CAUSES OF INCREASED TOTAL DISSOLVED SOLIDS AND CONDUCTIVITY LEVELS IN URBAN STREAMS IN GEORGIA

Ted Mikalsen

AUTHOR: TMDL Implementation Coordinator, Georgia Environmental Protection Division, 4220 International Parkway, Suite 101 Atlanta, GA 30340. *REFERENCE: Proceedings of the 2005 Georgia Water Resources Conference*, held April 25-27, 2005 at the University of Georgia. Kathryn J. Hatcher, Editor, Institute of Ecology, University of Georgia, Athens, Georgia.

Abstract. The goal of this investigation was to identify the major causes and likely sources of the increased electrical conductivity and related total dissolved solids (TDS in mg/L) concentrations typically found in urban streams. Using the Standard Methods formula for calculating TDS as a surrogate for EC, calculations of TDS were derived from the summation of measured and estimated constituent concentrations from a two year bi-monthly data set compiled for a comprehensive nonpoint source investigation of five clusters of streams (including comparable urban and control streams) in different ecoregions of Georgia. Measured components of the formula for calculating TDS concentration for pairs of urban and control streams and overall urban and control means were supplemented with estimates of unmeasured constituents derived from a comprehensive investigation of background water quality conditions in Georgia for control streams and investigations of Georgia and eastern U. S. urban streams. Calculated TDS concentrations for the Georgia study streams were compared with measured concentrations, expected ratios of calculated to measured TDS and EC, and a limited number of comparable investigations to verify the resultant calculations.

Though the differences between measured and calculated TDS for two pairs of Coastal Plain Province streams were likely increased by organic ions not included in the TDS formula for calculated TDS, the measured mean TDS concentration for urban streams of 114.8 mg/L was significantly (0.01 level) higher and the calculated overall mean for urban streams of 85.5 mg/L substantially (not tested) higher than the control stream mean of 29.8 mg/L. Calculated TDS concentrations were substantially (not tested) higher in each urban stream. Significantly higher pH (more alkaline) and water temperatures likely increased solubility rates in urban streams. Most (93.4%) of the overall mean difference in calculated TDS concentrations (54.2 mg/L) between the Georgia urban and control streams is accounted for by the carbonate portion of total alkalinity (23.6 mg/L), the related calcium (Ca^{2+}, 15.7 mg/L), sulfate (SO_4^{2-}, 6.1 mg/L), and chloride (Cl^-, 5.2 mg/L). While other components of the TDS calculation such as nitrate, sodium, and magnesium may increase substantially in urban streams, their concentrations are substantially less.

Given that differential weathering due to lithological variation and evaporative concentration are not likely causes, the significantly higher TDS concentrations in urban streams are likely due to the increased supply, solubility, and more efficient transport of the soluble ionic constituents of calculated TDS to urban waters. The likely sources and causes of the major contributors to the elevated TDS concentrations in the urban streams are: 1) increased alkalinity and calcium concentrations resulting from the weathering, efficient delivery, and accelerated dissolution of calcium carbonate found in the increased expanses of impervious surfaces and drainage systems in urbanized watersheds; 2) increased sulfate concentrations most likely resulting from more efficient delivery of deposited or spilled sulfur compounds from impervious areas and wastewater leaks or illicit discharges; and 3) elevated chloride concentrations resulting from varied sources as wastewater leakage, runoff of lawn fertilizers, and spills or discharges of varied substances containing chlorides, including road salts in North Georgia.

A copy of the entire paper may be obtained at the conference presentation or by request from the author.