What's On The Horizon?

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Professor and Extension Specialist

Excelsior Blanket Plus
Granular vs. Dissolved PAM
Runoff Results: Turbidity

Runoff Results: Solids (TSS)

PAM: polyacrylamide; GPAM: granular PAM; DPAM: dissolved PAM
PAM Concentration in Runoff
New Information!


Granular PAM + Cover
Dissolved PAM + Cover

Structure Effects
(blanket removed)

Excelsior + Granular PAM
Excelsior + Dissolved PAM

Less Surface Sealing, More Granular
Erosion Conclusions

- Adding PAM to the blanket substantially reduced erosion and turbidity
- Both granular and dissolved PAM worked well, with some advantage to the dissolved
- Less PAM is lost in runoff when it is applied dissolved
- PAM in runoff remains well below aquatic toxicity levels, even in first flush

Weather Factors in Grass Establishment

- Average rainfall per day
- Max intensity 1st event (negative)
- Amount of 1st event (negative)
- Max intensity of 2nd event (negative)
- Time between seeding and rain (negative)

Babcock and McLaughlin. 2013. J. Soil Water Cons. 68(3):221-227
Might be worth watering during dry spells…

Careful About Plastic Netting!
Soil Compaction: Poor vegetation establishment, high runoff rate

Tillage for Infiltration
No lime effect (1x vs 2x)
No mower traffic effect except at one location.
Compost had no effect but appeared to improve resistance to re-compaction from mower.

What About Drones?

Current Study at Auburn

Courtesy Mike Perez
PhD Candidate
Department of Civil Engineering
DJİ PHANTOM 2 VISION

- UAV Quadcopter
  - 13.8 in. length / 2.6 lb. weight
  - 25 min. / 984 ft. flight range
  - 34 mph max. flight speed

- Sensor
  - 14 MP photographs / 1080/30P video
  - 0-60 deg. gimbal tilt

- Operation
  - First person real-time view
  - GPS flight control enabled
  - Autonomous flight plan application

US HWY 27 / SR1 WIDENING  RANDOLPH COUNTY, GA
US HWY 27 / SRI WIDENING  RANDOLPH COUNTY, GA

CORRECTIVE ACTION (5/1/14)
PHOTOGRAMMETRY

- Obtaining reliable measurements from overlapping photographs
- Scaled three-dimensional reconstruction through triangulation
- Common applications
  - Large-scale topographic surveys, land-use maps, forestry covers
- Image resolution
  - Airplane / satellite: 7.9 to 19.7 in./pixel
  - Low altitude UAV: 0.40 in./pixel

PHOTOGRAMMETRIC DEM GENERATION
VOLUME ESTIMATION

STOCKPILES
- Haul & transport estimation
- Efficient material storage / handling

SEDIMENT BASINS
- Available storage volume
- Identification of dredging / maintenance needs

Point Cloud of Basin

3.7 million points from 30 images
CONSTRUCTION DOCUMENTATION

- Construction industry is burdened with legal disputes
- Assessment of pre-development conditions
  - Identification of natural resources
- Project progression
  - Evaluation of progress
  - Contractor claims / disputes
- Material management
  - Pavement sub-base thickness
  - Stock-pile volumes
- Project communication
  - Public meetings
  - Design engineers / contractors

INITIAL ROADWAY GRADING: MARCH 8, 2014

Alabama DOT Constructed Wetland
FOLLOWING HEAVY RAINFALL EVENTS: MARCH 30, 2014

ROADWAY BASE LAYER PLACEMENT: MAY 1, 2014
ROADWAY & VERTICAL CONSTRUCTION: JUNE 30, 2014

UAVs are fun, but...
National - Federal Aviation Administration

- In 2012, Congress mandated the FAA to determine how to integrate UAS into commercial airspace by September 2015.
  - Integration will be incremental
    - proposed rule for small UAS (< 55lbs)
  - Certificate of Authorization (COA)
    - permits public agencies and organizations to operate a particular UA, for a particular purpose, in a particular area.
    - Airworthiness Certificate

The State of the State: North Carolina UAS Legislation

In Short...

1) No State or Local agency can procure or operate a UAS without approval from the CIO

2) CIO and NCDOT Aviation will collaborate to develop a plan for statewide integration
   (funding, participants, data management, issues, governance of use)
North Carolina NextGen Air Transportation (NGAT) Center

- Primary Responsibility: coordinate all Unmanned Aircraft Systems (UAS) activities in the state
  - Institute for Transportation Research and Education at North Carolina State University (*non-profit, university-research center*)
  - Chartered by NCDOT Aviation (2012-relaunch)
  - Provides structure, process, and coordination for all UAS activities in North Carolina
    - university research, public safety, emergency management, and product

The State of the State: North Carolina UAS Governance Board

- Special 13 member Panel (*first in country*)
  - Regulate and Govern UAS in North Carolina
  - Create standards and policies for their use and operations
  - Approve or deny drone use requests (COA’s)
  - Certification, registration, and licensing

- $1.6 million initial investment (2014-2015 fiscal year)
  - $215,000 executive director and data analysis
  - $130,000 for data storage and management
  - $405,000 a year to operate and maintain UAS
  - $850,000 in initial set-up costs

The State of the State: North Carolina UAS Governance Board
Small UAS Notice of Proposed Rulemaking (NPRM)

- Framework of regulations that would allow routine use of certain small unmanned aircraft systems (UAS) in today's aviation system.
  - Finalized by June 2016

Operational Limitations
- Weight less than 55 lbs. (25 kg)
- Visual line-of-sight (VLOS) only
- Daylight-only operations
- Maximum airspeed of 100 mph
- Maximum altitude of 500 feet AGL
- Operations in Class G airspace are allowed without ATC permission
- May not operate over any persons not directly involved in the operation
  - Proposes a microUAS option

