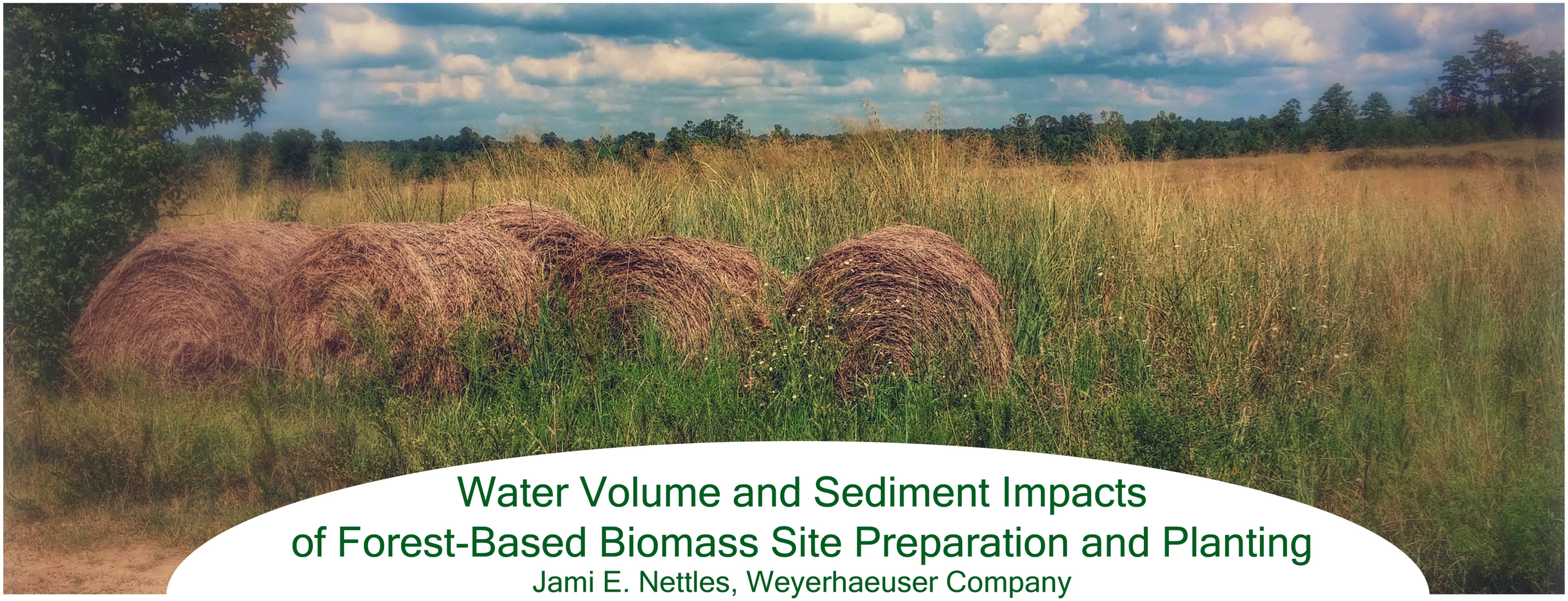


Water Volume and Sediment Impacts of Forest-Based Biomass Site Preparation and Planting

Jami E. Nettles, Weyerhaeuser Company

Project Overview

Operational-scale forest biomass studies were installed in the southeastern U.S. in 2009 and 2010 for evaluation as a potential bioenergy feedstock system. These consisted of switchgrass (*Panicum virgatum*) for bioenergy interplanted in loblolly pine plantations grown for sawtimber. Optimum site selection, planting, cultivation, and harvest methods were generally unknown for forest biomass production, and these were studied at the plot and management tract scale. Silvicultural BMPs were followed and additional site-specific mitigation techniques implemented.

In addition to research on production methods, studies on the environmental effects of these practices were installed. The studies are shown on the map, and include biodiversity, soils, and hydrology studies. As part of this, fourteen watersheds were instrumented in three locations, and a detailed analysis of the water quality and quantity effects of these practices is being conducted. The watersheds have a range of treatments, from mid-rotation forest to switchgrass only, designed to represent possible intensities as well as specific practices. Two intercropped treatments were installed – one co-planted with pine, and one planted in an existing plantation.

