Tying Research into Practical Solutions

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Erosion Control

Days of Old

- Erosion Control

What's going on in NC NOW?

Infiltration?

Infiltration!!!

Study Objectives

Create a simulated construction site environment to:

Determine the effects of tillage and amendments on

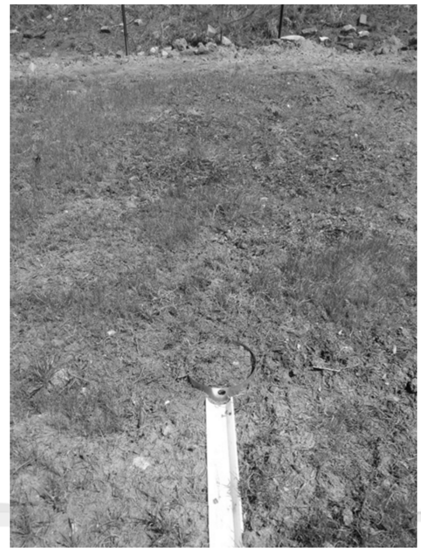
- Infiltration and runoff rates
- Grass growth above and below ground

Study Locations

3 sites

1. Piedmont: Raleigh, NC
2. Sandhills: Jackson Springs, NC
3. Mountain: Mills River, NC

Infiltration Plots and Measurements



Compaction review

•Bulk density increased on tillage treatments over time.

•Control plot bulk density remained unchanged.

  •Except at the Sandhills site.

•Mower traffic influenced only the upper 10 cm of the tilled

Infiltration Results
Piedmont Site 1

- **Irrigation rate 14-16 inches/hour**
- **Different letter means statistically significant within column**

Time After Treatment (months)				
	4	15	20	27
Treatment	Infiltration Rate (in/hr)			
Control	1.7 a	0.8 a	1.1 a	1.7 a
Shallow Till	13 b	12 b	4.6 a	6.5 ab
Deep Till	12 b	12 b	7.6 a	11 b

Infiltration Results
Piedmont Site 2

- **Irrigation rate 10-26 inches/hour; traffic = mowed, no traffic = trimmer**
- **Different letters mean statistically significant within column**

Time After Treatment (months)		
	6	13
Treatment	Infiltration Rate (in/hr)	
Control w/ traffic	0.6 a	2.7 a
Control no traffic	0.4 a	1.2 a
Deep Till w/ traffic	7.5 ab	2.4 a
Deep Till no traffic	15 b	7.0 a
Deep Till + Compost w/ traffic	17 b	18 b
Deep Till + Compost no traffic	21 b	17 b

Infiltration Results
Sandhills Site

- Irrigation rate 14-19 inches/hour; traffic = mowed, no traffic = trimmer
- Different letters mean statistically significant within column

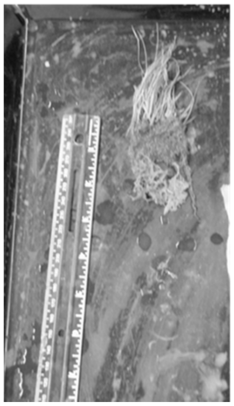
Time After Treatment (months)				
	1	5	17	24
Treatment	Infiltration Rate (in/hr)			
Control	0.2 a	1.2 a	3.5 a	2.0 a
Control + compost	0.1 a	1.2 a	5.4 ab	4.0 ab
Shallow Till	15 b	15 b	10 bc	9.6 bc
Shallow Till + compost	15 b	16 b	15 c	11 c
Deep Till	15 b	13 b	12 bc	11 c
Deep Till + Compost	16 b	17 b	15 c	11 c

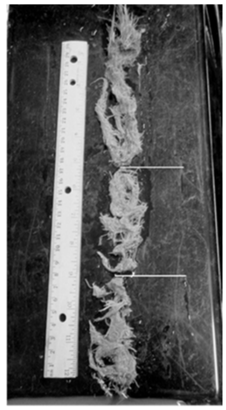
Infiltration Results
Mountain Site

- Irrigation rate 10-21 inches/hour
- Different letter means statistically significant within column

Time After Treatment (months)			
	1	2	11
Treatment*	Infiltration Rate (in/hr)		
Control	0.2 a	0.3 a	3.5 a
Shallow Till	19 b	12 b	9.5 a
Deep Till	20 b	13 b	9.5 a

*Compost had no statistical effect at this site.





