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# Characterising Groundwater-dominated Lowland Catchments - the UK Lowland Catchment Research Programme (LOCAR)

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This paper reports on a major £10million UK initiative to address deficiencies in understanding the hydro-ecological response of groundwater-dominated lowland catchments. We focus here on one of three sets of research basins – the Pang/Lambourn Chalk catchments, tributaries of the river Thames in southern England. The motivation for the research is the need to support integrated management of river systems that have high ecological value and are subject to pressures that include groundwater abstraction for water supply, diffuse pollution, and land use and climate change. We give an overview of the experimental approach and highlight some current research findings.

Despite the importance of the Chalk as a major UK aquifer, knowledge of the subsurface movement of water and solutes is poor. Solute transport in the dual porosity unsaturated zone depends on fracture/matrix interactions that are difficult to observe; current experimental and modelling research supports the predominance of matrix flow and suggests that slow migration of a time-history of decades of nutrient loading is occurring. Groundwater flows are complex; catchments vary seasonally and are ill-defined and Karst features are locally important. Groundwater flow pathways are being investigated using natural and artificial geochemical tracers based on experimental borehole arrays; stream-aquifer interaction research is using a combination of geophysics, borehole array geochemistry and longitudinal profiles of stream flow and solutes. A complex picture is emerging of localised subsurface inflows, linked to structural geological controls and karst features, and significant longitudinal groundwater flow below the river channel. Hyporheic zone research has shown significant areas of

methanogenesis and denitrification – the catchment-scale significance of this remains to be determined. Similarly, analysis of nutrient transformations in riparian wetlands is being linked to analysis of groundwater flowpaths to determine their catchment-scale significance.

Models of surface water quality have been used to interpret catchment-scale response through mixing analyses and longer term nutrient simulation. A new approach has been required to represent unsaturated zone nutrient storage. A conventional distributed groundwater model has been developed outside this research programme to aid the management of riparian ecosystems. The new experimental data has clearly shown that this fails to represent key hydrogeological features. This raises important questions concerning the confidence that can be placed in models as routinely used for decision support and the level of knowledge required for catchment management to be placed on a secure scientific foundation.