United States Department of the Interior
U.S. Geological Survey
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Maryland-Delaware-District of Columbia
Water Science Center
Seminar Series

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Base Flow Discharge to Streams and Rivers: Terminology, Concepts, and Base-flow Estimation using Optimal Hydrograph Separation

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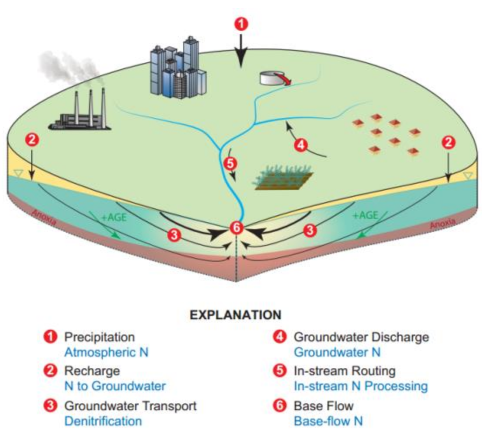
A reliable supply of freshwater is critical for sustaining human populations as well as ecosystem needs. One component of freshwater resources that contributes large volumes of water to stream discharge, but that is difficult to measure, is base flow. Quantitative estimates of base flow are necessary to address questions of the vulnerability and response of aquatic ecosystems to natural and human-induced change in environmental conditions.



Considering two scales of analysis (reach and watershed), a distinction is made between groundwater discharge (flux of water from the saturated groundwater system to a stream reach) and base flow (estimated using streamflow and other data at a measurement site or gage at the watershed scale).

Eckhardt (2005) proposed a recursive digital filter to estimate base flow that has two parameters: a recession constant (alpha) and a maximum base-flow index (beta). The recession constant can be estimated using a variety of approaches that use streamflow during time periods when groundwater recharge is not occurring. In this study, beta is estimated, or optimized, using observed discrete or continuous specific conductance (SC) data, and a time-varying base-flow SC value; quickflow SC and other parameters are estimated through the optimization. The method satisfies both water and chemical mass balances, and has a physical basis (the recession constant, alpha); it has been applied to select watersheds throughout the Chesapeake Bay watershed. The results of this study will be used to further several National Water-Quality Assessment (NAWQA) goals related to understanding lag times for nitrate transport to streams in the subsurface, and to assist in development of dynamic and base-flow SPARROW (Spatially Referenced Regression on Watershed Attributes) models.

Jeff Raffensperger is a hydrologist with the USGS MD-DE-DC Water Science Center. He received his Bachelor's degree in Geology from the University of Maryland in 1985, his Masters degree in Hydrogeology from Louisiana State University in 1988, and his Ph.D. in Hydrogeology from The Johns Hopkins University in 1993. Jeff has worked for the USGS MD-DE-DC Water Science Center since 1999 and has been involved with several projects studying hydrologic processes and modeling. He has been a member of the National Water-Quality Assessment (NAWQA) Integrated Watershed Studies (IWS) Team since 2013.

This presentation will also be available remotely via Webex: https://usgs.webex.com/

For directions to the USGS MD-DE-DC WSC: http://md.water.usgs.gov/directions/baltimore.html.