Rooting depths:

Compacted soil, shallow till, and deep till respectively

•Tillage is widely used in agriculture and has potential use for construction settings **to reduce runoff and improve vegetative growth.**

• Deeper tillage = deeper root penetration = less runoff.

•Assuming good vegetation establishment

•Infiltration remained high even with bulk density increases over time from either
- Soil settling
- Lawn mower traffic

•Infiltration rates MAY be able to handle runoff from impervious surfaces into these areas
- Treat like a stormwater BMP

Mulches for Controlling Erosion and Establishing Grass on Slopes: What Works

Final Results: Erosion

Treatment	Site 1, Kinston	Site 2, West Jefferson	Site 3, Garner	Site 4, Apex	Site 5, Holly Springs
			Total sediment loss (kg ha^{-1})		
Straw	7.8a	13a	3,685a	51bc	36b
Straw+PAM	6.6a	8a	1,261ab	29c	29b
SMM	N/A	11a	959bc	N/A	35b
BFM	8.9a	12a	1,930ab	N/A	N/A
FGM	N/A	14a	333c	164ab	N/A
WFM	7.4a	N/A	N/A	237a	120ab
WCB	10.5a	N/A	N/A	221ab	210a

PAM=Polyacrylamide. FGM=flexible growth media. SMM=stabilized mulch matrix. BFM=bonded fiber matrix. WFM=wood fiber mulch. WCB=70:30 wood fiber/cellulose blend.

Summary: Erosion

- For 2 sites, all mulches performed similarly.
- For 1 site, 2 of 3 hydromulches were better than straw; 1 hydromulch was better than straw+PAM; straw+PAM was as good as the BFM.
- For 1 site, straw+PAM was better than all 3 hydromulches; straw alone was better than WFM.
- Last site, straw = straw+PAM = SMM; WCB worse than all three.

Vegetative Cover

Treatment	Site 1, Kinston	Site 2, West Jefferson	Site 3, Garner	Site 4, Apex	Site 5, Holly Springs
			Cover (%)		
Straw	68a	49a	72a	56a	75b
Straw+PAM	66a	56a	68a	54a	67b
SMM	N/A	32a	65a	N/A	93a
BFM	53a	36a	70a	N/A	N/A
FGM	N/A	37a	59a	28b	N/A
WFM	55a	N/A	N/A	34b	94a
WCB	56a	N/A	N/A	32b	96a

Summary Vegetation:

- For 3 sites, there were no differences in cover for any mulch treatment.
- For 1 site, straw and straw+PAM had significantly more cover than FGM, WFM, and WCB.
- Last site, SMM=WFM=WCB and all were better than either straw treatment. However, high tackifier application was likely the cause.

Does PAM Reduce Erosion?

- PAM usually reduced erosion rates for typical ground covers.
- Straw + PAM (30 lb/ac) can outperform blankets and hydromulch.
- But poor ground coverage by mulch may reduce or eliminate PAM benefits.

Does PAM Improve Vegetation Cover?

- No clear evidence of improved grass stands when PAM was applied has been discovered.
- Previous work showed small but significant increases in early grass coverage (McLaughlin and Brown, 2006).

Conclusions

- Any ground cover is better than none (>90% reduction rule).
- Hydromulches and blankets alone *may* be more effective than straw alone.
- PAM may improve straw performance to hydromulch or blanket level.
- Minimum PAM application rate of **20 lb/acre** is needed to be effective, 20-30 lbs/ac best.
- The application of PAM to bare soil is not a substitute for mulch.

Careful with the Tackifier…

POLYACRYLAMIDE TOXICITY TO NATIVE FRESHWATER MUSSELS

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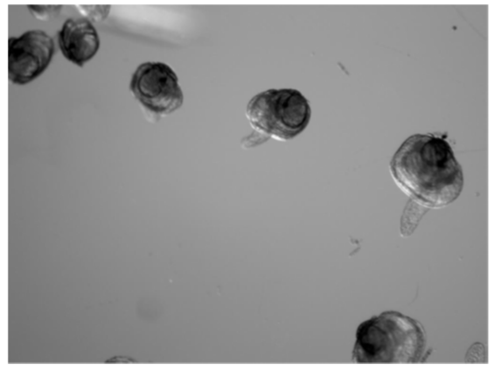
Objectives:

- Evaluate the toxicity of polyacrylamide to freshwater mussels
- Evaluate the impacts of turbidity on freshwater mussels
- Evaluate the response of freshwater mussels after the addition of polyacrylamide and suspended sediment



