HYDROLOGY AND STORMWATER QUALITY

Everyone who has dealt with stormwater issues is familiar with the term “first flush”. But what does the phrase actually mean? It depends.

“First flush” is defined by some as the first ½” (13 mm) of runoff, or the runoff from the first inch (25 mm) of rain. This may make sense in some areas, but almost none in others. Is it realistic that this definition of a first flush would equally apply for Washington State as it would for Florida where the rainfall patterns are completely different? Probably not.

When a first flush occurs, its effects can be deceiving unless we define whether we are talking about pollutant concentration or load. For small areas, a first flush may refer to pollutant concentrations but not necessarily to load. High concentrations during the rising limb of the hydrograph combined with the lower flow rates result in attenuated loads. By the same token, lower concentrations during peak rates produce similar loading. Chang (1992) found this to be true in a study of first flush and pollutant loading in Texas.

You can argue that the higher concentrations during the rising limb pose a greater threat to aquatic health than do the lower concentrations, but you could also argue that the long term cumulative effects of total pollutant loading are equally important. It can also be argued that a first flush does not occur all the time, since it is related to factors such as the distribution of intensities during a storm, the number of antecedent dry days and pollutant build up characteristics. Is stormwater quality really this complex? In a word…yes.

In spite of this, many jurisdictions throughout North America base their design criteria for stormwater quality facilities on a single hypothetical storm with a certain infrequency of occurrence. This single storm is obviously a poor substitute compared to a continuous analysis of long-term precipitation records. So why is the design storm event still used in stormwater quality design? For two reasons.

First, it is easy. Engineers are familiar with design events, and have decades of experience using them for flood and erosion control. They are extremely simple to define and reflect local rainfall statistics.

Second, since the cause and effect relationship between stormwater and ecosystem health is complex and ill defined, many agencies adopt simple criteria that are easily understood. The adoption of simple criteria is generally accepted since many people still question the basic need for stormwater quality control, let alone how to Design stormwater quality facilities.

Unfortunately, a real danger exists when simple criteria are applied to complex problems. Simple criteria such as the design event have been demonstrated to be ineffective (cumulative watershed effects of peak flow shaving) or capable of actually exacerbating problems (increased erosion due to near peak flows of peak flow shaving) if used incorrectly.

We should not make the same mistakes with stormwater quality, where the use of a simple design event ignores the hydraulic operation of the various measure. For example, an infiltration/ exfiltration device will operate hydraulically different than a detention pond or a flow through detention system such as an oil/sediment separator. Accordingly, hydraulic or hydrologic design criteria for these three systems should reflect their operation on an annual basis. Ontario's Ministry of the Environment (1994) accounted for this variability in operation by deriving design criteria based on annual hydrologic/ hydraulic operation of the various stormwater quality measures.

The "Golden Rule" in stormwater quality is to apply a holistic approach. We should simplify the design process wherever possible, but not at the expensive of both taxpayers and our environmental objectives.