New Paradigms for Landscape Design: The Chesapeake Challenge

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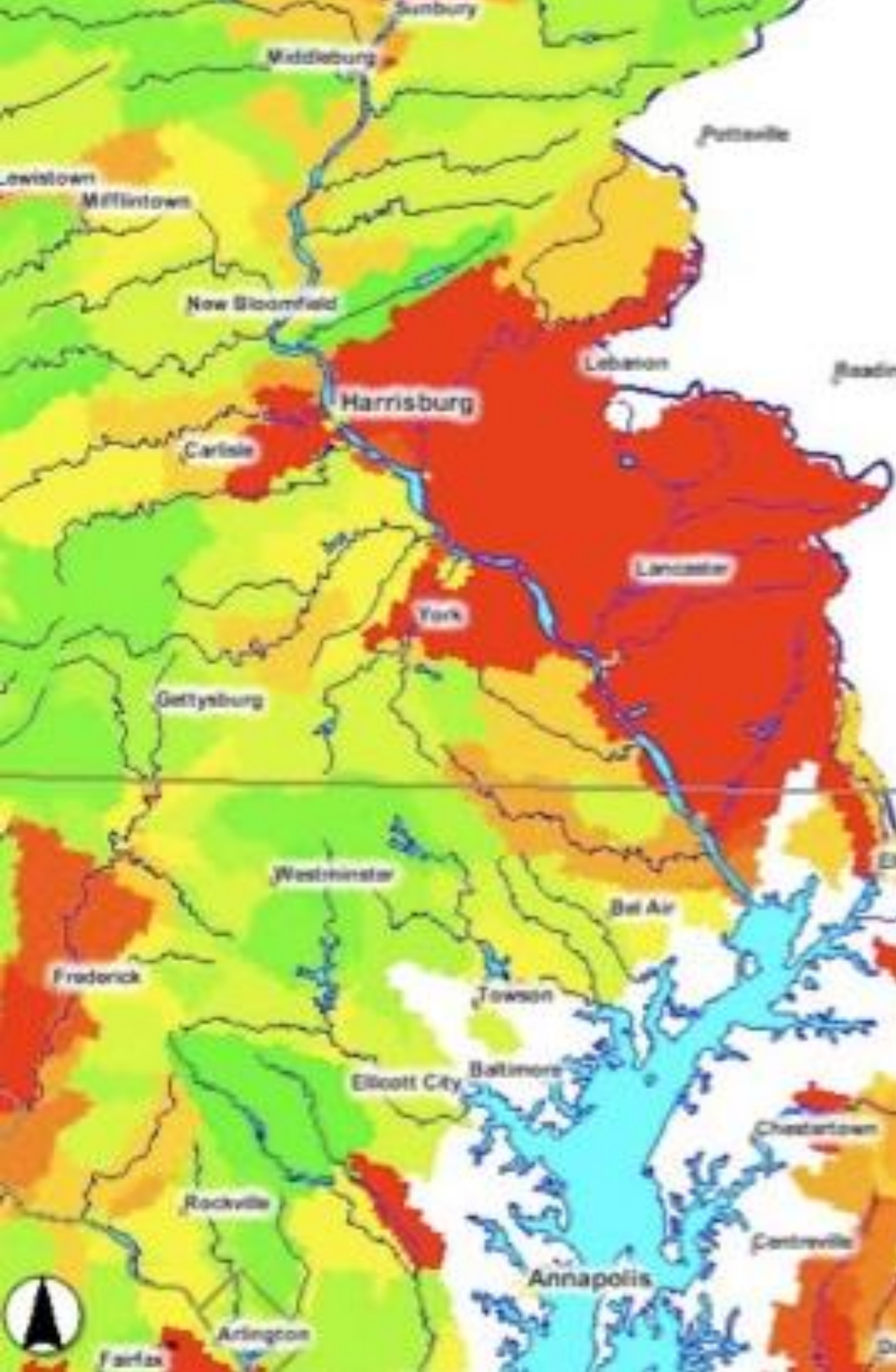
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June 21, 2007
This Image is Available at
Maryland DNR's
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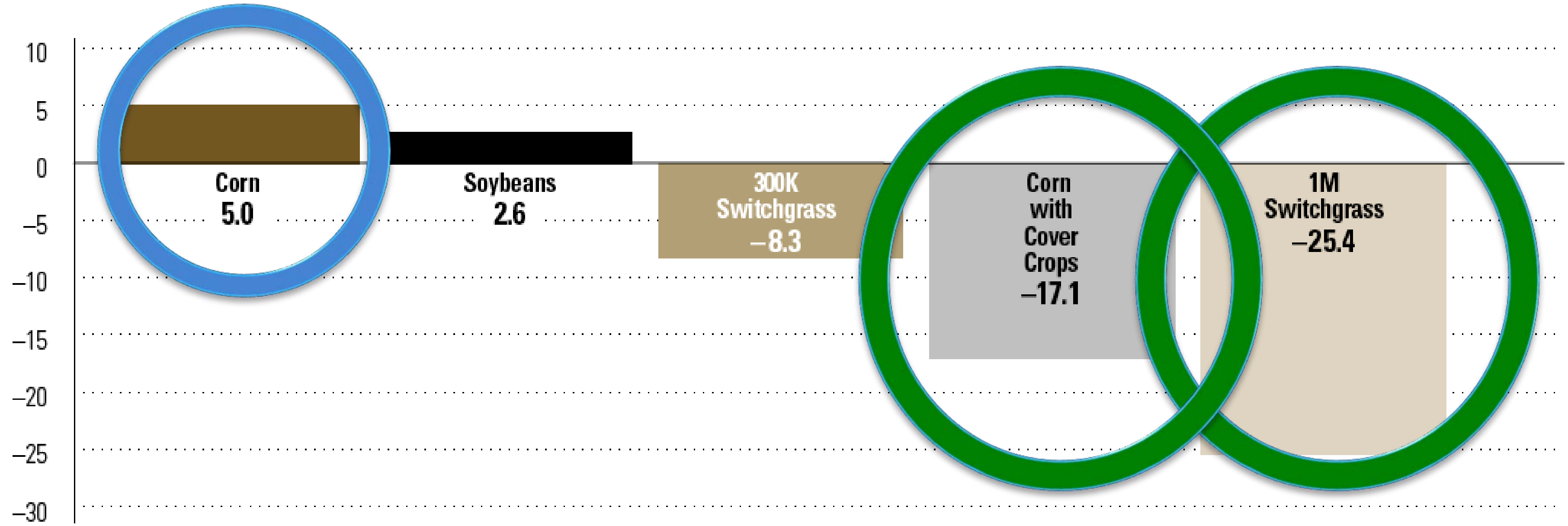
Biofuels and the Bay – From 2008 to Today