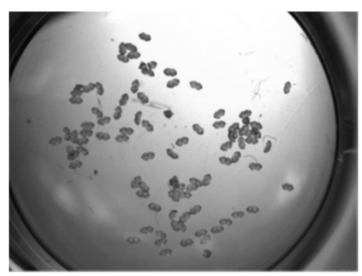
Methods: Acute Toxicity Experiments

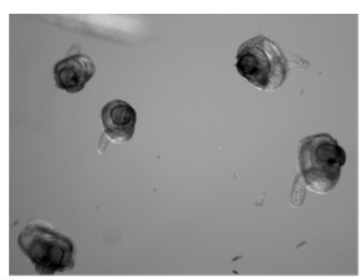
Glochidia and juveniles of:

- Appalachian Elktoe
- Yellow Lampmussel
- Threeridge

Polyacrylamide used:

- FLOPAM™ AN 913 VHM
- FLOPAM™ FA 920
- FLOPAM™ AN 923 SH
- FLOPAM™ AN 923
- FLOPAM™ AN 923VHM
- APS705





BACKGROUND OBJECTIVES METHODSRESULTS IMPLICATIONS CONCLUSIONS FUTURE PLANS

PAM Comparative Acute Toxicity

- LC50s for freshwater species
- Daphnia (48h LC50): 152 mg/L
- Fathead minnow (96h LC50): > 100 mg/L
- Mussels(24 –96h LC50): ? mg/L

Compound	Appalachian Elktoe Glochidia	Appalachian Elktoe Juvenile	Yellow Lampmussel Glochidia	Yellow Lampmussel Juvenile
FLOPAM™ AN 913 VHM	>1000	>1000	>1000	>1000
FLOPAM™ FA 920	>1000	>1000	>1000	>1000
FLOPAM™ AN 923 SH	>1000	>1000	>1000	563
FLOPAM™ AN 923	>1000	330	844	127
FLOPAM™ AN 923VHM	>1000	>1000	>1000	>1000
APS705	>1000	>1000	>1000	>1000

Results

- Yellow Lamp mussel more sensitive
- Juveniles appear more sensitive
- AN923 most toxic

- Acute exposure -highly relevant for application

Compound	Appalachian Elktoe Glochidia	Appalachian Elktoe Juvenile	Yellow Lampmussel Glochidia	Yellow Lampmussel Juvenile
FLOPAM™ AN 913 VHM	>1000	>1000	>1000	>1000
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FLOPAM™ AN 923VHM	>1000	>1000	>1000	>1000
APS705	>1000	>1000	>1000	>1000

Accomplishing additional objectives

- Evaluate the impacts of turbidity on freshwater mussels
- Evaluate the response of freshwater mussels in suspended sediment after addition of polyacrylamide
- More results to come!

Ongoing Projects

New Zealand Rainfall Activated PAM Doser

Figure 4. Rainfall Activated Flocculation Housing

Auckland Regional Council
TE RAUHITANGA TAIAO

The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff : Trials, Methodology and Design [draft]

