Design and Engineering Plan Review Considerations for Rolled and Hydraulic Erosion Control Products

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AECOM

Today's Discussion

- RECPs
  - Rolled Erosion Control Products
- HECP
  - Hydraulic Erosion Control Products
  - Hydraulically Applied Erosion Control Products

Why Use RECP's

Applications for slopes, channel liners, & shorelines

- Pros
  - Immediate erosion protection
  - More aggressive treatment
- Cons
  - Labor intensive
  - Added costs


Increase Seed Germination

Temporary/Biodegradable Erosion Control Products

- Straw Mulch
- Hydraulic Mulch
- RECP's
  - Jute
  - Straw
  - Excelsior
  - Coconut
  - Synthetic

RECP Types

Temporary

Degradable

Erosion Control Netting (ECN)

Open Weave Textiles (OWT)

Erosion Control Blankets (ECB)

Slopes

Channels

Long Term

Non-degradable

Turf Reinforcement Mats (TRM)

Erosion Control Netting (ECN)

- Planar woven natural fiber or extruded geosynthetic mesh
- Used as a component in RECP's
- Used as a temporary degradable RECP to anchor loose fiber mulches

Open Weave Textiles (OWT)

- Temporary degradable
- Composed of processed natural or polymer yarns woven into a matrix

Erosion Control Blankets (ECB)

- Temporary degradable; processed natural or polymer fibers

- Mechanically, structurally, or chemically bound together to form a continuous matrix

Turf Reinforcement Mats (TRM)

- Composed of non-degradable synthetic fibers, filaments, nets, wire mesh, or other elements
- Processed into a permanent, three dimensional matrix

Other Considerations

- Hard Armor vs. Soft Armor
  - Rip Rap
  - Gabions
  - TRMs
    - Composite
    - Synthetic
  - Geocells

Product Types

- Type 1 - Ultra Short Term
  - 3 months
- Type 2 - Short Term
  - 12 months
- Type 3 - Extended Term
  - 24 months
- Type 4 - Long Term
  - 36 months
- Type 5
  - permanent


ECTC Classification of RECPs
1A
1B
1C
1D
2A
2B
2C
2D
3A
3B
4
5A
5B
5C
3 Months
12 Months
24 Months
36 Months
Permanent
Manufacturer's Anticipated Functional Longevity or Durability

