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Coupled Numerical Modelling of Baseflow Response to Spatially-Distributed Stormwater Infiltration

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Abstract: Recent advances in coupled numerical models are allowing management scenarios to be explored where only post-hoc analysis was possible before. An example of this can be found in stormwater management. New management approaches install spatially distributed stormwater facilities, but altering installed spatial arrangements is not feasible. High-resolution physically-based models that couple surface and subsurface simulations provide a means for understanding under what scenarios different management approaches may be effective. This project aims to identify under what physiographic and climatic scenarios spatial arrangements of stormwater infiltration facilities can be used to manage baseflow magnitude and timing. A physically-based model, ParFlow, is used to simulate idealized watersheds. ParFlow is a fully-distributed integrated surface-subsurface model that solves three-dimensional Richard's equation for variably saturated subsurface flow, and simulates overland flow using a kinematic wave approximation. Contrasted with the conductance approach applied in many codes, ParFlow introduces a pressure head driven flux term to Richard's and kinematic wave equations allowing direct exchange between the surface and subsurface. These attributes make ParFlow especially appropriate for investigating baseflow responses where vadose zone behavior is expected to play a primary role. We hypothesize that stormwater infiltration sites distributed over larger areas will reduce subsurface saturation during precipitation events leading to lower hydraulic conductivities and increased vadose zone storage. Observed responses in event-based baseflow response may be delayed and magnitude of baseflow is expected to decrease depending on physiographic and climatic conditions. This work will contribute to recommendations on most appropriate spatial distributions of stormwater infiltration sites.

***Keywords**:* Stormwater; Baseflow; ParFlow; LID infiltration; Coupled modelling