Aircraft Requirements
- FAA airworthiness certification not required
- Aircraft markings required

Operator Certification
- Operators would be required to pass an initial aeronautical knowledge test
- Operators vetted by the Transportation Security Administration
- Obtain an unmanned aircraft operator certificate with a smallUAS rating
- Pass aeronautical knowledge test every 24 months
- Be at least 17 years old
- Report an accident to the FAA within 10 days

The 333 Exemption

- By law, any aircraft operation in the national airspace requires
  - A certificated and registered aircraft
  - A licensed pilot (sport pilots license or better)
  - Operational approval (COA)

- Section 333 of the FAA Modernization and Reform Act of 2012 (FMRA)
  - determine whether an airworthiness certificate is required for a UAS to operate safely
  - case-by-case authorization for certain commercial operations before Small UAS Rule
  - provides operators a legal, competitive advantage in the UAS marketplace

- Certificate of Authorization (COA)
  - permits public agencies and organizations to operate a particular UA, for a particular purpose, in a particular area.
Recreational Use

- < 4.4 pounds
- Operations below 400 feet
- Line-of-Sight
- during daylight conditions
- Inside uncontrolled airspace (Class G)
- > 5 miles from airport or aviation activities
- Away from gatherings – stadiums, concerts, etc.

So... You want to fly a UAV in NC

Entity
- Public Entity (federal, state, local governments, and public universities)
- Private Sector (civil)
- Hobby/Recreational
- Commercial

Mission
- Non-Commercial
- Non-Commercial
- Non-Commercial
- Commercial

Procedure
- Obtain COA through NC NextGen Center
- Follow model aircraft guidance rules
- Experimental Airworthiness Certificate and COA
  - Research and development
  - Training
  - Exhibition
  - Show Compliance
- Experimental Airworthiness Certificate and COA
  - Certified aircraft (333 Exemption)
  - Pilot (sports license)
  - Operating approval (COA)
Spray-On Ditch Liner?

Next, Optimizing Basin

- Standard Basin: 2:1 length:width, sized to NC standards
  - 325 sq ft/1 cu ft sec; 1,800 cu ft/acre
- Standard + sloped outlet
- “Sideways” : 1:2 length:width
- All with porous baffles, surface outlet
Flow in a Porous Baffle

Basin Designs

(a) L = 9 m
(b) W = 9 m
(c) W = 9 m

Plan View
Cross-section view A-A
Baffle
In Out
Plan View
In
Out
Cross-section view B-B
Baffle
Plan View
Cross-section view C-C
Baffle
In Out

W = 4.5 m
D = 0.9 m
6.3 m 1.8 m 6.3 m
34
34

L = 9 m L = 4.5 m L = 9 m
W = 4.5 m W = 9 m W = 9 m
D = 0.9 m D = 0.9 m
6.3 m
Idealized Settling

Normal 2:1 Basin

Sample In

Sample Out
2:1 With “Ramp”

Settling With Ramp

Outlet riser

Settling zone

Q/WD

L

D

V_s
### Basin Configuration Effects
No Flocculation

<table>
<thead>
<tr>
<th>PAM</th>
<th>Basin</th>
<th>Ditch exit</th>
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<th>Basin exit</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Horizontal</td>
<td>268 ± 25 a</td>
<td>197 ± 27 a</td>
<td>995 ± 79 a</td>
<td>125 ± 3 b</td>
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<tr>
<td>None</td>
<td>Ramp</td>
<td>262 ± 24 a</td>
<td>162 ± 19 a</td>
<td>1,121 ± 122 a</td>
<td>195 ± 14 a</td>
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<tr>
<td>None</td>
<td>Standard</td>
<td>271 ± 21 a</td>
<td>234 ± 22 a</td>
<td>1,258 ± 107 a</td>
<td>239 ± 30 a</td>
</tr>
</tbody>
</table>
### Basin Configuration Effects With Flocculation

<table>
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<td>234 ± 22 a</td>
</tr>
<tr>
<td>PAM</td>
<td>Horizontal</td>
<td>96 ± 20 b</td>
<td>30 ± 5 b</td>
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<tr>
<td>PAM</td>
<td>Ramp</td>
<td>98 ± 14 b</td>
<td>23 ± 4 b</td>
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<tr>
<td>PAM</td>
<td>Standard</td>
<td>78 ± 18 b</td>
<td>34 ± 5 b</td>
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</tbody>
</table>

### Basin Size: Flocculation Effect

Based on Equation: Area = 1.2 Q/V, where Q = flow, V = settling velocity

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unflocculated sediment</th>
<th>Flocculated sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling velocity (m s⁻¹)</td>
<td>0.0017</td>
<td>0.004</td>
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<tr>
<td>Particle diameter (D₅₀₀ μm)</td>
<td>46</td>
<td>74</td>
</tr>
<tr>
<td>Surface area requirement (m² per m³ s⁻¹)</td>
<td>700</td>
<td>300</td>
</tr>
<tr>
<td>Required basin surface area (m²)</td>
<td>40</td>
<td>17</td>
</tr>
</tbody>
</table>

Basin Design Conclusions

- For unflocculated sediment, the sideways basin configuration (w/ baffles & surface outlet) had a slight advantage.
- For flocculated sediment, configuration made no difference.
- To achieve high sediment retention, flocculated sediment requires much smaller basins. (how to guarantee it is flocculated?)

Upcoming Training Opps

- Southeast Chapter IECA – EPA MS4 Conference, Nashville May 16-18
- All through 2016: www.soil.ncsu.edu (NCDOT certification, turbidity, general workshops)