Maximum Nitrogen Load Changes for Biofuels

Millions of pounds per year of nitrogen delivered from the Chesapeake Bay watershed to the Bay under five modeling scenarios.



Assumptions for Alternative Scenarios:

- **Corn:** 300,000 additional acres of corn with typical levels of management practices
- **Soybeans:** 300,000 additional acres of soybeans with typical levels of management practices
- **300K Switchgrass:** 300,000 acres of switchgrass, converted primarily from hay and pastureland, with no fertilization
- **Corn with Cover Crops:** Cover crops on all existing and new (additional 300,000) corn acres and one quarter of all other row crops, watershed-wide.
- **1M Switchgrass:** 1 million acres of switchgrass, converted primarily from hay and pastureland, with no fertilization

SOURCE: U.S. EPA CHESAPEAKE BAY PROGRAM OFFICE

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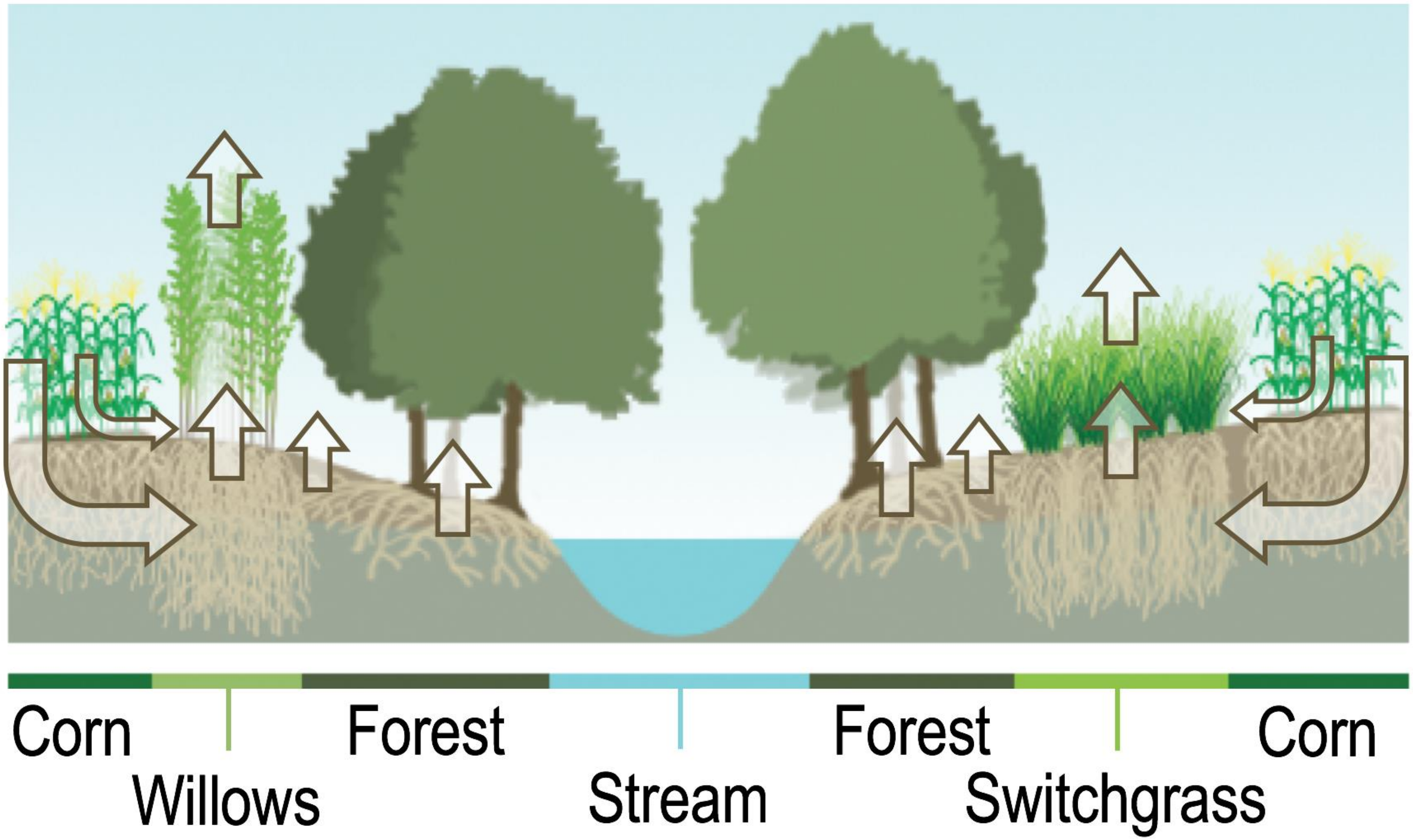
Working Buffers – by the numbers

* The Chesapeake Bay Watershed has 181,4400 miles of streams and rivers.
* WIPs require vegetative buffers for 70% of streambanks and shorelines. Currently at 58%. The difference represents 22,000 miles of new buffers.
* At 900 miles per year, this will take decades
* Each mile of two-sided 35 foot buffer = 8 acres.
* This represents 7,200 acres removed from production, and over 175,000 acres eventually – at $400/acre the lost revenue totals $70 million/year.
* In contrast, 100 foot wide market-based buffers could produce 250 million gallons of biofuel, with revenue of >$200 million/year for rural communities.

