STORMWATER ATTENUATION AND ENHANCED INFILTRATION SYSTEM IN AN URBAN ENVIRONMENT:
PART II – TO MITIGATE DROUGHT AND SALINE WATER INTRUSION

Stephen D. Thomas
OGI Groundwater Specialists, City of Durham, UK

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Abstract

This is the second of two posters describing a SAEIS for urban environments, designed to mitigate drought and reduce saline intrusion in coastal aquifers. The system includes attenuation trenches with perforated pipes in gravel, and numerous vertical infiltrators drilled through the trench base to enable infiltration into the partially saturated vadose zone. Finite element analysis shows that stormwater pressure in the trenches, combined with negative suction in the vadose zone, creates a pressure differential that forces water into the ground. This water enters the pore space and migrates downward to the water table.

Modelling demonstrates that this enhanced infiltration recharges the water table and raises its level beneath and adjacent to the system. Further contaminant transport modelling shows that rainwater infiltration reduces saline intrusion from the ocean into the aquifer. SAEIS represents a low-carbon, sustainable solution aligned with UN Sustainable Development goals.

Rainwater infiltration theory into unsaturated ground

Infiltration into unsaturated soils is driven (i) by the pressure difference between the stormwater system, and (ii) natural soil suction.

- During storms, water fills the trench and infiltrators, creating a high hydraulic head.
- Fine-grained soils may have soil suctions of -50 kPa, resulting in a pressure differential up to 88 kPa.
- This high pressure differential effectively promotes infiltration into the unsaturated soil void space.
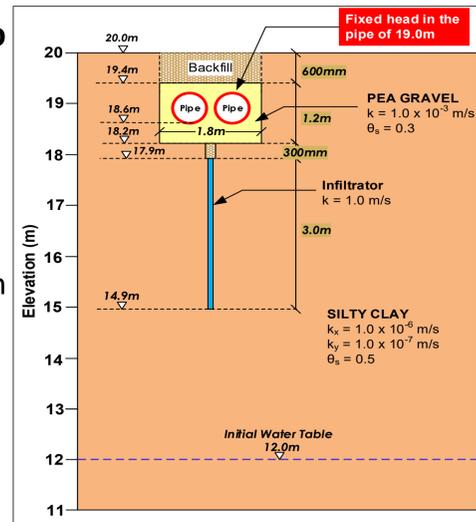
Figure 4. Conceptual model of a single infiltrator with ground properties used in the mathematical modelling.

French & Thomas used SEEP/W (GeoStudio, 2012) to simulate radial infiltration into anisotropic silty clay. Tens of thousands of elements are used to solve flow under steady-state conditions. This enables detailed analysis of infiltration in layered soils. An axisymmetric, steady-state radial flow model was developed to simulate flow and pressure through a typical UK anisotropic silty clay.
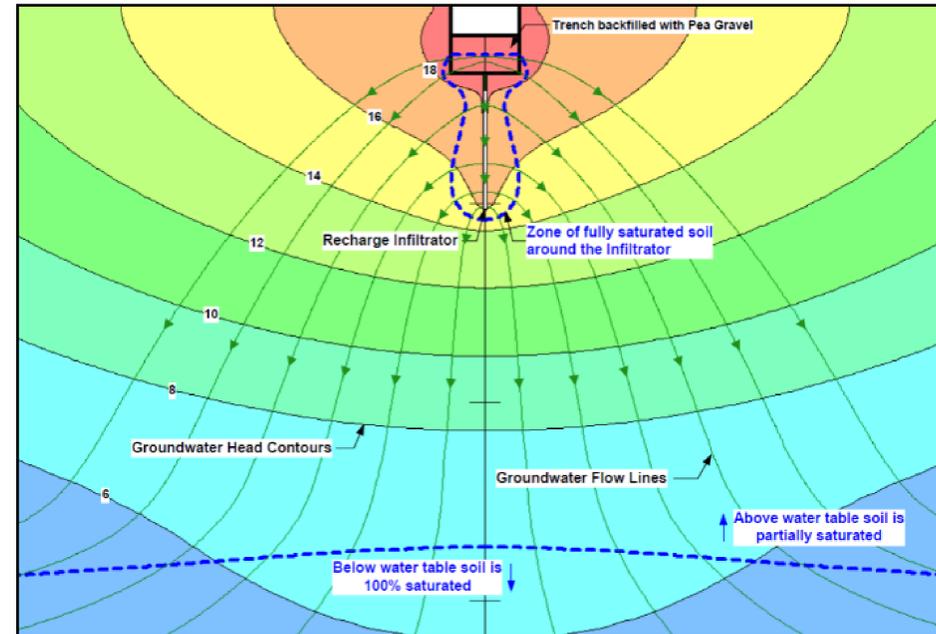
Figure 5. Simulated head contours (18m to 6m) and flow paths (green lines).

The model depicts water flowing from the sump through an infiltrator, driven by a 4.0m head difference (Figure 5). A saturated bulb forms and spreads laterally through permeable layers. Negative suction boosts infiltration. Flow paths illustrate groundwater velocity, controlled by the hydraulic gradient per Darcy's Law. This percolation reduces surface flooding and supports aquifer recharge, enhancing drought resilience.
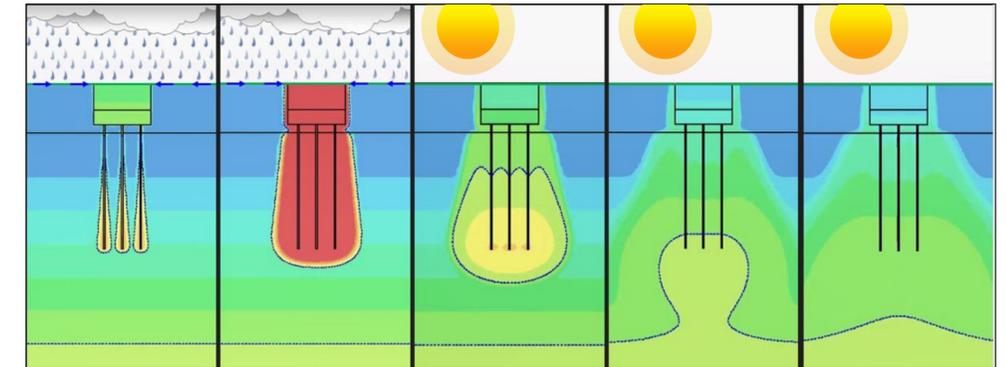
Figure 6. Stages of attenuation and enhanced infiltration during and following a storm event.

Deployed at 500+ UK sites, SAEIS delivers:

- Reduced surface flooding
- Improved infiltration in low-permeability & silty clay soils
- Groundwater recharge
- Runoff control in catchments up to 4 ha
- Integrated storage, passive infiltration, and pollutant treatment
- Low-carbon alternative to conventional attenuation and drainage
- Mitigates flood and drought risk across Europe, including Portugal
- Supports UN Sustainable Development **Goal 6: Ensure access to water and sanitation for all.**

Figure 7. The images depicts a project between Birmingham and Manchester, where a total rate of over 2000 m³/day of infiltration to the ground was achieved from 78 infiltrators.