INTERNATIONAL EROSION CONTROL ASSOCIATION

ENVIRONMENTAL connection

JULY/AUGUST 2015 | VOLUME 9 • ISSUE 3 | www.ieca.org

IECA
International Erosion Control Association
REGION ONE

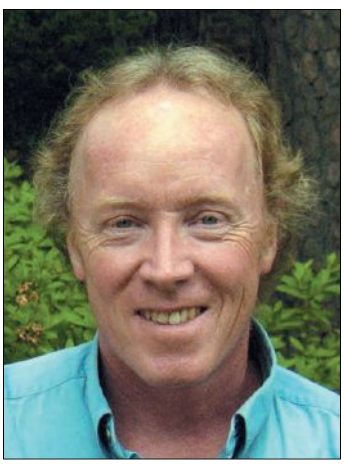
INSIDE

ENVIRONMENTAL CONNECTION 2016

Environmental Connection 2016
San Antonio, Texas
February 16 – 19, 2016

Two Contrasting Views of Stream Sediment Sources

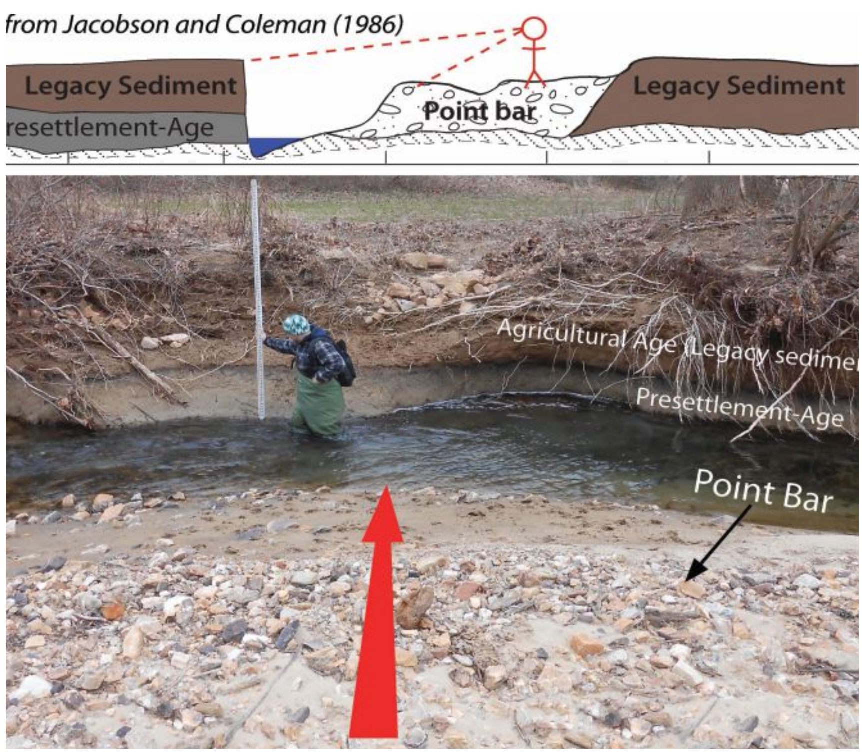
The purpose of this column is to provide knowledge to readers of Environmental Connection *by summarizing the latest results of relevant research. The sources mostly are referenced science and engineering journals, which means the information has been reviewed by other scientists and engineers before being published. The reader should interpret the results relative to his or her experiences.*



By Rich McLaughlin, Ph.D.

Dr. McLaughlin received a B.S. in natural resource management at Virginia Tech and studied soils and soil chemistry at Purdue University for his master's and Ph.D. degrees. He is a professor and Extension Specialist in the Soil Science Department at North Carolina State University in Raleigh, North Carolina, specializing in erosion, sediment and turbidity control.

Many of us are involved in protecting water quality in one way or another, often by stabilizing the landscape and preventing erosion. Urban and suburban streams still tend to become very turbid during storm flows; unfortunately, this reality is part of the reason sediment is one of the leading pollutants in our waters. But where does this sediment come from? Even apparently stable, built-out watersheds can produce muddy flows following storm events. Two studies in the Maryland Piedmont have arrived at very different conclusions about sediment sources in these streams.



This photo is of the lead author in the Donovan study surveying a stream cross-section. Note the "legacy sediment" (erosion from agriculture) on top of the pre-settlement deposits. The stick figure in the diagram on top indicates where the photograph was taken. Photo courtesy M. Donovan, A. Miller, M. Baker and A. Gellis

Smith and Wilcock Study

In one study, Smith and Wilcock selected six ponds that were far enough upland in the landscape to be receiving flow from areas that primarily have only one use type: forest, agriculture or suburban development[1]. All areas were in that land use for the life of the pond, and the researchers were able to use historical aerial photography to verify any changes in the channels leading into the ponds.

