STORMWATER METHODS AND TRENDS FOR "FIRST FLUSH" TREATMENT IN GEORGIA

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Abstract. With the NPDES Phase II Final Rule taking effect, more municipalities are confronted with the requirement to develop, implement, and enforce a management plan to control post-construction stormwater runoff. The ultimate objective is to reduce pollutant loads and improve water quality. To accomplish this goal, many municipalities have adopted regulations that require all new and redeveloped areas to treat the "first flush" (first 1.2") of rainfall prior to discharge. The engineer/developer must design a system that accomplishes this goal. Plans must then be approved by the local governing authority. The most common "first flush" treatment method to control post-construction stormwater (within the Metropolitan North Georgia Water Planning District) is Extended Dry Detention Ponds (EDDP). This paper will discuss the use of the EDDP as post-construction stormwater treatment and how it is being applied to new and re-development projects. In addition, the paper will address how the common practice of installing the EDDP online has negative, long term consequences that are only now becoming apparent.

BACKGROUND

Prior to environmental standards, stormwater was simply drained to the lowest point on a development and then released. As development increases in a given area, more impervious surfaces are created. These areas present reduced infiltration rates and increased stormwater runoff volume. As an area changes from rural to urban features, more people become affected because of the increased flooding and water quality issues. This phenomenon specifically affects those who live immediately downstream from the urban area. Higher runoff volume and increased flow velocity result in the erosion of stream banks and flooding.

To counteract this constant flooding, regulations were enacted to protect individuals downstream by requiring that stormwater runoff be detained for a period of time that is below pre-developed flow regime. Dry Detention ponds are designed to control peak flows and slow down the runoff velocities; hence, providing flood control but doing little to improve water quality. After flooding is controlled, regulators realized the need to monitor stormwater runoff within urban areas for water pollutants (i.e. oil, grease, heavy metals, sediments, and nutrients). These pollutants, once suspended in runoff, are carried to receiving waters, such as lakes, ponds, and streams. To counteract the long-term effects of water quality pollutants, governing authorities require the treatment of the "first flush" of stormwater. Methods commonly used to treat this "first flush," or water quality volume, include oil/grit separators, grass swales, infiltration trenches, water quality ponds, and some commercial products. The method most commonly used in Georgia is the water quality pond (due mostly to cost). The EDDP is the result of the combination of the Dry Detention pond design and the water quality pond design. The "first flush" is detained for a specified period of time that ranges from 24-48 hours to allow for the common pollutants to settle out. In addition, the EDDP will prevent flooding by allowing for pre-developed peak flows to equal post- developed flows via an orifice, weir, or combination thereof. The water released from the EDDP will improve water quality and protect individuals down stream from flooding during rain events. It is assumed that by allowing the pollutants to settle out in the pond, natural processes will breakdown some pollutants, improving the quality of Georgia streams and ultimately public health.

DISCUSSION

EDDPs, when not installed on a stream (offline), and when **sufficiently maintained,** tend to function as ideally intended. Unfortunately, this is not the current trend in Georgia. Within the state, EDDPs are being approved by local governing authorities to be installed on a headwater, creek, or stream (online).

Online EDDPs present two concerns, the water quality volume calculation and the base flow calculation. The engineer/designer must design a discharge orifice that allows for stormwater to be retained in the pond for 24-48 hours. The retention time allows for the settling of solids, alleviating some of the water quality concerns. In order to design the EDDP pond, the engineer must

calculate the base-flow of the stream and add it to the desired discharge flow. This allows the base-flow to run at all times while detaining the "first flush" during a rain event.

Under the mentioned scenario, two concerns are raised. The first relates to the base-flow calculation, which in many cases is arbitrary or incorrect, leading to the EDDP to retain the water for too long or releasing it too soon. The second concern is the size of the base flow/water quality discharge orifice. If the orifice is small, not protected (and constantly maintained), the EDDP will constantly hold water, becoming a wetland or a lake. The intended design is lost because the required water quality volume is never drained within the design parameters and the stream ecosystem is permanently changed from its native state.

In order to address the high failure rates of these EDDP's, the legislation that permits their present installation must be reviewed. While intending to protect Georgia's resources, the Georgia Erosion and Sedimentation Act contains exemptions that are contrary to the legislative intent of the act. These exemptions are creating loopholes that are commonly used to preserve developable land, yet simultaneously create negative environmental impacts. The Georgia Erosion and Sedimentation Act allows for two stream buffer variance exemptions, which have resulted in the construction of EDDPs upstream from road crossings or directly in the stream. These two exemptions are the roadway drainage structure (i.e. road crossing) exemption and the drainage structure exemption. The roadway drainage structure exemption "means a device, such as a bridge, culvert, or ditch, composed of a virtually nonerodible material such as concrete, steel, plastic, or other such material that conveys water under a roadway by intercepting the flow on one side of a traveled way consisting of one or more defined lanes, with or without shoulder areas, and carrying water to a release point on the other side." The drainage structure exemption "means a device composed of a virtually nonerodible material such as concrete, steel, plastic, or other such material that conveys water from one place to another by intercepting the flow and carrying it to a release point for storm-water management, drainage control, or flood control purposes." These exemptions allow for the installation of an outlet control structure (OCS) on the upstream side of the road with various flow control mechanisms (i.e. orifices, weirs) to release the water under the roadway at a pre-determined rate. The drainage structure exemption is used to treat and/or detain stormwater on a stream using a concrete wall (nonerodible material) placed in the center of the stream. In some instances, federal regulations are ignored because local governments adhere to state requirements assuming that they are inline with federal requirements. As a result, projects are allowed to proceed with development. According to the Federal Clean Water Act, it is illegal to alter waters of the United States without a permit from the United States-Army Corp of Engineers (USACE). However, developers are allowed to install a pond upstream from the roadway because the governing authority allows for EDDPs to be installed online since a variance is not required for the roadway. In turn, the EDDP alters waters of the United States by storing stormwater longer than pre-developed conditions and changing the previous hydrological and ecologoical characteristics of the stream. Federal regulations require that all other options are exhausted before considering inline treatment or storage. The developers, designers and local governments often do not seem aware of the federal requirement to abide by the Clean Water Act and obtain permits to put EDDPs on state or U.S. water ways. In most cases the ponds that are installed upstream of roadways and in the center of streams do not improve water quality and quantity issues, they only contribute to the concern.