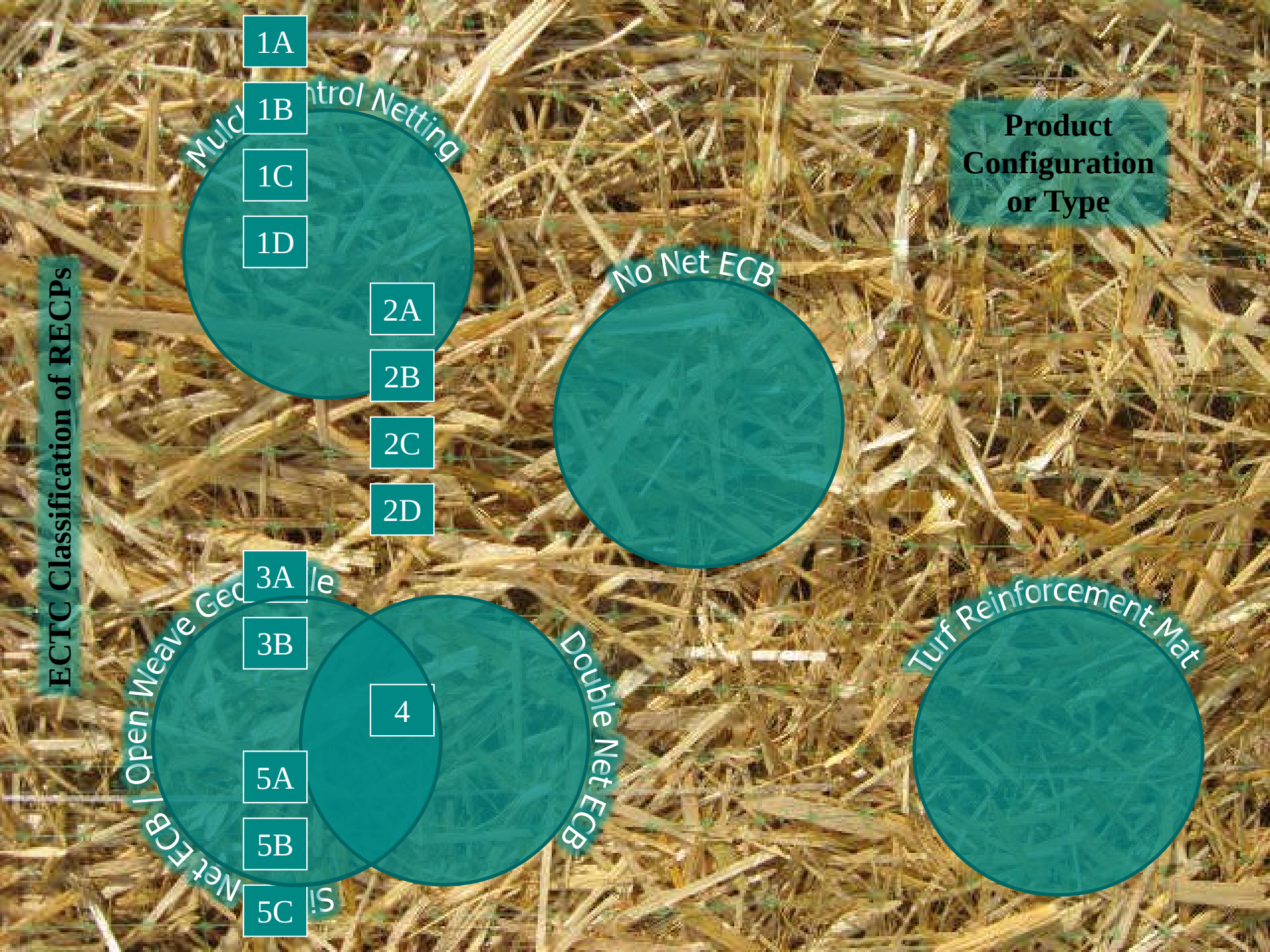
Configuration and Durability

Table ECB-3 Typical Configuration and Durability of Temporary Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
1.A Ultra-short term mulch control netting	Mulch control netting consisting of rapidly degrading photodegradable synthetic mesh or woven biodegradable natural fiber netting.	3 months
1.B Ultra-short term netless erosion control blanket	An erosion control blanket composed of processed rapidly degrading natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.	3 months
1.C Ultra-short term single net erosion control blanket or open weave textile	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single rapidly degrading, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix.	3 months
1.D Ultra-short term double net erosion control blankets	An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 rapidly degrading, synthetic or natural fiber nettings to form a continuous matrix.	3 months
2.A Short-term mulch control netting	Mulch control netting consisting of photodegradable synthetic mesh or woven biodegradable natural fiber netting.	12 months
2.B Short-term netless erosion control blanket	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.	12 months
2.C Short-term single net erosion control blanket or open weave textile	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single degradable, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.	12 months
2.D Short-term double net erosion control blanket	An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 synthetic or natural fiber nettings to form a continuous matrix.	12 months
3.A Extended-term mulch control netting	Mulch control netting consisting of a slow degrading synthetic mesh or woven natural fiber netting.	24 months
3.B Extended-term erosion control blanket or open weave textile	An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	24 months
4 Long-term erosion control blanket or open weave textile	An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	36 months

Table ECB-4 Typical Configuration and Durability of Permanent Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
5.A Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent
5.B Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent
5.C Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent


ECTC Classification of RECPs
Product Configuration or Type
1A
1B
1C
1D
2A
2B
2C
2D
3A
3B
4
5A
5B
5C
No Net ECB
Turf Reinforcement Mat
Double Net ECB

Typical Slope and Channel Applications

Table ECB-1 Temporary Erosion Control Blanket Classes and Applications

Class	Application
1.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
1.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.
1.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.
1.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
2.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
2.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.
2.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and char stresses up to 1.5 pounds per square foot.
2.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
3.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
3.B	Designed for use on geotechnically stable slopes with gradients up to 1.5:1 and channels with shear stresses up to 2 pounds per square foot.
4	Designed for use on geotechnically stable slopes with gradients up to 1:1 and channels with shear stresses up to 2.25 pounds per square foot.