Integrated with Forest Buffers



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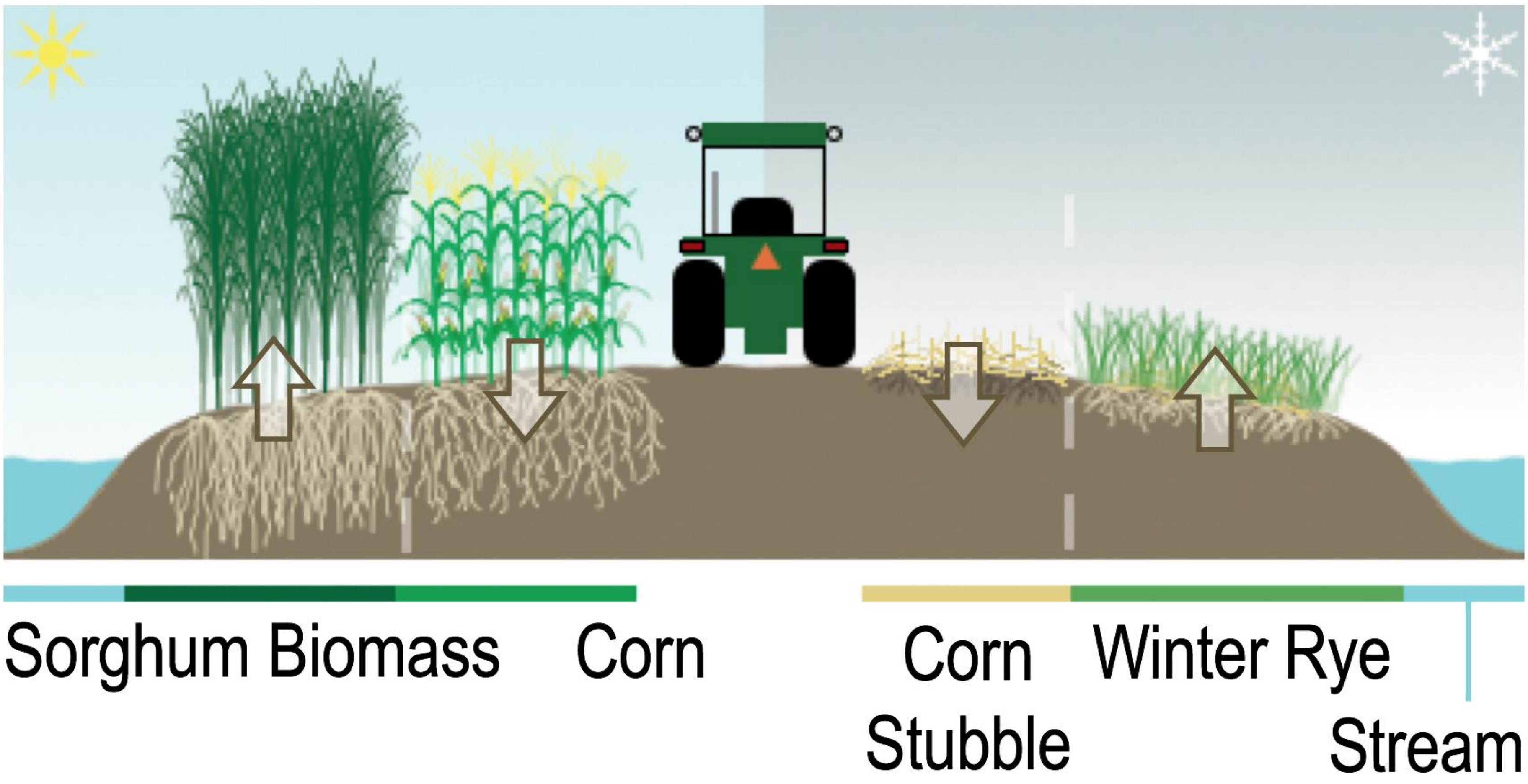
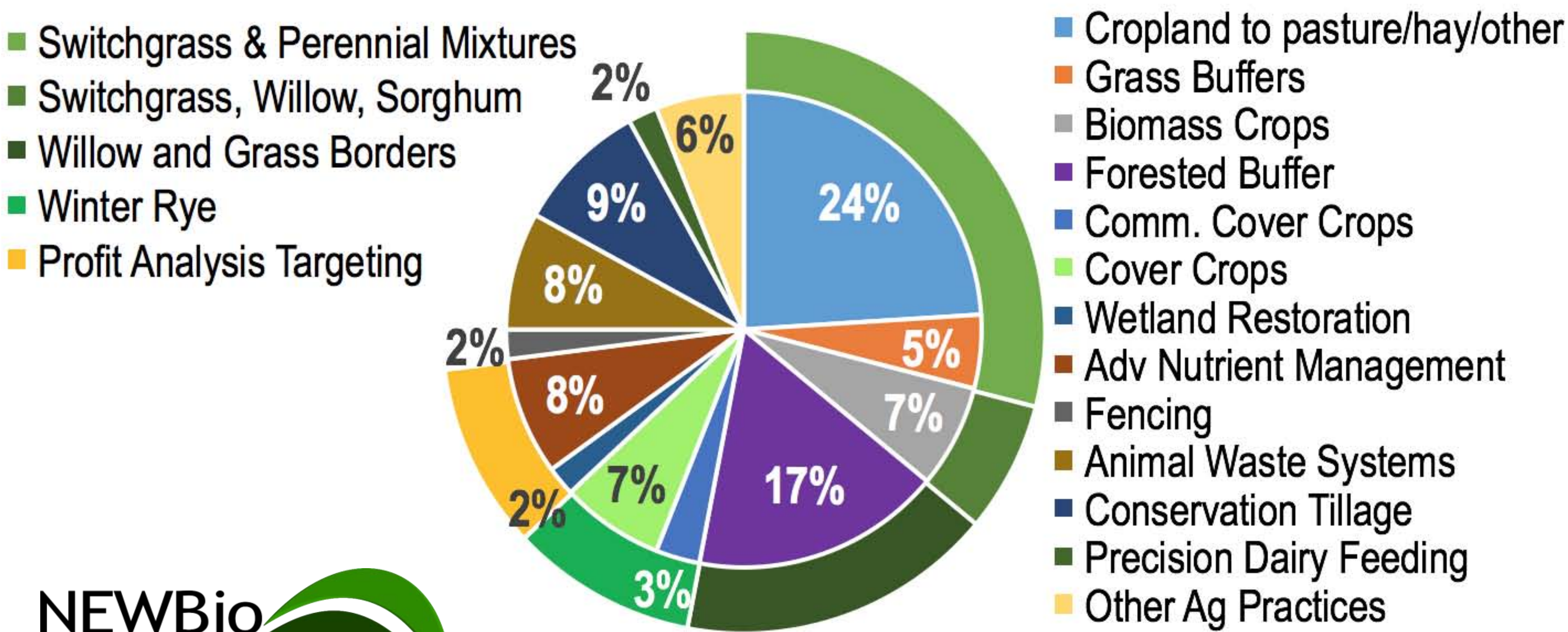
And with annual cropping systems…



