ NCG-01 Compliance Note on EC Title Sheet
- ▶ Stabilization Time Frames Sheet

Surface Dewatering Devices

- ▶ Skimmer Devices
- ▶ Infiltration Basins
- ▶ Silt Basin B (excavated below ground)

NOT Surface Dewatering Devices

- ▶ Temporary Rock Silt Checks
- ▶ Temporary Rock Sediment Dams
- ▶ Stone Inlet Protection Devices
- ▶ Wattles

Temporary Rock Silt Check Type A

- ▶ Utilize at the outlet of diversion ditches and berms for offsite runoff
- ▶ Place at the outlet of permitted ditches in Buffer Zones
- ▶ Utilize at outlet of proposed tail ditches

Temporary Rock Silt Check Type B

- ▶ Utilize in diversion ditches and berms for offsite runoff
- ▶ Place in any temporary and permanent ditch
- ▶ Use spacing of 250 / % ditch grade
- ▶ Use at inlets of sediment basins and driveway pipes

Type A Inlet Protection

- ▶ Use Type A Rock Inlet Sediment Traps (RIST-A, PIST-A) in high flow situations
- ▶ Utilize Type A Inlet Protection devices in medians and ditches on new alignments
- ▶ Must be at least 30 ft. from travel lane

Type B Inlet Protection

- ▶ Use Type B Rock Inlet Sediment Traps (RIST-B, PIST-B) in moderate flow situations
- ▶ Utilize Type B Inlet Protection devices in urban areas; widening projects
- ▶ No minimum offset distance from travel lane

Type C Inlet Protection

- ▶ Use Type C Rock Inlet Sediment Traps (RIST-C) in low to moderate flow situations
- ▶ Utilize Type C Inlet Protection devices in urban areas with C&G; widening projects
- ▶ Use RIST-C's for fill slope drainage inlets at shoulder break points

Low Impact Bridge EC Plans

- ▶ Do not require EC Title Sheet; include notes
- ▶ Stabilization Timeframe Sheet required
- ▶ Utilize PAM devices
- ▶ Include all Details and Reforestation if needed

Rail Project EC Plans

- ▶ Create EC Plans similar to TIP Projects
- ▶ Stabilization Timeframe Sheet required
- ▶ Utilize PAM devices
- ▶ Include all Details and Reforestation if needed

Final EC Thoughts

- ▶ Consider Final Grade erosion control while designing Clearing & Grubbing phase
- ▶ Submit Water Quality AND Checklist sheets
- ▶ Don't place EC device in streams!
- ▶ Soil & Water Engineering Section is open to new ideas!

Erosion Control Resources

- ▶ REU Soil & Water Engineering Web Page
http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/soil_water/
- ▶ NCDOT Construction BMP Manual
http://www.ncdot.org/doh/operations/BMP_manual/
- ▶ NCDOT Toolbox for BMPs (Hydraulics Unit)
http://www.ncdot.org/doh/preconstruct/highway/hydro/pdf/StormwaterBMPMarch08_A1.pdf

Questions?