Table ECB-2 Permanent Erosion Control Blanket Classes and Applications

Class	Application
5.A	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 6 pounds per square foot.
5.B	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 8 pounds per square foot.
5.C	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 10 pounds per square foot.


ECTC Classification of RECPs
Typical Slope Applications
Mulch Control Netting
1A
2A
5H:1V
3A
No Net ECB
1B
4H:1V
2B
Turf Reinforcement Mat
5A
5B
0.5H:1V
5C
Single Net ECB | Open Weave Geotextile
1C
3H:1V
2C
Double Net ECB
1D
3B
1H:1V
4
2H:1V
2D

C – Factor Performance

- Cover Factor “C”
- Effectiveness – Primary soil loss value
- Ability to minimize soil movement during rain events

Engineering Properties

Table ECB-5 Minimum Physical Requirements For Erosion Control Blankets

Class	Minimum Tensile Strength (pounds/ft.) (ASTM D 4595) [1]	Mi Pe St (p (A	Property: Maximum "C" Factor for Temporary Products (ASTM D 6459) [2], [6]	ility n % etention) anent 4355) r exp.)	Minimum Thickness (inches) For Permanent Products (ASTM D 6525) [4]
1.A [6]	5	0.2	0.10 @ 5:1		N/A
1.B	5	0.5	0.10 @ 4:1		N/A
1.C	50	1.5	0.15 @ 3:1		N/A
1.D	75	1.7	0.20 @ 2:1		N/A
2.A [6]	5	0.2	0.10 @ 5:1		N/A
2.B	5	0.5	0.10 @ 4:1		N/A
2.C	50	1.5	0.15 @ 3:1		N/A
2.D	75	1.7	0.20 @ 2:1		N/A
3.A [6]	25	0.2	0.10 @ 5:1		N/A
3.B	100	2.0	0.25 @ 1.5:1		N/A
4	125	2.2	0.25 @ 1:1		N/A
5.A [7]	125	6.0	N/A		0.25
5.B [7]	150	8.0	N/A		0.25
5.C [7]	175	10	N/A		0.25

1 Minimum average roll values, m
loading and/or high survivability
2 Minimum shear stress the rolled
damage or excess erosion (>.5"
test values should be supported
using Erosion Control Technolog
levels were established for each
roughness coefficients in the ran
3 "C" factor calculated as ratio of s
gradient) to soil loss from unprot
supported by periodic bench sca
Technology Council Test Metho
4 Minimum average roll values.
5 Other large scale test methods n
6 Obtain maximum "C" factor and
with pre-applied mulch material.
7 For turf reinforcement mats cont
degradable portion of the matting alone.

field conditions with high
eater.
an sustain without physical
le testing. These performance
ditions and failure criteria
the permissible shear stress
aracterized by Manning's

lope (tested at the specified
rmance test values should be
ria using Erosion Control