Mapping Biomass to Water Quality



NEWBio

NEWBio is supported by AFRI Competitive Grant No. 2012-68005-19703 from the USDA National Institute of Food and Agriculture.

NEWBio's mission is to lay the foundation for a sustainable bioenergy future for the Northeastern United States. Our objectives are to design, implement, analyze and evaluate robust, scalable, and sustainable value chains for the biomass industry, with the ultimate goal the eventual development of lignocellulosic biomass suitable for advanced transportation fuels in our region.

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

Pennsylvania Iowa

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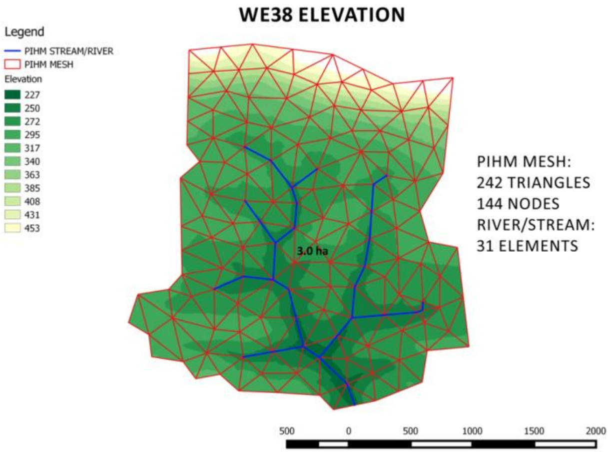
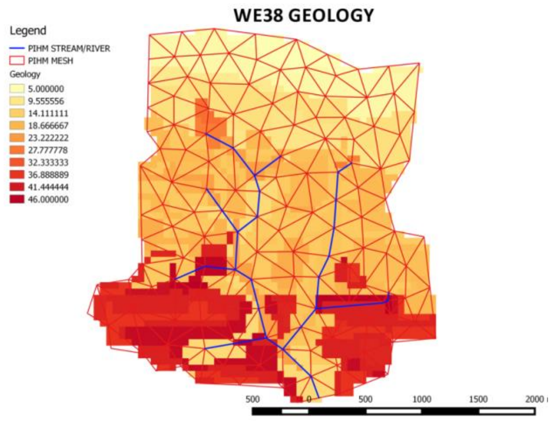
Equipment & Precision Ag Data Vary