June 2004 Technical Publication 227

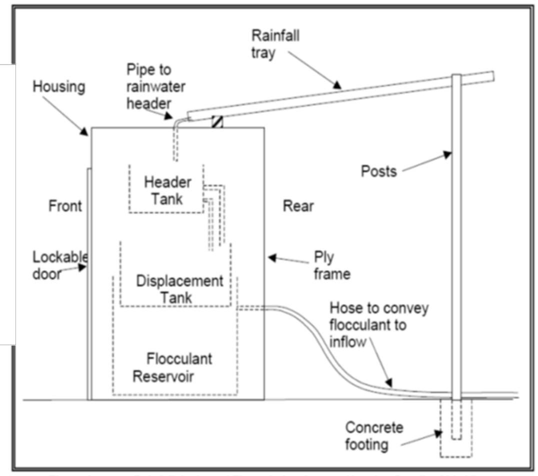
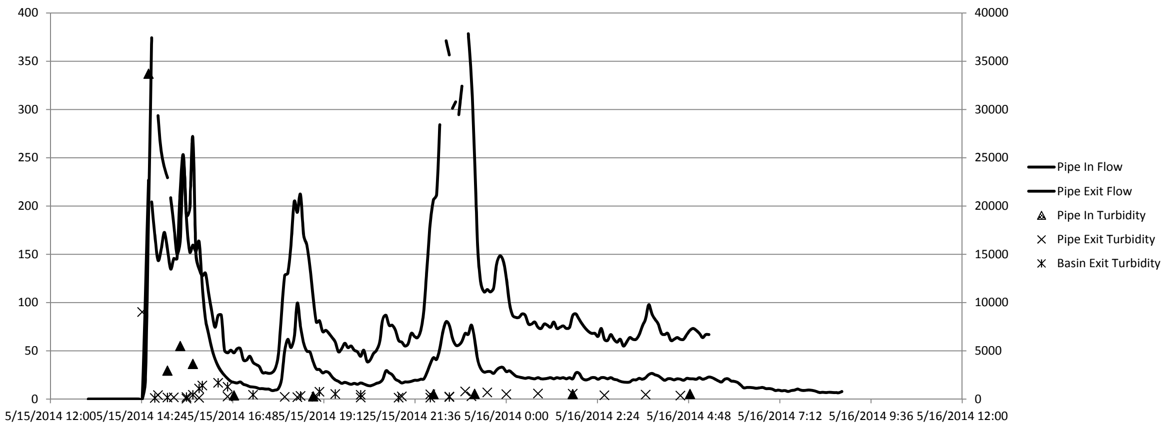


Figure 3. Rainfall Activated Flocculation System Housing Detail – Side View

New Zealand Rainfall Activated PAM Doser

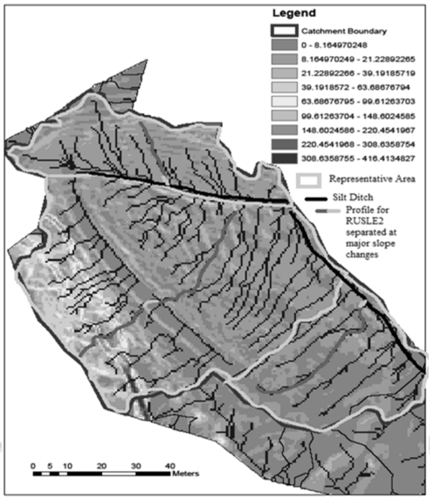
Turbidity (ntu) and Flow (gpm) over time



Float Valve Doser

Why Line Ditches?

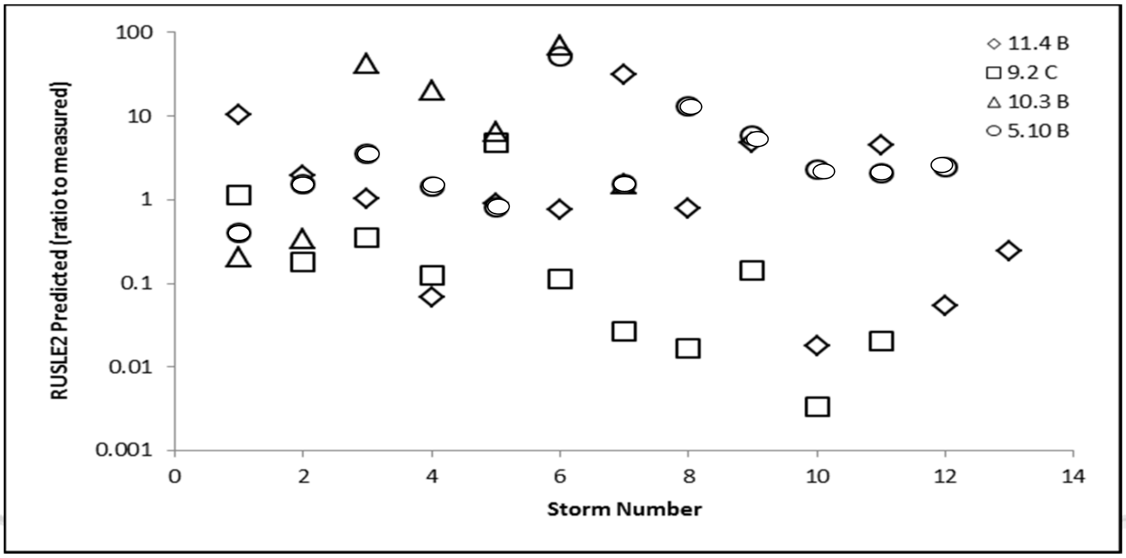
- Case Study – Using RUSLE2 to predict soil loss



