

EVALUATING THE EFFECTS OF WOODY BIOMASS PRODUCTION FOR BIOENERGY ON WATER QUALITY AND HYDROLOGY IN THE SOUTHEASTERN UNITED STATES

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Forestry is a dominant industry in the southeastern United States, and there is interest in sustainably growing woody feedstocks for bioenergy in this region. Our project is evaluating the environmental sustainability (water quality, quantity) of growing and managing short-rotation (10-12 yrs) loblolly pine for bioenergy using watershed-scale experimental and modeling approaches. The 3 study watersheds (R: 45 ha; B: 169 ha; C: 117 ha) are located in the Upper Coastal Plain of South Carolina, with characteristics typical of the landscape including low-relief topography and low- to moderate-quality sandy soils overlaying a clayey argillic horizon. In 2010, the watersheds were instrumented and hydrologic and water quality (nitrogen, phosphorus, dissolved organic carbon, herbicides) measurements began in streams, riparian and deep groundwater, interflow, precipitation, and throughfall. After 2 years of baseline monitoring (2010-2012), approximately 40 percent of the 2 treatment watersheds (B, C) were harvested (2012) and planted with loblolly pine seedlings (spring 2013) with the third watershed (R) serving as an unmanipulated reference. Fertilizers and herbicides were applied yearly following planting to achieve high yields. All silvicultural activities followed South Carolina Best Management Practices (BMPs), and thus our project will also evaluate whether typical BMPs are adequate to protect water resources under short-rotation woody crop production for bioenergy feedstocks.

Overland flow has not been observed in these low-relief watersheds, and while seeps appear during wet climate periods in newly planted areas, water reinfilters within the first few meters of the riparian zone. Interflow (water flowing through soils) occurs on and within the clay layer following precipitation events, but a combination of shallow topography and anomalies in the clay result in short interflow distances (tens of meters). Therefore, the hillslopes where pine is planted are largely hydrologically disconnected from the streams, except in steeper-sloped areas near the riparian zone. A combination of runoff ratios, temporal groundwater elevation profiles, and water and nitrate stable isotopes suggest that groundwater is the dominant flowpath in these watersheds. Thus excess fertilizers or herbicides will likely first enter groundwater and then stream water following a several year lag. The post-treatment water quality data support this hypothesis. There have been no appreciable increases in stream water ammonium, nitrate, or soluble reactive phosphorus concentrations in the treatment watersheds (B, C) compared to the control (R) watershed. However, the post-treatment groundwater nitrate concentrations are increasing (<2 mg N/L in 2014). Measurements are planned to occur until canopy closure (2018).

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