Prior to construction, the engineering community is pressured to save developable land and minimize the time it takes for land development plans to be approved by the proper authorities. Under the current system, the most cost effective method to satisfy all regulatory requirements is to drain newly created stormwater to the buffer edge (often eroding the soil from the buffer to the stream bed) and then detain and treat it on a stream. The designer uses the natural topography of the stream bed to create a pond- in most cases an EDDP. As stated above, this usually occurs at the lowest point on the property where a road crosses a stream. In effect, the developer decreases cost by maximizing land use. In most cases the pond never functions correctly and the native vegetation dies off due to extended inundation periods, thus leaving the stream bed ecosystem forever changed from its native state. With extended inundation periods constant the design volume of the EDDP is lost resulting in water quality and water quantity concerns downstream.

The alternative to the EDDP would be to install a planted wetland, extended wet detention pond, or a lake. The concern now becomes time and construction costs. The USACE/State permitting process can take many months (often years) to get final approval on a set of plans prior to construction. This results in time costs. The other concern is that once the USACE/State gives approval to install a constructed wetland, extended wet detention, or wet detention (i.e. lake), the construction costs increase (i.e. removing trees in buffer, installing an aquatic/safety bench, dam engineering) along with potential liability of open water.

RECOMMENDATIONS

There is an economic balance that can be achieved between the environmental community and the development community. If the state governing authority (DNR/EPD) required all stormwater in developments to be drained to a water quality pond first, only retaining the first 1.2" of runoff for 24-48 hours, the land area that the developer would have to sacrifice would be minimal. The "first flush" would be treated prior to entering Georgia water bodies. The developer would then be allowed to dam up a stream, and detain the flood volumes online. This could be done preferably through constructed wetlands, extended wet detention, or wet detention ponds. While online dry detention ponds could be used under these circumstances it is not recommended. Past experiences have shown that online dry detention ponds have high design failure rates similar to EDDPs. The detention/discharge orifices (while usually significantly larger than EDDP discharge orifices) are located on the pond bottom where over time (even with there greater size) have a high probability of clogging. The constant accumulation of debris/sediment coming through the stream channel and settling around the orifice ultimately causes online dry detention ponds to increased water quantity flows downstream and increased detention volumes upstream the result is flooding.

For ponds to function ideally however; all stormwater should be treated and detained offline whenever possible. An example can be seen in Hall County, Georgia. The development regulations of Hall County do not allow any treatment of stormwater online. Storage of stormwater is allowed online but only with approval by the State and/or USACE.

The second recommendation is to streamline the USACE/EPD permit process to allow more constructed wetlands, extended wet detention, and/or wet detention ponds in new and re-developments. In the current situation, the engineer/land developer is forced to use EDDPs because of the extensive time needed for the USACE permit process. The discharge orifices for these types of stormwater facilities are not sitting at the bottom of the pond where the constant flow of water (and all its contents sediment, debris) will inevitably cause the discharge orifice to clog and fail. These methods improve water quality by allowing natural processes to breakdown pollutants and also by allowing water to be removed from the top of the water body where the water is cleaner. These methods while altering the natural ecosystem of the stream bed will still function within their design parameters (i.e. With these systems, the design volumes remain intact). Where as, online EDDPs do not function as designed (do to loss of design volume and the high probability of clogging) and inevitably will altering the natural stream bed ecosystem.

The third recommendation to improve Georgia's water resources suggests allowing treatment and detention online **ONLY** in those areas that are "hot spots" - areas where urbanization has caused detrimental effects to water bodies where any design adjustment to the stream would inevitably improve water quality conditions downstream.

CONCLUSIONS

As Georgia's counties start to adopt ordinances that address "first flush" treatment into their stormwater management plans, and as engineers and developers choose to use online EDDPs, streams will inevitably be affected. If ponds are continued to be installed online, more stormwater retention facilities will have to be installed online (by municipalities) to counteract those that have been designed inadequately. The time and cost associated with the permitting process at the state and federal levels will continue to be avoided as long as loopholes in the current system exist. The implementation of necessary change is the professional responsibility of the (EPA/EPD/USACE) officials and local area governments. These officials have the authority to specify the allowable practices and ban those practices that may meet all regulatory requirements on paper but upon observation and analysis do not function as designed.

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