



HARROW & HILLINGDON GEOLOGICAL SOCIETY

A Local Group of the Geologists' Association

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2024 Geo-futures

A series of talks showcasing advances in the research and practice of geology.

Wednesday 12th June 2024 at 8pm on Zoom

“Working with the local community to better characterise groundwater flow and emergence in the River Terrace Gravels of Staines”

by Dr Jonathan D. Paul (Royal Holloway, University of London)

Abstract: Groundwater behaviour in superficial gravel aquifers is often poorly understood, especially across urban regions where drinking water is sourced from elsewhere. We focus on one such region around Staines, where local River Terrace Gravels form a thin (<10 m) superficial aquifer. Our objective was to explain the unusually broad and long-lived distribution of flooding by investigating local groundwater level fluctuations and flow. Over a period in January 2024, we instigated a targeted citizen science program to leverage local knowledge of floodwater, which was determined to match groundwater chemistry.



We designed geophysical surveys (ground-penetrating radar and seismic refraction) to produce high-resolution water table maps, validated against well measurements. Flow rates and hydraulic conductivity, K , of the gravels were determined both in the field (via pumping and tracer tests) and laboratory, to obviate any scale effects. K depended non-linearly on hydraulic gradient, in conditions approaching turbulent flow. Dramatic, localised fluctuations in groundwater level, combined with the existence of several fast-flow pathways, are explained by the strong heterogeneity of the gravels, as well as their sensitivity to the imposition of sub-surface obstacles such as clay-lined backfilled gravel pits, or deep basements. These manifestations of urbanisation drive observed patterns of groundwater emergence, together with aquifer thickness, rather than changes in river stage or surface elevation alone. Our experience motivates us to suggest that groundwater flooding be considered as significant as fluvial flooding in the production of risk maps by environmental regulatory bodies (e.g. the EA).



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Dr Jonathan Paul is a Senior Lecturer in Earth Science at the Department of Earth Sciences, Royal Holloway, University of London, where he leads the MSc in Engineering Geology and Hydrogeology, and lectures modules in Applied Geophysics, Geodynamics, and Subsurface Hydrology.

His research interests are many and varied and include

- Influence of mantle convection (dynamic topography) on the formation of naturally fractured reservoirs/aquifers
- Development of algorithms for improving the quality of citizen science datasets
- Sustainable cooling of subsurface structures using pumped groundwater/river water and heat exchangers
- The use of porous rock (especially limestones) as a natural filter to generate new sources of freshwater for water-stressed areas
- Development of new sensing technologies and participatory approaches for launching community-led hydrological data collection programmes
- The link between hydrogeology and archaeology/Quaternary geomorphology of the chalk and limestone landscapes of southern England
- The interface between disease risk / epidemiology and climate change