Sediment Survey

Early predictions of the environmental effects of biofuel practices have estimated large sediment effects. The goal of this research project was to look at the incremental riparian effects of sediment from a forest-based biofuel operation. This study looked at operational scale treatments of switchgrass intercropped in an existing pine plantation, after site preparation, planting, and early growth and examined:

- Sediment movement due to intercropping practices
- Hydrologic connectivity of the incremental sediment load to structured channels

This was based on a field survey and designed to be an early look at the sediment effect of these practices – detailed analyses are provided by dedicated research sites with controls and a pre-treatment period. While quantitative estimates of loading cannot be made from these methods, research has shown these surveys to be helpful in understanding the effectiveness of Best Management Practices (BMPs), especially riparian buffers, in preventing direct delivery of sediment to streams.

Methods

Sites were selected randomly from the most erodible sites planted based on soil and slope – 1/3 selected.

2 teams of 4 people from Weyerhaeuser, Forest Service, and contracted students surveyed the last row of switchgrass before the SMZ and measured incursions of sediment due to switchgrass planting:

- Location, incursion length, distance, distance to stream, connectivity, soil texture
- Minimum incursion length of 2 m (approximate distance between switchgrass and tree row)
- Water incursions also noted, but not compiled

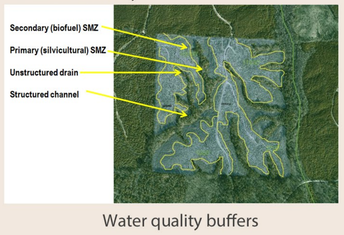
However, field methods of delivery determination proved unreliable for final determination. Dense understory blocked access to streams, and even with training, the results varied by team and surveys showed contradictory data. DEMs from detailed lidar data were acquired for all surveyed streams and the route mapped from each incursion to structured channel by determining:

- Secondary SMZ – contractor-selected area of pine plantation not intercropped
- Primary SMZ – SMZ established for plantation silviculture
- Unstructured drain
- Structured channel – showing evidence of banks.

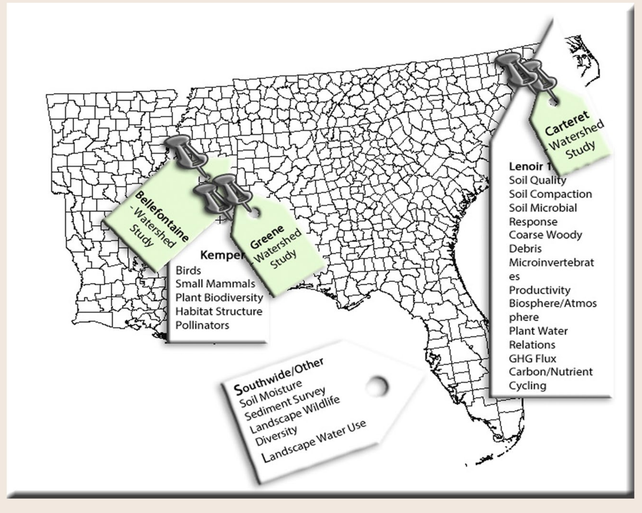
Site prep in existing pine stands

Pine understory

Intercropped



Water quality buffers



Results

- Sites surveyed – 9
- Total area – 385 ha
- Total surveyed length – 15.5 km

Average buffer widths – distance between incursion point and structured drainage

- Secondary – 20m
- Primary – 19m

Distance along non-structured drain – 100m

Total 139m

First survey

Sediment delivery points – 4

- 1 - Sediment delivered to a stream - Sediment directly delivered to an intermittent stream at a road crossing
- 2 - Sediment delivered to a structured channel - Sediment plumes had visual and mapped connectivity to an intermittent or perennial stream, both cases associated with contour confluence
- 1 - Sediment delivered to a mandatory buffer, generated or pushed into perennial stream buffer

Erosion points not delivering - 29

Site Revisit

1 incursion still active - Sediment directly delivered to an intermittent stream at a road crossing.

