2023_02_BGS_Jackson: Chalk stratigraphy and its role in managing groundwater abstractions in Chalk river catchments

Supervisors: Dr Christopher Jackson (mailto:crja@bgs.ac.uk); Prof Adrian Butler (Civil and Environmental Engineering, ICL); Dr John Bloomfield (BGS)

Department: British Geological Survey

Chalk rivers are a unique and internationally important freshwater habitat. There are only about 200 chalk streams in the world and most are in southern England. The chalk aquifer sustains their flow, importantly during dry periods, but is also crucially important for public water supply. The summer 2022 heat wave and projections of more severe droughts under climate change have highlighted the tensions between providing water for people and for the environment. The environmental regulator, working with water companies, has sought to minimise the impacts of groundwater abstraction on river baseflow. However, balancing water supply to the region's large population with maintaining and enhancing healthy aquatic ecosystems is an ongoing process, which needs to be underpinned by sound science. To improve the management of the resource further, better understanding is needed about when and where groundwater abstraction affects river baseflow. This will become more important as the UK's weather becomes more seasonal as climate changes, and droughts become more intense [1].

The variation of abstraction impacts in time and space is controlled by surface water catchment characteristics, but also by the structure and properties of the Chalk aquifer [2]. In the River Colne catchment groundwater level measurements at different depths indicate significant vertical hydraulic gradients. This may be due to low hydraulic conductivity horizons within the Chalk, but because such data are rare, understanding is limited. The hypothesis is that vertical heterogeneity significantly controls groundwater levels along a chalk hillslope and with depth. If low hydraulic conductivity horizons exist above the level from which groundwater is pumped, then could the impacts on river baseflow be spread more widely over space and time during droughts than is currently thought?

The principal method used to test this hypothesis will be numerical groundwater modelling of the River Colne catchment, at a range of scales. The research will investigate how subsurface heterogeneity controls behaviour, but also address limitations and uncertainty in models conventionally applied. The project will use of a suite of modelling tools previously developed to investigate the Chalk aquifer [e.g. 3-5], underpinned by a range of other activities, including: data-based analyses, geological modelling, hydrogeological conceptualisation, and field work. Field work could include geological interpretation of exposures, the installation of sensors, river flow gauging, and the running of pumping tests. The project is in collaboration with Affinity Water and will make use of their data and knowledge, in addition to a range of other available hydrogeological datasets.

1. Met Office (2019) UKCP18 Science Overview Executive Summary.
2. https://doi.org/10.1016/j.jhydrol.2006.04.036
3. https://doi.org/10.1016/j.jhydrol.2008.11.043
4. https://doi.org/10.5194/hess-20-143-2016
5. https://doi.org/10.1016/j.envsoft.2019.03.018

For more information on how to apply to us please visit: https://www.imperial.ac.uk/grantham/education