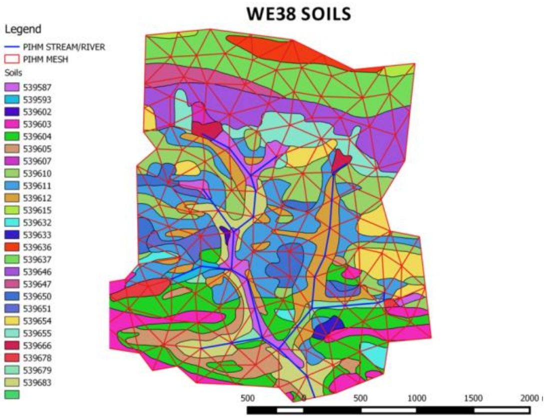
Pennsylvania as a Microcosm

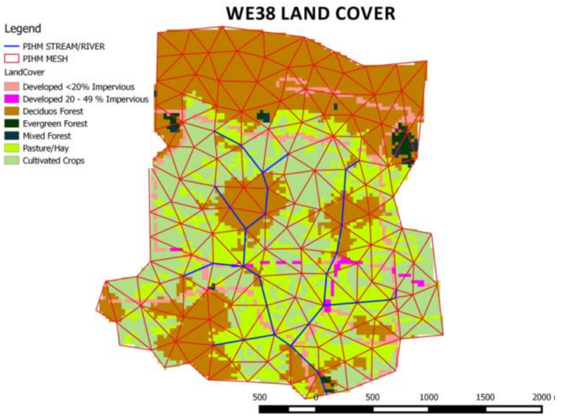
Parameter	PA (range of states)		Ten State Total
Number of Fields	278	(1 to 595)	3796
Ave. years of data/field	3.7	(1.4 to 6.5)	3.1
Profit per acre (all years)	$49	(-$137 to $922)	$27
Ave. max profit/acre	$146	(-$27 to -$338)	$128
Ave. min profit/acre	-$578	(-$693 to -$27)	-$148
Total Annualized ROI	0.62	(-9.64% to 6.78%)	0.46

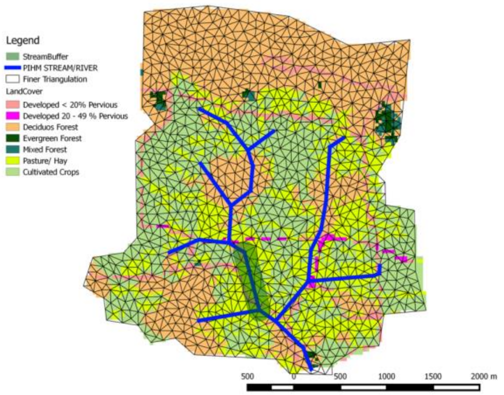
High Fidelity Simulation Models











Expected Outputs:

1) Design for Sustainability
2) More profitable farms,
3) Improved water quality,
4) Sustainable biofuels

Montes, Kemanian et al. 2016

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Existing Regional Markets

Fiber

* Mushroom Compost – 250,000 tons/year current demand
* Poultry Bedding
* Stormwater erosion control

Energy:

* Pellet Mills: Ernst Conservation Seeds
* Biomass Boilers: St. Mary's
* Fuels to Schools: Hughesville, Penns Valley
* Biomass Power Plants – ReEnergy, Lockheed Martin in Owego NY, Evergreen Power in Reading, PA

Future Regional Opportunities

Aviation and Military Biofuels:

* Renmatix, global headquarters in King of Prussia, PA, partnering with Amyris Biotechnologies and Total to make jet fuel from cellulosic biomass.
* Delta, operating a former Conoco-Phillips refinery in Trainer, PA. Capacity: 3 billion gallons/year
* The Navy's Great Green Fleet
* Naval Station Norfolk
* BWI, Dulles, Philadelphia Airports