Case Study - Results

Basin ID	Days	Number of Storms	Total Precipitation (mm)	Field Sediment Yield (Mg)	RUSLE2 Representative Slopes from Surveys (Mg)	RUSLE2 Representative Slopes from Plans (Mg)
11.4 B (CG)	52	4	69	0.674	0.651	1.96
11.4 B (MG)	181	9	89	28.0	2.64	4.95
9.2 C (CG)	146	9	67	30.2	1.74	1.89
9.2 C (MG)	32	2	14	14.5	0.330	1.26
10.3 B (FG)	175	6	154	1.37	0.178	0.948
10.3 B (PP)	18	1	28	0.00227	0.000267	0.00207
5.10 B (CG)	134	10	150	5.74	3.31	7.62

Case Study - Results



Case Study

Ditch Stabilization Treatments

Hydraulically Applied Concrete Product

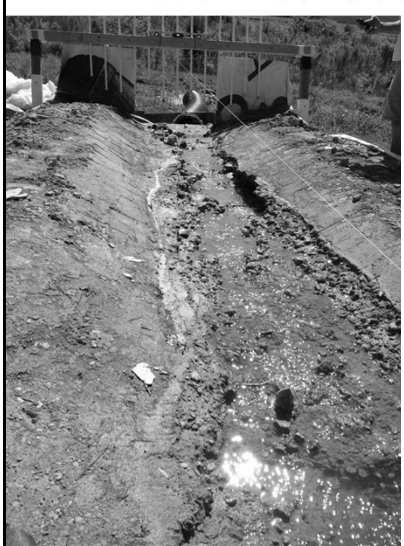
Excelsior

Jute

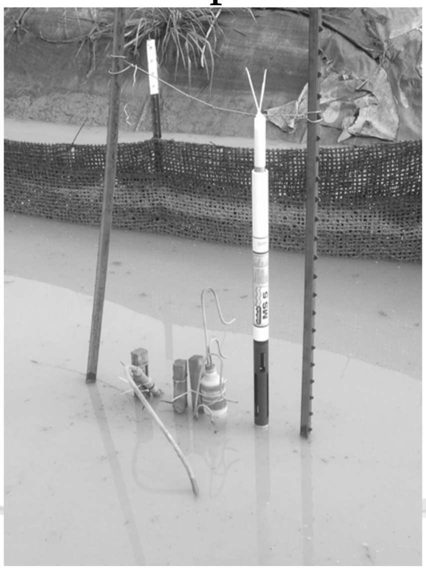
Jute + PAM

Bare/Control

Test Methods



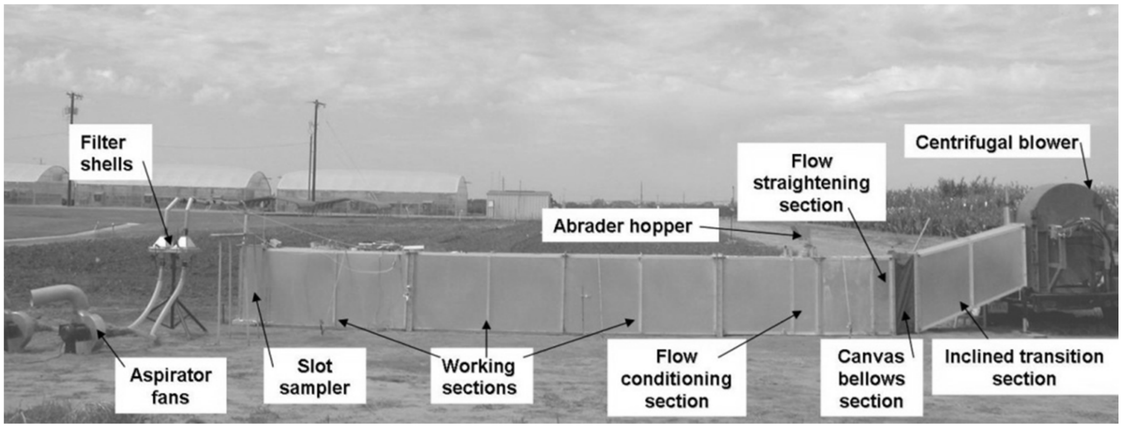
Comparison of Sampling Methods



Bottles on a Stick
Automated Sampler
Grab Samples
Turbidity Sonde

Upcoming Projects

Straw Mulch Tackifier Project



Questions???