Options to minimize plastic based best management materials **during and post construction** and retrofit options for stormwater conveyance capture



2026 Great Lakes Microplastics Summit
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University of Minnesota Program Instructor

Where does plastic/synthetic material or waste end up?



All plastic waste lost to stormwater goes someplace.



Not all plastic waste is the same.



Permanent solid and sharps waste collection bag







Plastics (synthetic fibers) in Erosion Prevention & Sediment Control Practices

Have we reached a point of the bandage being worse than the wound?

Sediment, when originating from construction activities is considered a pollutant. However not all sediment is bad, as sediment is also an important component of natural geomorphic processes of our streams and rivers. A goal of designers and regulators is to prevent erosion within a construction site and control sediment from being added to our waters by implementing Best Management Practices (BMP). Many of these BMP devices include synthetic elements such as synthetic fibers (plastics), polymers, plasticizers, and dyes. These products are not a natural component of any streams ecology. Are there unintended consequences of these products? At what point do they themselves become a pollutant? What is the eventual fate of these components as they degrade and are carried off site? What initially may be 'good' for erosion prevention and sediment control may later become 'bad' for animals and other ecological concerns. The solution to this conundrum is to utilize alternatives that do not contain these components to begin with. Some alternatives are shown below.

Plastics[1]	Plastic Equivalent[2]	Alternatives. Reduce temporary stabilization needs by going to final grade and stabilization within permitted timelines. IE Reduce amounts of temporary stabilization with appropriate staging.
in Rolled Cover	**per 100 square yards**	
• **Erosion control blanket** netting weighs 0.24oz/sq yd	70 bottles or 150 shopping bags	- Products woven with natural fiber[3], disc anchor natural mulch, watering
• **Polyethylene sheeting** 6 mil weighs 4.13oz/sq yd	1,200 bottles or 2,500 shopping bags	- Stage work to reduce need, use mulch alternatives, reuse instead of single use applications
• **Geogrid** minimum of 7.0 oz/sq yd	2,000 bottles or 4,300 shopping bags	- Reduce need by reducing slopes, or use of rock, or combination rock/vegetation
• **Turf Reinforcement Mats** contain 8.9 to 14.7oz/sq yd	2,300 - 6,000 bottles or 5,000 - 13,300 shopping bags	- Reduce need by reducing slopes, or use of rock, or combination rock/vegetation
in Perimeter Control	**per 100 feet**	Reduce overall use by only using where actually needed for downslope protection
• **Control Log (bio roll)** 6-8" Tubing contain up to 1oz/ft	290 bottles or 630 shopping bags	- Woven with natural fiber[3], wood chip berms, vegetated berms
• **Silt fence (3ft tall)** weighs 1.28oz/ft	370 bottles or 800 shopping bags	- Wood chip berms (from clearing/grubbing operations), vegetated berms, burlap
• **Silt Curtain** fabric weighs 12oz or 15oz/ft	3,400 - 4,200 bottles or 7,500 - 9,200 shopping bags	- Limit use to only those times of actual in-water disturbance. Remove when not needed. Thus reducing its degradation and increasing reusability.
in Hydraulic applications	**per 100 square yards**	
• **Synthetic Fiber** content up to 0.07oz/sq yd	19 bottles or 41 shopping bags	- Choose products with only natural fiber[3]

These products are all permanently placed on site or if removed, enter the garbage stream (zero percent recycling is expected)

MnDOT alone, is estimated to apply 31 tons of these plastics (synthetic fiber) per year (three year average 2016-2018)

Other Biotoxicity Issues?

- **Malachite Green**[4] (Colorant): Mayfly LC50 0.079 mg/L, Smallmouth Bass LC50 0.04 mg/L, Rainbow Trout LC50 0.267mg/L, Toad (larvae) LC50 0.068mg/L)[5]
- **Methyl Acrylate** (Acrylate polymer degradate): Green Algae EC50 15mg/L, Water Flea LC50 1.2-9.6mg/L, Bony Fish LC50 5-7.5mg/L[5]
- **Ethyl Acrylate** (Acrylate polymer degradate): Scud LC50 1.86mg/L, Fathead Minnow LC50 2.5mg/L)[5]
- **Diethylhexyl phthalate** (Plasticizer): Green Algae EC50 0.96mg/L, Water Flea EC50 0.133mg/L, Fathead Minnow LC50 71.5mg/L, Redear Sunfish LC50 6.18mg/L, Leopard Frog LC50 4.44mg/L[5]
- **Dibutyl phthalate** (Plasticizer): Green Algae LC50 0.21mg/L, Water Flea LC50 4.3mg/L, Opossum Shrimp LC50 0.5mg/L, Bluegill LC50 1.23mg/L, Channel Catfish LC50 3.72mg/L, Rainbow Trout LC50 1.6mg/L)[5]

We must balance erosion prevention & sediment control products from doing more ecological harm than the pollutant they are designed to prevent.