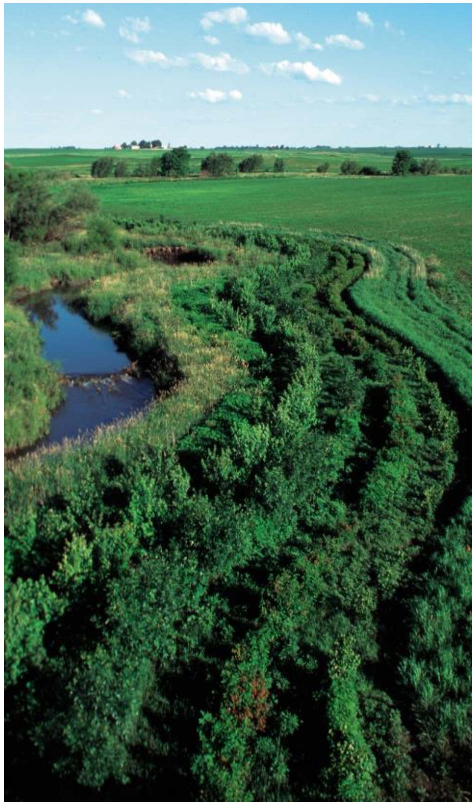
Other:

* Applied Biorefinery Sciences, CoolPlanet, Enchi, AgriTech
* Tranlin, building a $2 billion pulp mill in Chesterfield, VA
* American Refining Group – biolubes in Bradford, PA

Challenges for Change

Key questions:

* Why would farmers plant biomass crops?
  * Is it more profitable than existing crops?
  * Is it easy to manage and market?
* Why would businesses buy biomass?
  * Is it less expensive than current feedstocks?
  * Are there logistics or scale advantages?
* What are the water quality benefits if they do?
  * Are there ways to monetize those benefits?
* Can a market-based solution succeed?



Chespeake Landscapes: Scaling-Up!

- ✓ Benchmark Payments for Ecosystem Services (> $0.20/gallon) (FAA)
- ✓ NRCS pilots with AgSolver: 8 farms in Pennsylvania earlier this year (double the 4 farm target), 1 in Delaware (NRCS)

Next steps (funded by USDA-NIFA through NEWBio; BETO; FAA-ASCENT):

1. High resolution flood mapping (NIFA)
2. Watershed assessment: Mahantango Creek (NIFA)
3. 12 additional case study farms, socio-agroecological analysis (NIFA)
4. Simulate harvest and supply chain costs (BETO, FAA)
5. Assess water quality benefits; farmer & supply chain risks (FAA)

Future needs:

6. "Discovery Farms" instrumented for water quality
7. Additional farm pilots (50? 100?) and commercial demonstrations
8. Expand existing markets, demonstrate new markets

Summarizing the Opportunity:

* **Perennials** are recognized as a **least-cost strategy for improving water quality**. They can also be **low cost biomass feedstocks**.
* Farmers currently **assume** that converting land to perennials will **reduce** profits.
* Sub-field economic analysis suggests strategic planting of perennials can instead **increase** profits.
* The Bay-State Watershed Implementation Plans include planting **hundreds of thousands of acres** of perennial crops, cover crops and riparian buffers.
* Managing those areas for biomass represents an opportunity for not just improving **water quality**, but improving **farm profitability, rural economic activity, and sustainable energy for the region.**

Credits

Sponsors: DOE BETO: Landscape Design; USDA-NIFA: NEWBio; FAA-ASCENT: Supply Chain Analysis

Collaborators:

Penn State, Agsolver, Antares, FDC Enterprises, Idaho National Lab, USDA ARS National Lab for Agricultural and Environment, Oak Ridge National Lab, USDA ARS Pasture Systems and Watershed Management Lab, NRCS, Cornell University, State University of New York Environmental Sci. & Forestry, West Virginia University, University of Maryland Eastern Shore, U. Md Center for Environmental Science, University of Virginia, Commercial Aviation Alternative Fuels Initiative, Farm 2 Fly 2.0, Ernst Conservation Seeds, Renmatix, Enchi and many more.

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