Article 79

The Environmental Impact of Stormwater Ponds

Stormwater ponds are one of the most effective techniques for providing channel protection and pollutant removal for urban streams. However, persistent concerns have been raised about the possible secondary environmental impacts produced by ponds. This article reviews available data on the negative impacts of stormwater ponds on downstream water temperature regimes, downstream dry weather water quality, downstream bedload movement, downstream trophic shifts, upstream fish passage, upstream channel degradation, and destruction of riparian cover and wetlands. The article concludes by suggesting design and "fingerprinting" techniques that can be used to avoid or mitigate these environmental impacts.

Stormwater ponds are among the most adaptable, effective and widely applied stormwater treatment practices in developing areas. The popularity of stormwater ponds can be attributed to their proven ability to attenuate flows from design storms; economies of scale compared to other types of stormwater practices (Wiegand *et al.*, 1986); high urban pollutant removal capability (Schueler and Helfrich, 1989); longevity, particularly in comparison to other types of stormwater practices (MDE, 1991); community acceptance (UWLI, 1987); and effect on adjacent land prices (Schueler, 1987).

In recent years, many communities have adopted regional stormwater pond policies to achieve maximum stormwater benefits at the watershed scale at minimum cost. Individual ponds serve areas ranging in size from 50 to 500 acres, and are located within the larger watershed using hydrology simulation models.

However, large stormwater pond systems have recently come under increased scrutiny from state and federal environmental regulatory agencies in the mid-Atlantic region. In many cases, pond designers must obtain both a Section 401 (water quality certification) and/or Section 404 (wetland) permit prior to construction. In an increasing number of cases, permits for pond construction are denied or are issued with rigorous conditions. The most common impacts cited are wetland disturbance, downstream warming, and the sacrifice of upstream stream reaches. Other frequently cited negative impacts of ponds include the creation of barriers to fish passage, poor quality of pond effluent, downstream shifts in stream trophic status, and loss of forests in the floodplain.

To date, very limited research has been conducted on the environmental impacts of stormwater ponds. Typically, the severity of impacts attributed to ponds has been inferred from limnological research studies on the effects of larger impoundments and reservoirs on large river systems (for an excellent review, see Ward and Stanford, 1979 and Petts, 1984). In these systems, impoundments are a "serial discontinuity" and have a pervasive and persistent impact on aquatic life downstream. How well does this paradigm apply to the case of urban stormwater ponds? For a number of reasons, it may not apply totally.

First, stormwater ponds are typically located in first and second order headwater streams, as opposed to larger rivers. Second, stormwater ponds tend to be extremely shallow (five to 10 feet), and thus experience only weak stratification. Impoundments, on the other hand, may be from 15 to 150 feet deep, and exhibit very strong seasonal stratification. Third, and most importantly, urban streams differ in many important characteristics from more natural systems. Urbanization profoundly changes the hydrology, morphology, water quality and ecology of streams, and the severity of these changes is directly related to the degree of watershed imperviousness (see article 1).

Environmental Impacts Associated With Stormwater Ponds

This article presents some new research data on the severity of secondary impacts of stormwater ponds. In addition, several design techniques are suggested to minimize secondary impacts.

The range of potential environmental impacts that ponds can exert is shown in schematic fashion in Figure 1. Ponds can have both positive and negative impacts on the local and downstream environment, as discussed below.

Alteration on Downstream Temperature Regime

It has been recognized for many years that urban streams tend to be warmer than undisturbed streams (Pluhowski, 1970). A recent study of headwater streams in the Maryland Piedmont confirmed the existence of a "heat island effect" in urban streams (Galli, 1991). The increase in urban summer stream temperatures from an undeveloped reference stream baseline (denoted as the