

# BIOFILMS PROVIDE CRITICAL ECOSYSTEM SERVICES IN URBAN PIEDMONT STREAMS VIA RETENTION OF CARBON, NITROGEN AND PHOSPHORUS

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**Abstract.** There are many stressors associated with urban watersheds, specifically increased nutrient loading and altered hydrology, which affect the functions that streams provide. An important ecosystem service provided by all streams is in slowing the movement of materials downstream (retention) so that biological processing of materials can occur. We evaluated the role of stream biofilms in terms of their retention of carbon, nitrogen and phosphorus (C, N and P). These elements are tied up in particulate organic matter and associated microorganisms that grow or settle on rocks or sediments in streams. We quantified the mass of these materials and their nutrient content (C, N and P) bimonthly for two years from urban, suburban, mixed-use and forested watersheds in Athens-Clarke County (Upper Oconee River basin) Georgia. Based on the hypothesis that altered hydrology associated with % watershed impervious surface cover (% ISC) reduces retention of biofilms, we tested whether the mass of biofilms was related to the % ISC. To test whether biofilms were important in the uptake and retention of N and P, we tested whether biofilm nutrient content was related to nutrient concentrations in stream water. We found that the quantity of biofilms was reduced in streams with greater % ISC and found that higher streamwater nutrient concentrations were reflected in higher nutrient content of biofilms. On a stream-reach scale, increased % ISC was associated with lower overall capacity to retain nutrients in biofilms, as the overall mass of biofilms was reduced. Our results illustrate that important ecosystem services that streams provide, nutrient and carbon uptake and retention, are reduced in urban streams and are a function of the % ISC in the watershed. These services can potentially be enhanced by implementing management that reduces the negative effects of hydrology and excess nutrient loads associated with watershed urbanization.