(1) Average plastic (synthetic fiber) weight equivalents per survey of manufacturer's product specifications and application recommendations
(2) Rounding based on: 0.5 liter water bottle = 0.35oz, Typical shopping bag being 12 microns thick & 11.5" x 6.5" x 21" = 0.16oz
(3) Natural fiber = 'Biodegradable', as meaning the product will decompose under ambient soil conditions into carbon dioxide, water, and other naturally occurring materials within one year
(4) Malachite Green is a dye commonly used in hydromulch/hydroseeding applications. MnDOT has removed Malachite Green from its approved products list due to Biotoxicity concerns.
(5) EPA ECOTOX Database, https://cfpub.epa.gov/ecotox/ LC50: Concentration of toxicant for 50% test population mortality. EC50: Concentration of toxicant at which 50% of test population shows an impaired biological function.

DEPARTMENT OF NATURAL RESOURCES DEPARTMENT OF TRANSPORTATION

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Photographs by Peter Leete
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Plastic materials are here to stay. Plastic materials solve a problem, at the lowest (initial) cost.
The goal should be to use judiciously

- But we can specify/require plastic material alternatives for construction
  - Natural site design and implementation
- But we can require plastic material reuse
- But we can require true plastic material recycling
- and, we can retrofit roadways to capture plastic waste

Plastic-free hydromulches



Plastic-free erosion prevention products



Plastic-free perimeter controls



Learning Objectives

1. Recognize design and management options for natural materials for construction NPDES permit compliance.
2. Learn options for continuous process improvement of plastic management, capture, and retrofit
3. Create stronger contracts for waste controls
4. Learn how plastic materials are used in construction
5. Recognize change does not happen without you.

Three Questions:

- How much plastic waste is generated by construction activities?
- How much plastic waste is ‘donated’ by the public?
- Does macro-plastic released into the environment become microplastic by solar (UV), physical (abrasion), or biological degradation?

Macroplastics.
Not all plastics used in construction are bad if they solve a problem.
But wind, water and tires can create microplastics.

- Use **natural** alternatives
- **Reuse** synthetic materials
- Address **education** for both owners, contractors, business, and public
- Retrofit to **capture**

Turf-reinforcement Mats







Engineered Soil Walls



















Reinforced green space for parking (Green Stormwater Infrastructure)

Refresher: SWPP**P**

- This is a **p**lan developed by the owner of a construction project, for the contractor to implement for the management of stormwater.
- This is a **p**rogram based on population that is developed by an entity (city, University, etc.) for how pollution is managed post construction of created stormwater treatment infrastructure.

SWPPP Items

- Design (communication tool) for natural best management practices
  - Use site conditions, e.g Migrating topsoil berms
  - Require natural materials for erosion prevention, sediment control
  - Minimize areas that are exposed
  - Provide clear plan narratives for trash management, and $$$ consequences for failure to perform.













Daily pickup Requirement





Timely Removal, < 50% full

New MnDOT Research, Auburn University: Dr Micheal Perez

Characterization, Functional Longevity, and Performance of **Natural Textiles** Configured as Sediment Control Retention Materials

