Article 58

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Improving the Trapping Efficiency of Sediment Basins

Sediment basins that are designed to settle out suspended sediments in stormwater runoff are typically the last line of defense at construction sites. Many communities employ the same basic and fairly simple design specification for sediment basins (see Table 1). While most specifications refer to optional design features such as de-watering devices, baffles or perforated risers, these "extras" are seldom installed in the field for cost reasons. In practice, the criteria are often used to tell the contractor how much dirt needs to be scooped out to provide the requisite storage.

Consequently, in many regions, sediment basins are really no more than an engineered hole in the ground (HIG). HIGs can be seen at almost any construction site around the country: steep-sided rectangular holes, that may or may not have standing water, with a ring of bright orange safety fencing, a reusable corrugated metal pipe (CMP) riser and perhaps a truckload of rip-rap dumped near the outlet.

It is not surprising, then, that most HIGs are a poor settling environment, and few are probably capable of consistently removing 70% of incoming sediment, much less the 95 to 99% removal needed to achieve a relatively clear water discharge. A large number of factors work to reduce the trapping efficiency of a basin in the field (Table 2), some of which could conceivably be "engineered away" through better design. Thus, the key question is how much improvement in performance can be expected if the basic design of sediment basins is modified?

A steady stream of sediment basin design improvements have been advocated over the years, including perforated risers, perforated risers with gravel or filter fabric jackets, filter fence baffles, floating skimmers, "dual basins in series," greater storage volumes and various combinations thereof (see Figure 1). Until recently, however, these design improvements were seldom subjected to experimental testing or field monitoring to determine if they actually improved trapping efficiency. Lacking proven performance data, many local and state erosion programs have been reluctant to adopt these improvements, given the potential cost and maintenance ramifications.

Sediment Basin Re-Design

Our understanding about the performance of innovative sediment basin designs has recently been increased by a series of laboratory experiments, field monitoring and modeling studies conducted by A. R. Jarrett and his colleagues at Pennsylvania State University and Rich Horner of the University of Washington. While it is difficult to make direct comparisons between studies because of differences in soils, rainfall, design storage and experimental techniques, the research does offer some insight into these innovative techniques.

Table 1: "Standard" Sediment Basin Design Criteria Compiled from Various State and Local ESC Manuals

- Provide 1,800 cubic feet of storage per contributing acre *
- Surface area equivalent to one percent of drainage area **
- Riser w/ spillway capacity of 0.2 cfs/acre of drainage area (peak discharge for two-year storm, undeveloped condition)
- Spillway capacity to handle 10-year storm with one-foot freeboard
- Length-to-width ratio of two or greater **
- Basin sideslopes no steeper than 2:1 (h:v)
- Safety fencing, perforated riser, de-watering **

* A number of states (MD, PA, GA and DE) recently increased storage requirement to 3600 ft^3 or more.

** Optional technique, but seldom actually required during plan review.