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Storm Water Management – Pollution and Treatment

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The reorientation of urban drainage towards source-controlled storm water management ('best management practices') has left behind a single-objective concept based upon storm water discharge in underground sewers. Instead, minimizing the impacts of urban drainage on the local water balance in both terms of hydrology and pollutant matter has become a major target. This is expressed in both, the European Standard EN 752 "Drains and sewer systems outside buildings" [CEN, 2008] and the German Working Sheet DWA-A 100 "Guidelines for integrated urban drainage" [DWA, 2006]. In addition, DWA-A 100 demands for a well-balanced consideration of hygienic safety, hydraulic reliability and flood protection on the one hand and local water balance and water quality control on the other hand.

In regard to water quality standards that have been established for natural water bodies by European Water Framework directive, the impacts of wet weather flow on receiving waters have become a major concern. It is generally acknowledged that decentralized, source-based storm water management concepts in combination with low impact and water sensitive urban developments strongly support this objective. They include the application of pervious pavements, whenever tolerable in regard to area use and pollution accumulation on the surface, storm water infiltration through vegetated soil, bio-swales or infiltration basins, storm water retention and rainwater harvesting where feasible.

Source-controlled storm water management concepts serve both objectives, improving hydraulic reliability and drainage system performance and receiving water quality control as well. However, source-based infiltration and retention facilities will not be able to completely hold the volume of extreme storm events that pour down 50 mm of rainfall depth (50 liters per m^2) and more within a few hours. But also the underground installations – sewers and concrete retention basins – have proved to have limited capability to avoid urban flooding as stand-alone solutions. Furthermore, climate change is expected to cause increased intensities and/or frequencies of flood inducing torrential rainfall, demanding for even higher drainage and flow discharge capacities. However, both the high uncertainty of future rainfall behavior and restricted financial resources demand for more intelligent solutions rather than extending underground sewers. The new perception has grown that effective urban drainage flooding protection must be understood as a joint community effort and put into action by interdisciplinary planning [Schmitt, 2011]. Above all, a purposeful flood risk analysis is needed to identify local hazards as well as effective and efficient protective measures including surface features, e.g. street cross-section and open space areas, to retain or convey excess surface runoff.

In terms of water quality control, pollution load of surface runoff, storm and combined sewer flow must be evaluated in order to limit receiving water stress by discharge of storm water. There is a clear understanding that storm water runoff with no or only minor pollution should not be discharged and conveyed in underground sewers together with sanitary sewage or otherwise polluted dry weather flow. In that view, the new German Water Act [WHG, 2009] gives preference to separate sewer systems.

However, the quality of storm water is strongly affected by urban development, civil, commercial and industrial activities as well as motorized traffic. Thus, surface runoff carries quite a number of pollutants – in different quantities - with adverse effects to receiving waters, both surface waters and groundwater. For a purposeful characterization of polluted surface runoff, meaningful pollutant parameters have to be selected

that reflect the origin of runoff (sub-catchment) as well as the possible impacts on the receiving water. Pollutants of major interest are total suspended solids, oxygen-consuming organics, nutrients and toxic/hazardous micro-pollutants, e.g. heavy metals and trace organics.

German policy of water quality control suggests a combination of emission-based and receiving water related requirements. For the emission-based limitation of pollution discharge from surface runoff, preference is given to Total Suspended Solids (TSS) as a 'guiding parameter'. Suspended solids are a dominating pollutant in surface runoff with accumulating effects in the receiving water body. Besides, quite a number of priority pollutants are adsorbed to the solids' surface and thus transported or retained according to TSS. A specific analysis based on the effected receiving water characteristics would include additional site-specific pollutants.

In terms of water quality control, once again source-controlled storm water management is seen as a purposeful approach clearly to avoid surface pollution, prevent storm water runoff and/or the pollution discharge with on-site retention, infiltration and treatment devices. With two thirds of the population served by combined sewer systems in Germany, the reduction of combined sewer overflow occurrence and pollution discharge is still a major concern. In combination with source-based storm water management, increased treatment capacity of wastewater treatment plants for combined sewer flow and storage volume in the sewer system still are the most promising measures.

Management of polluted surface runoff is based on the categorization of runoff areas depending on land predominant land use and area type into 3 categories 'minor – mean – heavily polluted', where mean and heavily polluted runoff would require treatment before discharged to either surface or underground receiving waters [BLAG, 2008]. For the treatment of category II, preference is given to on-site infiltration through vegetated soil or source-based treatment devices. Heavily polluted runoff should be given biological treatment equivalent to the efficiency of WWTP. As on-site monitoring during storm events will not be a feasible option, a major task will be to develop technical standards for centralized treatment facilities and establish a procedure for the pre-qualifying of on-site treatment devices to secure long-term operation and efficiency.

Literature:

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