July 7, 2026

Warren Tuel PSS, MnDOT Office of Environmental Stewardship, Project Champion

Dwayne Stenlund MSc., CPESC, CESSWI, MnDOT Retired, Champion Emeritus

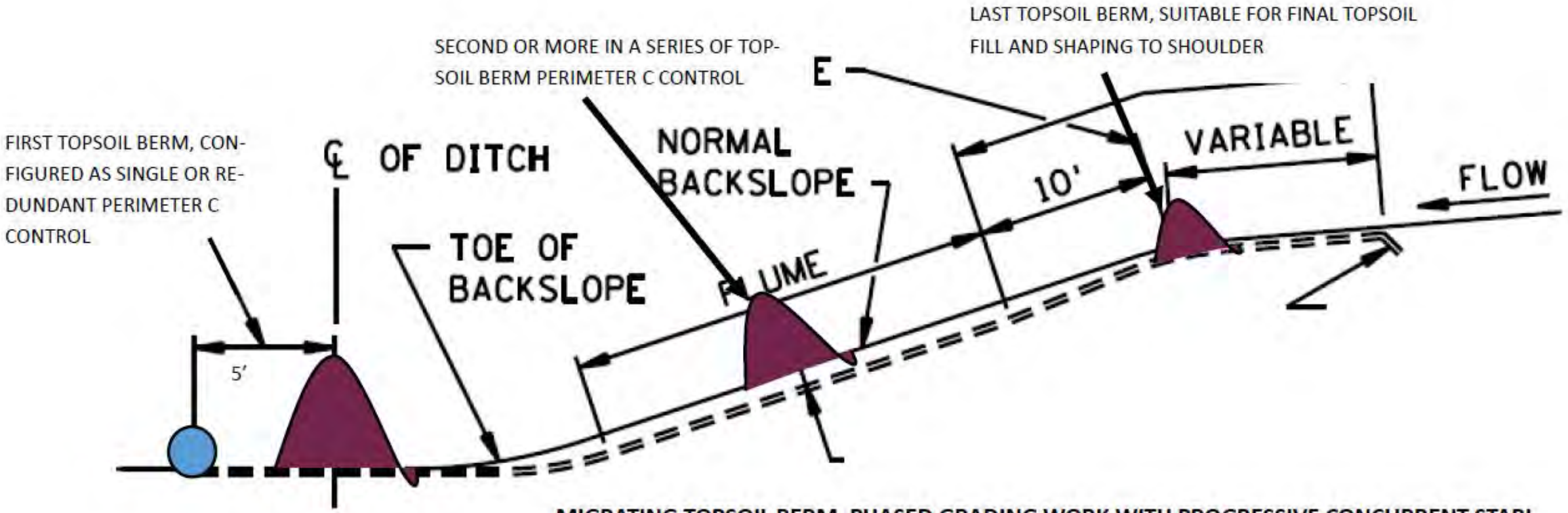

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J-Hooks
Tree Protection
Sediment Basin
Ditch Checks + Floc
Hydroseeding
Erosion Control Blankets
Vegetated Buffer
Vegetation Plots
Stockpile Mgm't
Rainfall Simulators
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science for a changing world


Auburn University Erosion & Sediment Control Testing Facility

Natural Material Sediment Control Awareness

- Perimeter Control
  - Topsoil berms
  - Wood Slash berms
  - Slash mulch berms
  - Organic fences (hemp, flax, coconut)
  - Wrapped (hay) bale barriers
  - Sediment filter strips
  - Sheet pile (iron ore)

Utilization of topsoil berm perimeter control over the life of the contract to reduce use of plastic/synthetic materials



MIGRATING TOPSOIL BERM, PHASED GRADING WORK WITH PROGRESSIVE CONCURRENT STABI-LIZATION.

