What’s On The Horizon?

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Professor and Extension Specialist

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

- No runoff Event 1 Rest period Event 2

Runoff Results: Solids (TSS)

- No runoff Event 1 Rest period Event 2

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

![Graph showing PAM concentration in runoff over time]

- Granular PAM + Cover
- Dissolved PAM + Cover


Structure Effects
(Blanket removed)

- Bare Soil
- 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 1\textsuperscript{st} event (negative)
- Amount of 1\textsuperscript{st} event (negative)
- Max intensity of 2\textsuperscript{nd} 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
Piedmont #1 Infiltration Rate Over Time

- 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
DJI 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
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
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
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

<table>
<thead>
<tr>
<th>Operational Limitations</th>
<th>Aircraft Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight less than 55 lbs. (25 kg)</td>
<td>FAA airworthiness certification not required</td>
</tr>
<tr>
<td>Visual line-of-sight (VLOS) only</td>
<td>Aircraft markings required</td>
</tr>
<tr>
<td>Daylight only operations</td>
<td></td>
</tr>
<tr>
<td>Maximum airspeed of 100 mph</td>
<td></td>
</tr>
<tr>
<td>Maximum altitude of 500 feet AGL</td>
<td></td>
</tr>
<tr>
<td>Operations in Class G airspace are allowed without ATC permission</td>
<td></td>
</tr>
<tr>
<td>May not operate over any persons not directly involved in the operation</td>
<td></td>
</tr>
<tr>
<td>Proposes a microUAS option</td>
<td></td>
</tr>
</tbody>
</table>

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)
- **Mission**
  - 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
  - Commercial
    - 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/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
W = 4.5 m

(b) W = 9 m
L = 4.5 m

(c) W = 9 m

Cross-section view A-A

Cross-section view B-B

Cross-section view C-C

Plan View

Plan View

Plan View

NC STATE UNIVERSITY

DEPARTMENT of SOIL SCIENCE
Idealized Settling

Normal 2:1 Basin

Sample In

Sample Out
2:1 With “Ramp”

Settling With Ramp
"Sideways" 1:2 Basin

<table>
<thead>
<tr>
<th></th>
<th>Turbidity (NTU)</th>
<th>TSS (mg L⁻¹)</th>
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<tbody>
<tr>
<td></td>
<td>Basin</td>
<td>Ditch exit</td>
</tr>
<tr>
<td>PAM</td>
<td>Basin</td>
<td>268 ± 25 a</td>
</tr>
<tr>
<td>None</td>
<td>Horizontal</td>
<td>262 ± 24 a</td>
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<tr>
<td>None</td>
<td>Ramp</td>
<td>271 ± 21 a</td>
</tr>
<tr>
<td>None</td>
<td>Standard</td>
<td>96 ± 20 b</td>
</tr>
<tr>
<td>PAM</td>
<td>Ramp</td>
<td>98 ± 14 b</td>
</tr>
<tr>
<td>PAM</td>
<td>Standard</td>
<td>78 ± 18 b</td>
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</tbody>
</table>
### Basin Configuration Effects With Flocculation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unflocculated sediment</th>
<th>Flocculated sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td>268 ± 25 a</td>
<td>197 ± 27 a</td>
</tr>
<tr>
<td>None</td>
<td>262 ± 24 a</td>
<td>162 ± 19 a</td>
</tr>
<tr>
<td>None</td>
<td>271 ± 21 a</td>
<td>234 ± 22 a</td>
</tr>
<tr>
<td>PAM</td>
<td>96 ± 20 b</td>
<td>30 ± 5 b</td>
</tr>
<tr>
<td>PAM</td>
<td>98 ± 14 b</td>
<td>23 ± 4 b</td>
</tr>
<tr>
<td>PAM</td>
<td>78 ± 18 b</td>
<td>34 ± 5 b</td>
</tr>
</tbody>
</table>

### Basin Size: Flocculation Effect

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

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<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>
</tr>
<tr>
<td>Particle diameter (D₅₀, 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)