Effects of legacy sediment removal on hydrology and biogeochemistry in a low order stream in Pennsylvania, USA

Paul Mayer - USEPA
Michelle Audie – Oregon State University
Renee Brooks - USEPA
Ken Forshay – USEPA
Jeffery Hartranft – Pennsylvania DEP
Dorothy Merritts – Franklin and Marshall College
Robert Walter - Franklin and Marshall College
Julie Weitzman – Penn State University

Historic forest conversion to agriculture and associated stream impoundments built for hydropower led to extensive burial of valley bottoms throughout the mid-Atlantic region of the US. These so-called legacy sediments are sources of nutrient and sediment pollutant loads to downstream waters including the Chesapeake Bay. Recent efforts to remove legacy sediments to restore ecosystem function created an opportunity to assess the effect of such restoration on hydrology and biogeochemistry. We present hydrologic and biogeochemical patterns in pre- and post-restoration stages of Big Spring Run, a stream in Lancaster County, Pennsylvania, USA.

Carbon and nitrogen are closely linked in both ground and surface water, suggesting that microbial processes such as denitrification may be carbon limited. Spatially variable but temporally stable hotspots and coldspots of nitrate nitrogen were detected in groundwater throughout the restoration reach watershed. Residence times of groundwater, measured using stable isotopes of water, suggested that greater nitrogen transformation occurred along more active flow paths of ground water. Denitrification potential was lowest in legacy sediments and significantly higher in buried wetland soils. Other restoration effects were dramatic; exposed buried wetland soils allowed native vegetation to regrow from the seed bank, shorebirds were observed following sediment removal in newly exposed riparian wetlands, and bank erosion from freeze-thaw processes and extreme storm events was drastically muted where incised banks were removed and stormwater could spread throughout the floodplain. A fundamental understanding of the history of sites, including legacy effects of past land use, is essential to identify feasible restoration recovery goals.