Minimizing Exposed Soils





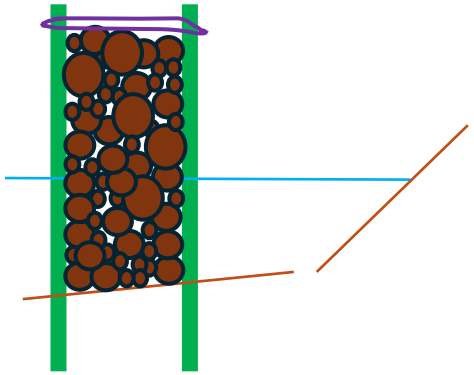



Topsoil Berm




Woody Debris Berm

Brush Wall Energy Dissipator/ turbidity control











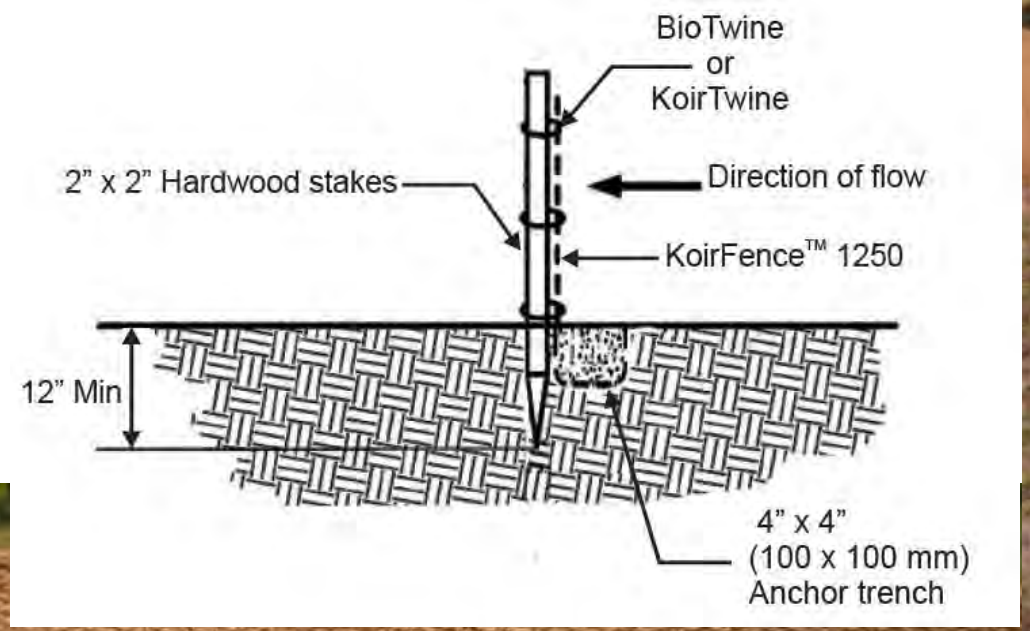
Natural Textile Proof of concept installed at MnROAD



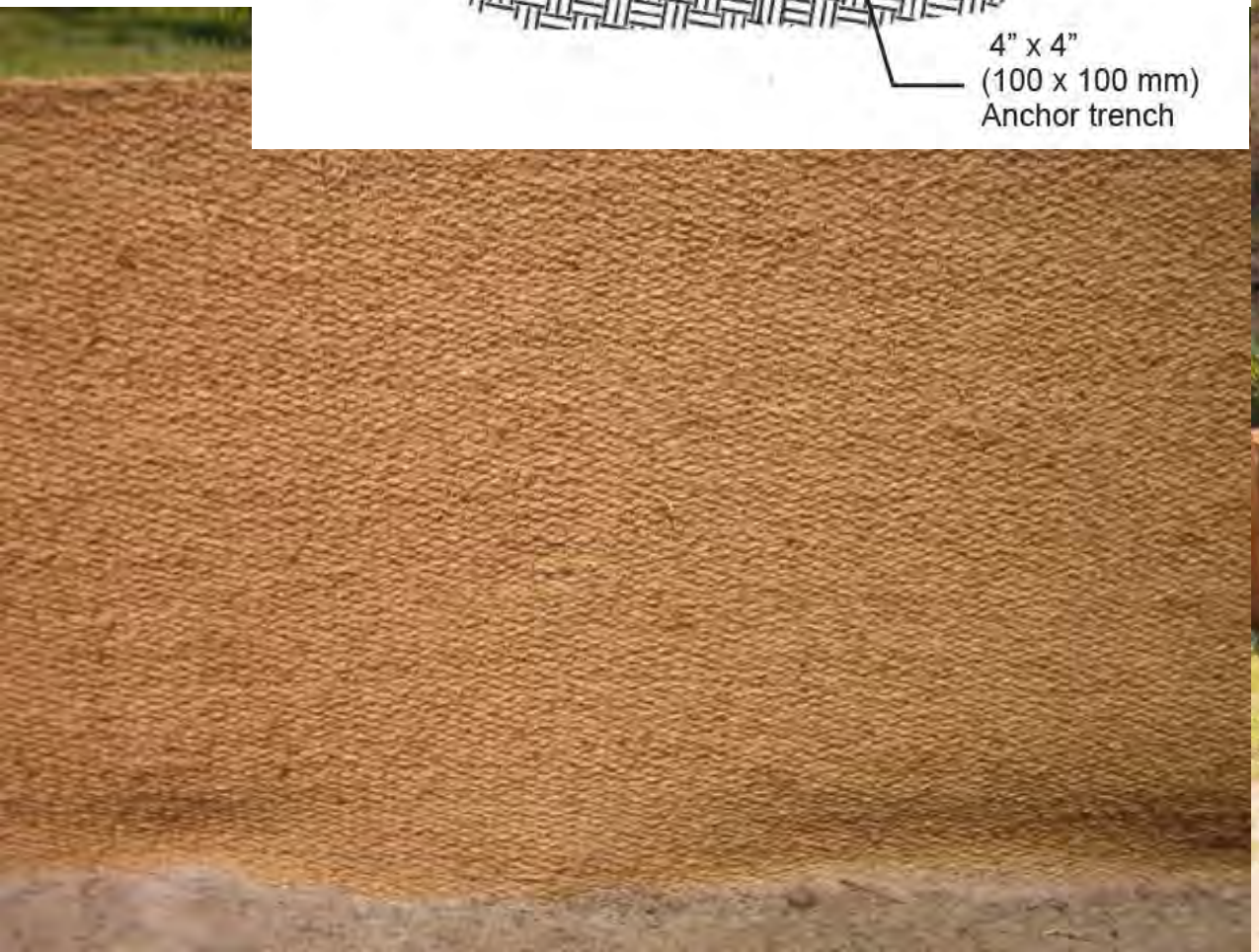
Cotton fiber (sleeve) compost sediment filter log



