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Storm-Runoff Simulation Approaches for External Natural Catchments of Urban Sewer Systems

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Abstract : According to German guidelines, external natural catchments are greater sub-catchments without significant portions of impervious areas, which possess a surface drainage system and empty in a sewer network. Basically, such catchments should be disconnected from sewer networks, particularly from combined systems. If this is not possible due to local conditions, their flow hydrographs have to be considered at the design of sewer systems, because the impact may be significant. Since there is a lack of sufficient measurements of storm-runoff events for such catchments and hence verified simulation methods to analyze their design flows, German standards give only general advices and demands special considerations in such cases. Compared to urban sub-catchments, external natural catchments exhibit greatly different flow characteristics. With increasing area size their hydrological behavior approximates that of rural catchments, e.g. sub-surface flow may prevail and lag times are comparable long. There are few observed peak flow values and simple (mostly empirical) approaches that are offered by literature for Central Europe. Most of them are at least helpful to crosscheck results that are achieved by simulation lacking calibration. Using storm-runoff data from five monitored rural watersheds in the west of Germany with catchment areas between 0.33 and 1.07 km2 , the author investigated by multiple event simulation three different approaches to determine the rainfall excess. These are the modified SCS variable run-off coefficient methods by Lutz and Zaiß as well as the soil moisture model by Ostrowski. Selection criteria for storm events from continuous precipitation data were taken from recommendations of M 165 and the runoff concentration method (parallel cascades of linear reservoirs) from a DWA working report to which the author had contributed. In general, the two run-off coefficient methods showed results that are of sufficient accuracy for most practical purposes. The soil moisture model showed no significant better results, at least not to such a degree that it would justify the additional data collection that its parameter determination requires. Particularly typical convective summer events after long dry periods, that are often decisive for sewer networks (not so much for rivers), showed discrepancies between simulated and measured flow hydrographs.

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