Assessing the performance of urban drainage systems for groundwater recharge

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The prolonged drought in the Western States of USA has increased the use of groundwater for water supply and other uses. Consequently, aquifers are over-pumped and increasingly stressed and groundwater recharge program provides a potential solution to mitigate this stress and provide sustainable groundwater resources. Groundwater recharge program often leverages the Low impact developments (LIDs) or sustainable urban drainage systems (SUDS) built for urban stormwater management, to infiltrate the urban runoffs. To diversify the water supply portfolio, agencies are implementing groundwater recharge programs and there is a need to understand the surface water and groundwater interaction at these LIDs. This triggered recent research into their performance and effectiveness for groundwater recharge. Here, we investigate the performance of two SUDS types, a dry well and a bioswale. A representative site has been identified for each of those within Los Angeles County, California. At each site, boreholes were drilled and electrodes attached to the PVC casing for 2D and 3D electrical resistivity tomography (ERT) monitoring. At each site, a controlled infiltration experiment was conducted and monitored using ERT and soil moisture measurements along the boreholes. While the drywell showed rapid and deep infiltration below its two wells (pretreatment and main infiltration well), the bioswale showed changes in the upper 2-meter only. This highlights that drywells can provide considerably more recharge to the aquifer than bioswales. Monitoring of real storm events at the dry well site confirmed the infiltration pattern observed during the controlled experiment, but also highlighted more complexity as water from outside enters the imaging domain.

Groundwater recharge models are currently being developed that will be calibrated on the geophysical monitoring data and will provide more insight on the distribution of hydraulic conductivity, and will allow for a quantitative assessment of groundwater recharge. These developments contribute considerable insight into the functioning of SUDS for groundwater recharge, and will help urban planners to design appropriate SUDS not only for stormwater management but also groundwater recharge.