Coir (coconut) fiber net (sleeve) and filler


BioTwine
or
KoirTwine
2" x 2" Hardwood stakes
Direction of flow
KoirFence™ 1250
12" Min
4" x 4"
(100 x 100 mm)
Anchor trench











Sediment Filter Strip (natural netted blanket)

Very Robust



Erosion Prevention Natural Material BMPs

- Straw mulch
- Woody debris fields
- Slash mulch covers
- Natural-Netted REPPs
- Compost blankets
- Organic fibers applied in a hydro-slurry
- Vegetated riprap

All Season Mulching








Tree Debris Field







Trees to slash mulch covers

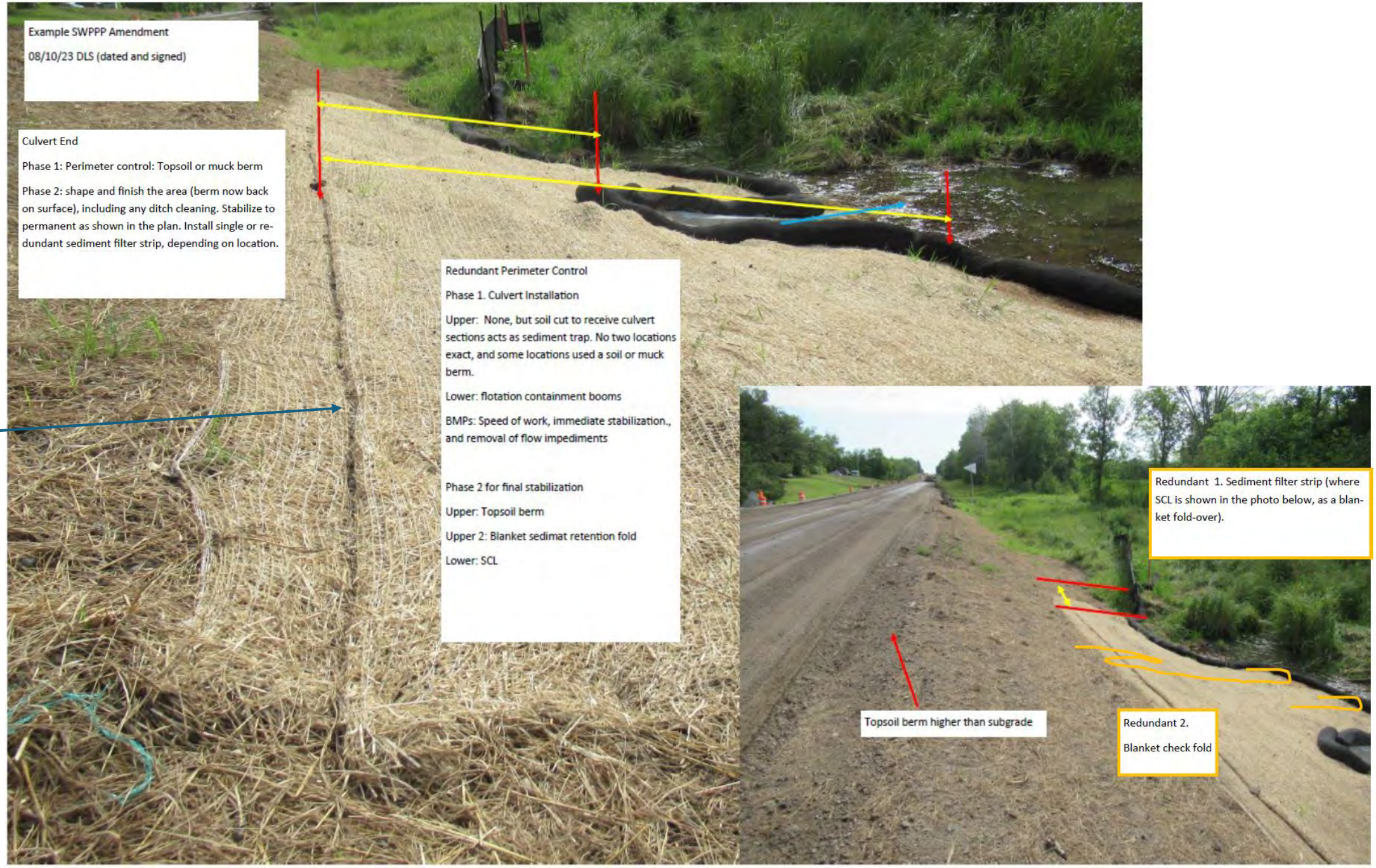






Organic Fiber Mulches (in combination with natural netted blankets)

Using blanket for redundant perimeter control



Coir open weave textiles













Rock Filter Checks

Fine Plastic Retention?





Natural Site Design







Reusable trackout controls







Reusable BMP

Adopt a Roadside
Adopt an Inlet
Adopt an Infiltration Basin



Getting Involved

- Must be safe for wildlife and public
- Means public involvement
  - ADOPT A HIGHWAY
  - ADOPT A POND
  - ADOPT AN INLET
- Get involved, complain or call someone



Adopt a Highway (trash pickup)



Call Someone






1519
Dwayne Scotland