They conducted detailed surveys of the ponds to determine how much sediment had accumulated over the thirteen to thirty-nine years that the ponds were in place. The forested watershed yielded 0.3 to 1.4 Mg ha^{-1} yr^{-1} (0.1 to 0.6 ton ac^{-1}); the agricultural watershed yielded 1.0 to 3.4 Mg ha^{-1} yr^{-1} (0.4 to 1.5 ton ac^{-1}); and the suburban watershed yielded 3.7 to 5.3 Mg ha^{-1} yr^{-1} (1.6 to 2.3 ton ac^{-1}). In all cases, the higher sediment yield was the result of erosion in the channel leading into the pond.

The authors suggested that the highest yield - the suburban landscape - which was often considered "stable," is likely the result of many small areas of high erosion rates. In comparison, they cited previous studies of sediment influxes to area reservoirs that were in the range of mostly 1 to 3 Mg ha^{-1} yr^{-1} (0.4 to 0.1.2 ton ac^{-1}). One outlying reservoir received nearly 7 Mg ha^{-1} yr^{-1} (3.1 ton ac^{-1}), which the researchers explained was likely due to a great deal of highway and suburban development in that watershed during the measurement period.

They suggest that the lower accumulation relative to some land uses is due to storage in the stream floodplains, with net accumulation of 2 mm y^{-1}, similar to other studies in the region. From these results, they concluded that stream banks are not contributing significant sediment to the system.

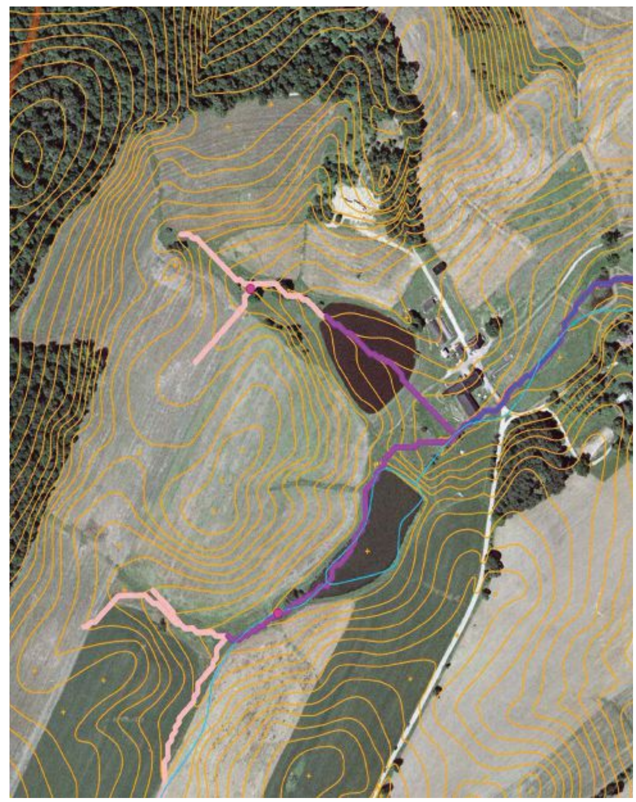
Donovan Research

Another study used different methodology in similar landscapes located just north of the Smith and Wilcock study. In the study, Donovan and the team of researchers concluded that stream banks contribute seventy percent of the sediment in Piedmont streams[2].

The authors used aerial photographic images of forty stream sections in Baltimore County, Maryland, USA, taken from 1959 to 1961 to compare 2005 topographic data developed from LiDAR data (3-dimensional radar from planes). They then collected samples and survey data from those same stream cross-sections to estimate the amount of sediment either deposited or eroded at that point. They also differentiated "legacy" sediment (which was generated after European settlement and marked by high erosion associated with agriculture and development) from pre-settlement sediment. See photo included with this article.

The area studied is more rural than the Smith and Wilcock study area, with much less (less than twenty percent) suburban and urban development. Over the forty-four to forty-six years, the streams migrated laterally an average of 2.5 percent of stream width each year. The resulting bank erosion rate ranged from 0.4 to 3.1 Mg ha^{-1} yr^{-1} (0.2 to 1.4 ton ac^{-1}), but much of this material is redeposited downstream for a net export average of 1.0 Mg ha^{-1} yr^{-1} (0.4 ton ac^{-1}), 70 percent of which came from bank erosion.

The researchers noted that stabilizing stream banks would go a long way toward achieving TMDL goals in the region. They also emphasized the importance of studying stream dynamics over large areas and over long periods of time in order to obtain an accurate assessment.



Aerial photograph of two ponds in the Smith and Wilcock study. Both ponds receive water via first order streams in agricultural watersheds, but the top one has no stream erosion while the stream above the bottom one is eroding. Photo courtesy S.M.C. Smith and P.R. Wilcock

References

1. Smith, S.M.C. and P.R. Wilcock. 2015. "Upland Sediment Supply and its Relation to Watershed Sediment Delivery in the Contemporary Mid-Atlantic Piedmont (U.S.A.)." *Geomorphology* 232 (2015) 33–46, http://dx.doi.org/10.1016/j.geomorph.2014.12.036.
2. Donovan, M., A. Miller, M. Baker and A. Gellis. 2015. "Sediment Contributions from Floodplains and Legacy Sediments to Piedmont Streams of Baltimore County, Maryland." *Geomorphology* 235 (2015) 88–105, http://dx.doi.org/10.1016/j.geomorph.2015.01.025.