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The Stormwater Maze - an alternative design method to Stormwater Management Practices

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During the last several years, I have often written on erosion control methods that use old techniques in a new way to address tight work areas, the need to filter the stormwater quickly, and other unusual field conditions. Continuing this discussion, I recently presented a paper at the Northeast chapter of the International Erosion Control Association regarding the use of an enhanced wet swale to improve water quality both during construction and for long term occupancy.

In 1999, we began a project located in the New York City Watershed. It required specific pollutant removal in order to be approved. The plan began with a swale connecting two larger detention basins. Two detention basins worked to handle the needed water quantity storage, but wasn't enough to handle the phosphorous removal required for the system. NYCDEP determined that we needed to use some other kind of Stormwater Management Practice (SMP) in order to specifically provide phosphorous and sediment removal.

We began to look at alternate methods such as a wet swale, created wetlands, and stormwater methods. Most of these SMPs were originally designed by Thomas Schueler of the Metropolitan Council of Governments. In the world of stormwater design, each of these SMPs requires specific design characteristics, none of which suited the site. So we were forced to come up with our own alternative.

Based on those original SMPs, we decided to take the winding path of the low flow area of the stormwater wetlands, make it wide and wet like a wet swale, and then turn at 180Â° to make the water slow down and drop sediment. We added plant material and limited the project velocity like a created wetland. The purpose of the system was to encourage evaporation, provide soil and plant adsorption, and to allow for biological uptake.

What we ended up with - a twisting combination of broad, wet, flat planes, and micropools - we called a "Stormwater MazeÂ©" due to its shape and design intent.

The Stormwater Maze uses a low flow circuitous route without a larger storm-based volume. Since there were no specific design guidelines for this, we created our own based on the list of design functions from Schuelers' Design of Stormwater Wetland Systems:

1. Treatment Volume (provide micropools)
2. Surface area to Volume ratio (provide as much surface area as possible by widening the flow paths)
3. Length and depth of flow pattern (provide as long a path as possible - length to width ratio of 10:1 was used)
4. Deep water pools (provide a forebay to handle the discharge velocity and micropools)
5. Treatment redundancy (part of overall system)
6. Off-line design (specifically not used system is completely in-line)

7. And we added one of our own - force the water to change direction in order to slow any velocity and to allow sediment to fall out like an oxbow stream

Since the original installation in 2002, we have used the Maze in a variety of locations and have been able to test our variations. Based on six locations, the Stormwater MazeÂ© is most effective with a very small pipe (6" is preferred). This allows for a steady flow of water which makes the most of the twists and turns without creating velocity that could be erosive at the turn. Three 180Â° turns provide the maximum pollutant removal. The broad straight sections can be varied in length to suit your site or reduced if your soil particle size is large or your drainage area is limited in size.

We also used the Maze at construction sites and found it very effective during low to moderate storm events. The turns effectively reduce the sediment load. Also, the layout is conducive to using a flocculent. The flocculent (such as StormKlearÂ©) can be placed within the water flow easily and replaced regularly as needed. This, surprisingly, works in the winter time when most flocculent is less effective. The MazeÂ© does not do well in big storms or with large depth of water (over 6") of heavily silted material, especially during construction. Additional check dams, storage, and treatment should be provided before entering the Maze. It is very east to blow out the Maze during construction. But if used properly, it is highly effective, does not require regular maintenance, and allows for a final polishing if needed before discharge.

Overall, the Stormwater MazeÂ© has proven to be an effective stormwater quality tool both during construction and for long term pollutant removals.

Terri-Ann Hahn, is a principal of LADA, P.C.-Land Planners, Simsbury, CT.