Nothing Constructed is Maintenance-Free



The litter removal was part of the KLB “Love the Boot Week,” a statewide event in which groups compete to win the award, which gets its name from Louisiana’s boot-like outline. The agency picked up more litter than any other group during the week in April, cleaning up 152,475 pounds at more than 10 cleanup sites across the state. In a news release announcing the award, Louisiana DOTD noted that its commitment “to tackling litter-related issues extend far beyond “Love the BooT Week.” In 2023, the department budgeted $11.7 million toward picking up litter, proving the activity “is not limited to a single week but is on ongoing responsibility.”

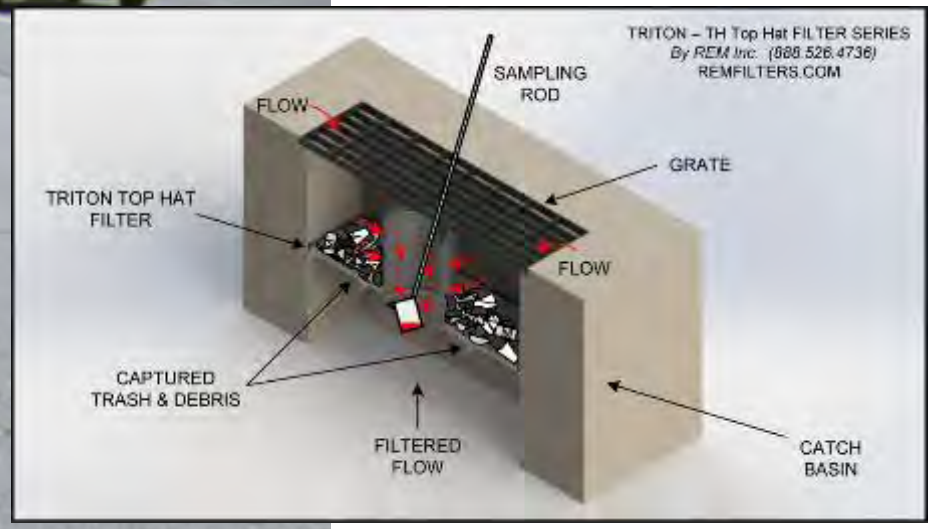
[*Editor’s note: the Oklahoma Department of Transportation was one of four Oklahoma state agencies including the Oklahoma Turnpike Authority, Oklahoma Department of Environmental Quality, and Oklahoma Department of Agriculture Food and Forestry to be receive a national award for its environmental stewardship.*]

The agency also noted a reality faced by all state departments of transportation: Litter has environmental and economic consequences.