he netting used in conjunction

st be obtained on the non-

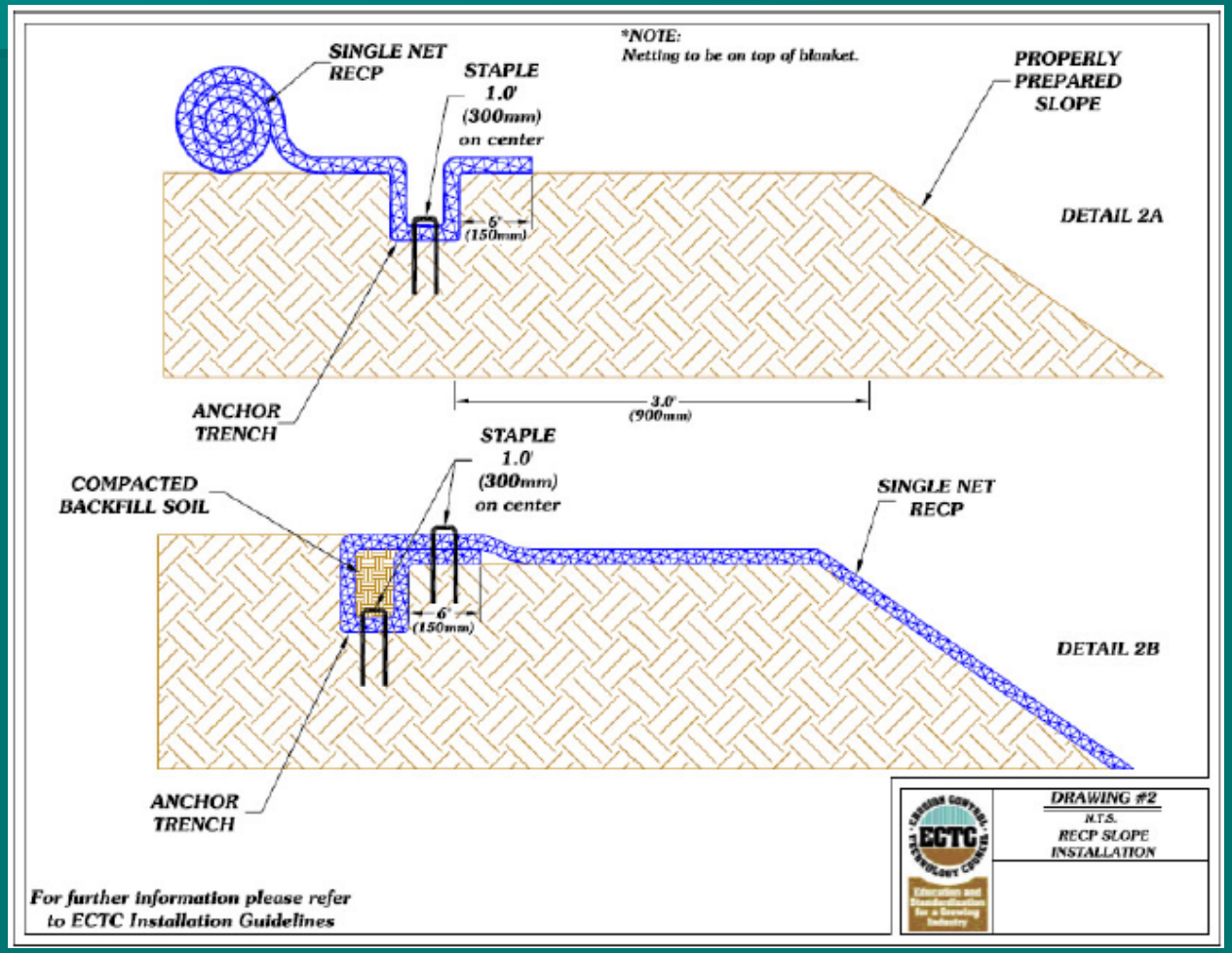
Riparian Buffer Considerations

- Netless vs. Net

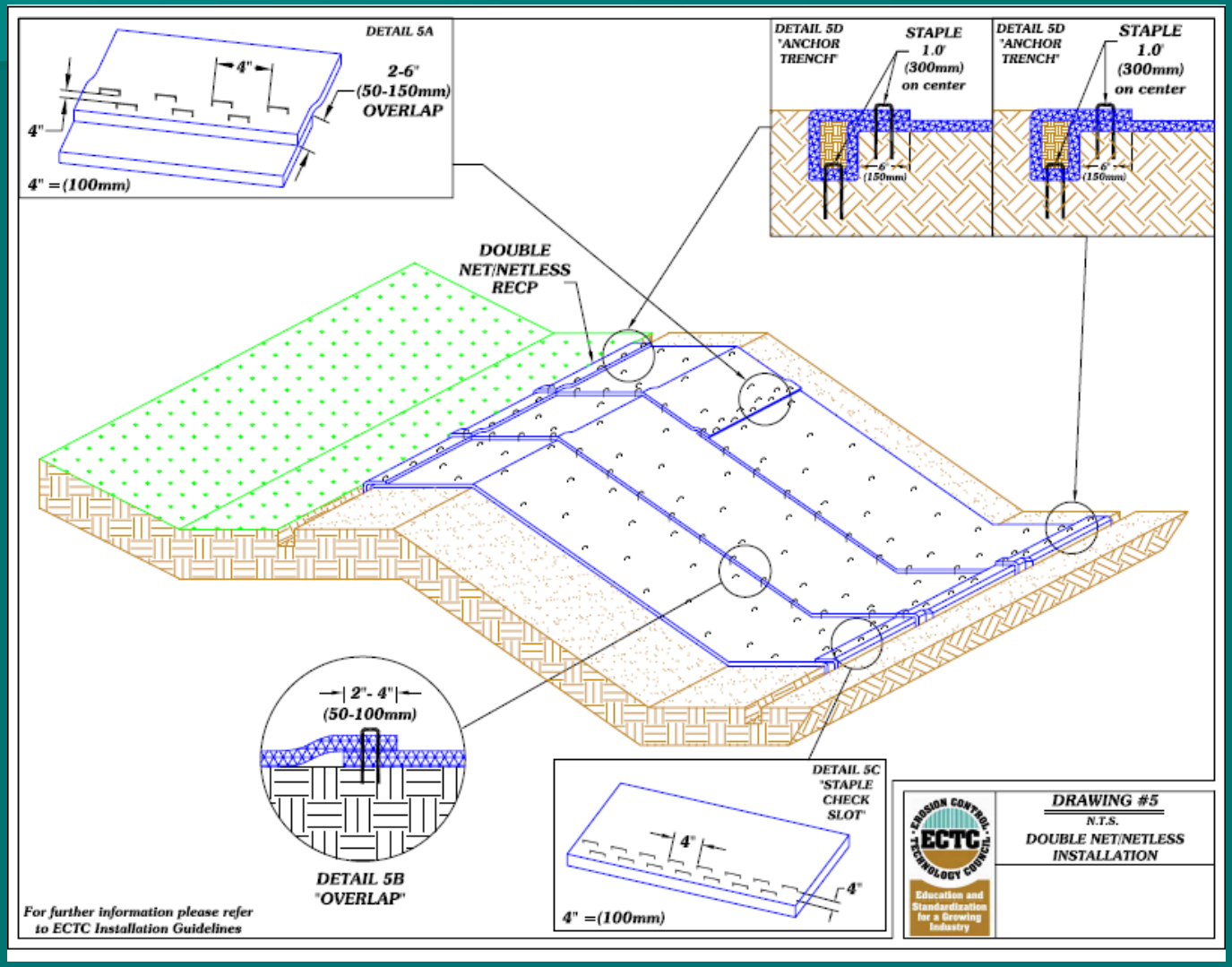
RECP Installation

- Site Preparation
  - Fine graded to a smooth profile
  - Free from clods, roots, stone, etc.
- Seeding
  - Select seed mix to the geological area
- Trenching
  - 6” deep by 6” wide anchor trench at top of slope
- Staples

Slope Installation



Slope Installation




Why is stapling important?

Installed Costs

- Type 1 – $0.50 - $0.75/sy
- Type 2
  - Single Net - $1.50/sy
  - Double Net - $1.75/sy
- Type 3 - $2.00 - $5.00/sy
- Type 4 - $6.00/sy
- Type 5 - $6.00 - $7.00/sy

HECP and RECP

Why use HECP's

- Easy to Install
- Better contact with soil
- Site prep savings

Characteristics

- Quality raw materials – no germination inhibitors
- Long fiber lengths provide excellent erosion control and moisture absorption
- Thermally refined fibers provide greater moisture retention and ground coverage

HECP Types

- Hydraulic Mulch (HM)
- Stabilized Mulch Matrix (SMM)
- Bonded Fiber Matrix (BFM)
- Fiber Reinforced Matrix (FRM)

Hydraulic Mulch

- Contains defibrated paper, wood and/or natural fibers
- May or may not contain tackifiers
- Use on mild slopes

Stabilized Mulch Matrix

- Contains defibrated organic fibers with at least one of the following:
  - Soil flocculants
  - Cross linked hydro-colloidal polymers
  - Cross linked tackifiers
- Use on moderate slopes

Bonded Fiber Matrix

- Matrix containing organic defibrated fibers and cross-linked insoluble hydro-colloidal tackifiers
- Use on steep slopes

Fiber Reinforced Matrix

- Matrix containing organic defibrated fibers
- Cross linked insoluble hydro colloidal tackifiers and reinforcing natural or synthetic fibers
- Use on very steep slopes

