A simple model for estimating sediment outflow from a small detention pond

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Small detention ponds located in urbanized areas at local streams play an important role in storm water management due to two major reasons. First, by capturing and detaining the stormflow, they reduce peak flows and, consequently, the risk of flooding below the pond. Second, by trapping sediments and associated compounds, they improve runoff quality downstream. Unfortunately, due to a fast silting pace, they may lose these functions already after few years of operation. Providing a tool for assessing the pond performance can thus greatly support the pond management and optimize its long-term functionality.

This work presents a simple approach for estimating the discharge and the suspended sediment concentration in the pond outflow during passage of flood flows. This method relies on flow and suspended sediment continuity equations and has only one parameter – the suspended sediment decay coefficient – which is used for mathematical description of the sediment deposition in the pond. The model was developed and tested for a small detention pond located in Warsaw (Poland) on the basis of field study outcomes which included records of the inflows to and the outflows from the pond. The data gathered was used to identify the suspended sediment decay coefficient and to reconstruct the sediment outflow of recorded events. In this study, we propose the regression model to describe the decay coefficient in relation to detention time and d50 grain size. Our results indicate that the model performed well in reconstructing past flood events and thus the proposed approach may efficiently support urban planning and decision-making related to environmental protection (storm water management) and engineering at a small scale of urbanized catchments.