“The financial investment made by Louisiana DOTD in litter removal each year raises important questions about resource allocation,” the release said. “Each year, money spent on picking up litter could have been used in other critical areas, such as road improvements, maintenance, and overall transportation enhancements.”

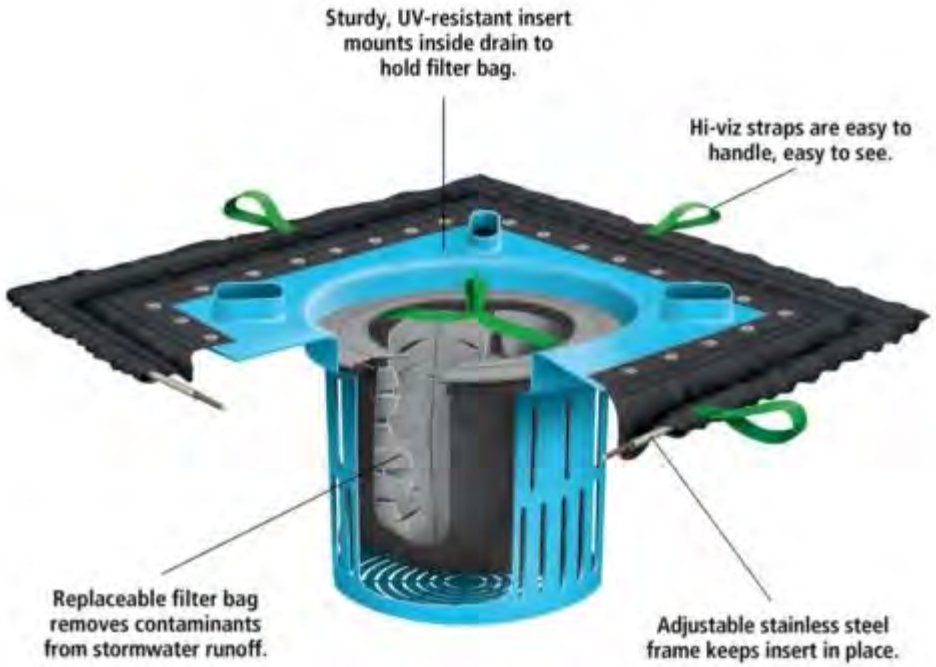
Retrofit example locations

- Inlets
  - Diapers
- Conveyances (ditches)
  - Trash checks
- Culvert outfalls
- Wind Fencing





Trash collecting Inlets







Images from various commercial manufactures



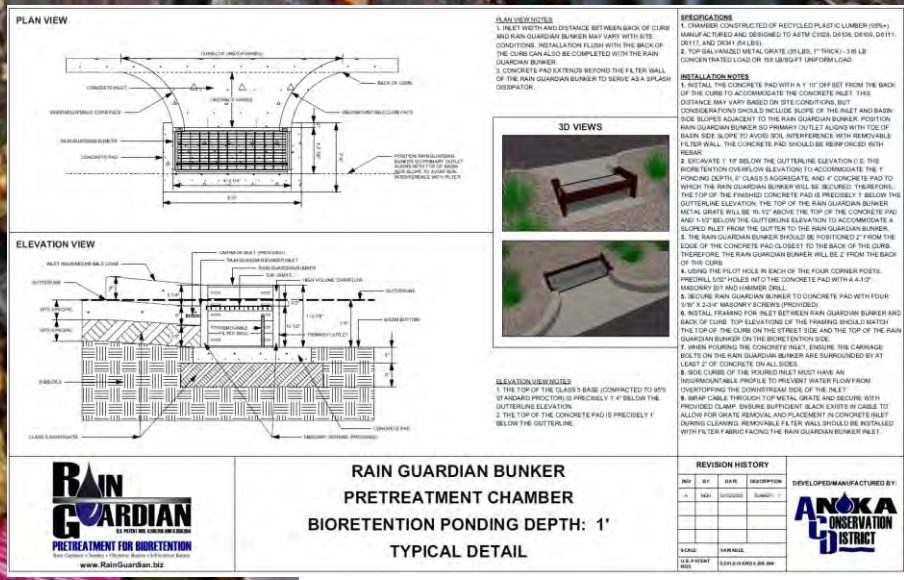






Image from internet







Trash collecting ditches













Underground trash vaults

Trash Screen







Trash collection fencing



Trash collection berms







Culvert outfall bags







Images from others







Wet Pond Trash Skimmers

Thank-you

- Questions
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