Application Rates

Hydraulic Erosion Control						
Type	Functional Longevity	Typical Application Rates (lbs/ac)	Typical Maximum Slope Gradient (H:V)	Maximum Uninterrupted Slope Length (ft)	Maximum C Factor	Minimum Vegetation Establishment
HM	up to 3 mo.	2000-3000	≤ 3:1	25	0.5	150%
SMM	min. 3 mo.	2000-3500	≤ 2:1	50	0.15	200%
BFM	min. 6 mo.	2500-4000	≤ 1:1	75	0.1	300%
FRM	min. 12 mo.	3000-4500	≤ 0.5:1	100	0.02	400%

Mixing Techniques

- Mechanically Agitated Machines
  - Have paddles to mix slurry in tank
  - Can use a wide range of fiber mulch materials
- Jet Agitated Machines
  - Generally smaller machines that mix slurry with jets
  - May have difficulty pumping wood based fiber mulch materials

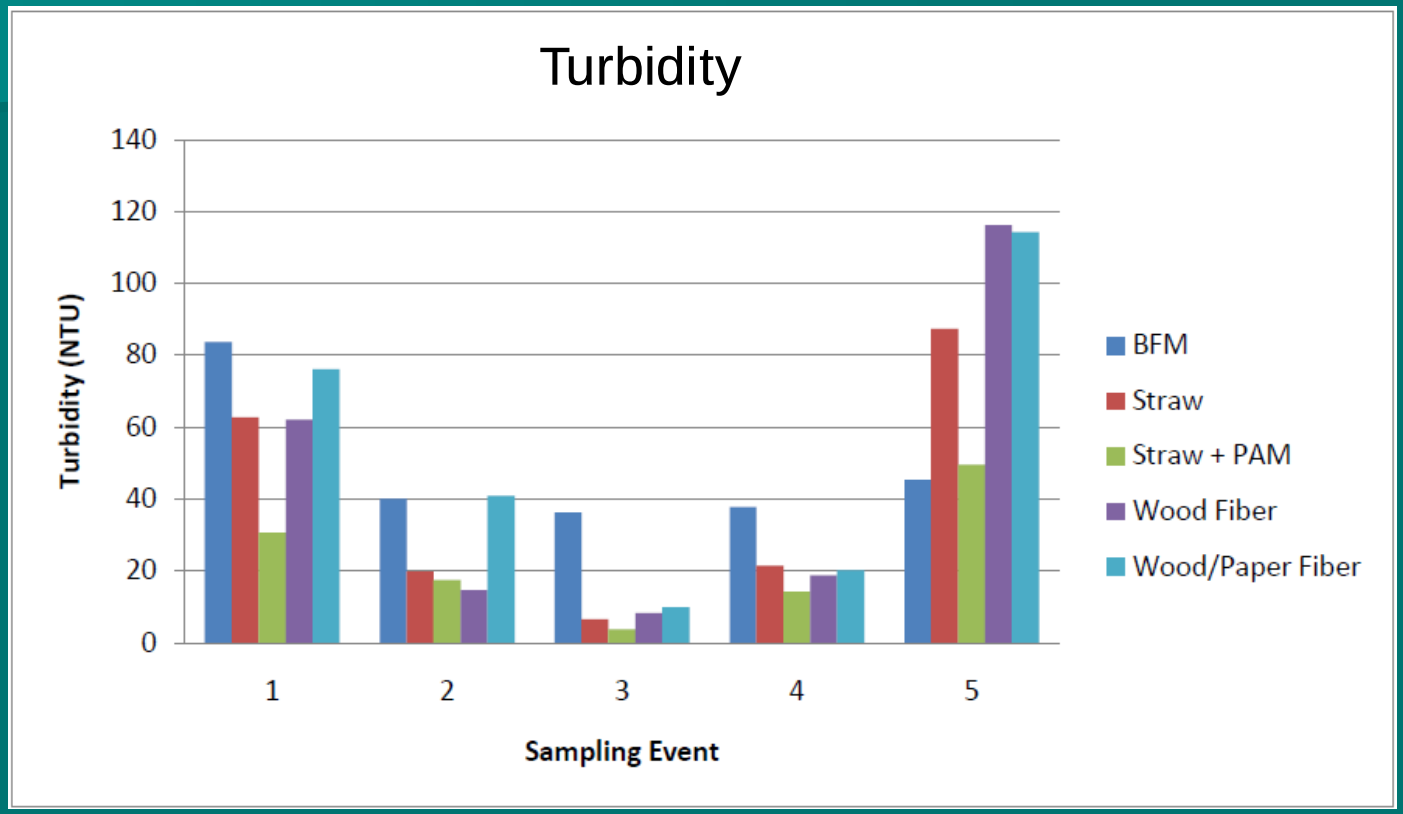
HECP Research

- 30’ x 200’ area
- 20 plots
- 5 treatments were applied
- Each treatment replicated 4 times