Other sites not delivering sediment

Conclusions

Forest BMPs offer protection from sediment movement, even under higher intensity practices through:

- Contour planting
- Conservative SMZs – width and complexity
- Herbaceous understory and litter layer

Intercropped systems showed minor sediment delivery after planting, SMZs and litter from more mature trees prevented delivery

- Berms created during site prep were major sediment barrier
- Secondary SMZs doubled original protection
- Operators adapted practices to the site

After site prep and planting, there was an incremental increase in sediment incursions to streams at approximately 1 point/100 ha. However, there was no systematic load increase associated with the more intense practices, and experience and planning changes could eliminate most problems.

Nettles, J.E. J.M. Grace, Z.H. Leggett, E. Schilling, 2014. Field implementation and effectivess of riparian buffers in forest biofuel operations". Symposium on Forestry Best Management Practice (BMP) Effectiveness in the Eastern US, Blacksburg, Va., May 12-15

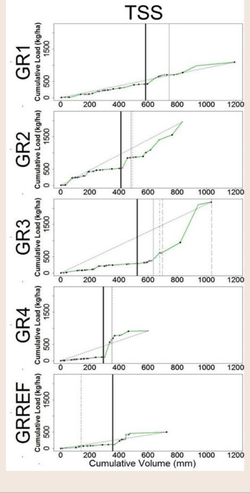
Site delivering at revisit

Sites not delivering at revisit

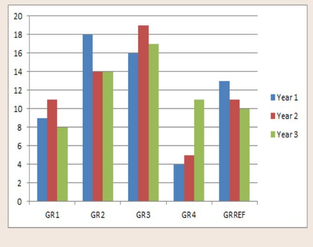
		Ha	Acres	Plantable Acres	Treatment	Tree birth year	Grass Planted	Replanted	Success
Calhoun, MS	BF1	14.1	34.8		Pine/understory removal	2007	N/A	N/A	Established
	BF2	12.8	31.7	19.8	Thinned/intercropped	2007	2012	Jul-13	Medium
	BF3	10.9	26.9	22.1	Switchgrass only	2006/Removed	2012	Jun-13	High
	BF4	15.2	37.6	37.6	Replanting intercropped (Age Zero)	2006/2011	2013	Jul-13	Medium
	BFREF	12.6	31.1		Mid-rotation pine (Reference)	1995	N/A	N/A	Established
Greene, AL	GR1	11.3	28.0		Pine/understory removal	2008	N/A	N/A	Established
	GR2	25.1	62.1	33.9	Thinned/intercropped	2008	2012	May-13	High
	GR3	24.4	60.2		Replanting intercropped	2006/2011	2013	May-13	High
	GR4	16.5	40.7	25.9	Switchgrass only	2006/Removed	2012	May-13	High
	GRREF	8.0	19.7		Mid-rotation pine	1994	N/A	N/A	Established
Carteret, NC	D0	24.0	59.3		Pine/understory removal	2009	N/A	N/A	High
	D1	24.7	61.0		Intercropped	2009	2011	2013, spot overseed 2014	High
	D2	23.6	58.3		Mid-rotation pine	1996	N/A	N/A	Established
	D3	26.8	66.2		Switchgrass only	/Removed	2011	2013, spot overseed 2014	Medium

Greene County Sites 1 - 4 (right to left)

Instrumentation at each site



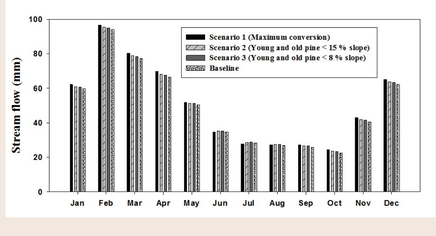
Watershed monitoring data



All Flashiness Indicators, pre and post treatment

Erin Bennett, François Birgand, George M. Chescheir, Elizabeth Allen, Timothy Appelboom, Robert Lagacé and Jami Nettles, 2014. Hydrology and Water Quality Impacts of Site Preparation for Loblolly Pine (Pinus taeda) and Switchgrass (Panicum virgatum) Intercropping in Upland Forested Watersheds in Alabama. In review

Landscape scale model (SWAT)



Modeled changes in long term streamflow due to maximum feasible pine to switchgrass conversion in the Tombigbee basin, SE US.

Sheila F. Christopher, Stephen H. Schoenholtz, Jami E. Nettles, 2014. Water Quantity Implications of Regional-Scale Switchgrass Production in the Southeastern U.S.

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