Hydromulch Research

Plot Type	HM subsample weight (g)	DOT recommended rate (lb/ac)	Actual application rate (lb/ac)
100% wood	6.7	2000	3300
100% wood	8.4	2000	4100
100% wood	12.6	2000	6200
100% wood	11.8	2000	5800
BFM	17.3	3500	8500
BFM	7.7	3500	3700
BFM	10.1	3500	4900
BFM	11.2	3500	5500
70/30	6.8	2500	3300
70/30	6.5	2500	3200
70/30	9.3	2500	4500

Hydromulch Research



- Event 1 - 3.87” rainfall
- Event 2 - 1.55” rainfall
- Event 3 - 2.07” rainfall


Easy Fill


Soil Prep


Seeding


Placed BFM over Straw

Only BFM that can be used over Straw

Results looked good compared to check.

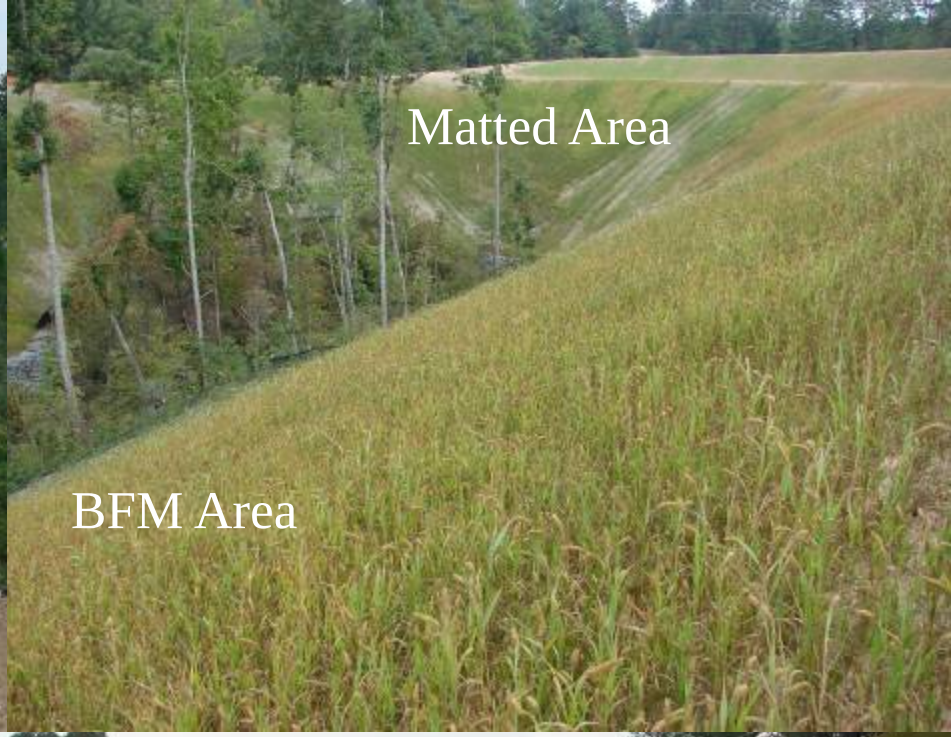
New Test Areas
Potential to save on matting quantities.

Resident & Contractor Prefer BFM

About half the cost of matting: $4700/ac

Matting can be expensive if you have to re-walk and re-mat.


BFM
Straw Matting


Matted Area
BFM Area


Matting
Easier to patch than matting.


Matting
Patched Area

Aerial Hydro Mulching

Installed Costs

- Hydraulic Mulch - $1500-$3000/ac
- Stabilized Mulch Matrix - $3000-$4000/ac
- Bonded Fiber Matrix - $4000-$5000/ac
- Fiber Reinforced Matrix - $5000-$6000/ac

Summary

- A right tool for every job!
- Select product based on engineering properties and site/slope warrants
- HECP's may serve as equivalent to some RECP's at a cost savings

Questions

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