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Innovative approaches to water resources management during flood and drought periods using semi-natural processes

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The Chalk is considered an important aquifer in the Southeast of the UK as it supports flows in ecologically sensitive Chalk streams, as well as significant groundwater abstractions for public water supply purposes. Based on the Water Framework Directive (EU directive) objectives, all rivers need to be in good ecological status or support good ecological potential by 2027. The environmental regulatory body (Environment Agency) have designated the area located Northwest of London as over-licensed and over-abstracted in terms of groundwater availability from the Chalk aquifer. As a result of this, a long-term management strategy has been proposed, allowing for significant groundwater abstraction reductions for implementation between now and 2050.

Whilst under a range of river flow conditions, the proposed abstraction reductions are expected to allow greater baseflow to enter the rivers, it is possible that under higher flow conditions there will be an elevated risk of flooding, especially in downstream locations. An alternative approach is presented in this case study near London, aiming to utilise the well-established river-aquifer interactions during a range of hydrological conditions to balance the effects of winter floods and low flows during droughts.

The proposal for this case study is in an unconfined Chalk aquifer setting, supporting a number of groundwater abstractions, as well as providing baseflow to a river which is also supported by an effluent discharge. A nearby surface water reservoir located on top of clay deposits, is also available but currently unused for public water supply. Groundwater abstractions in the area are known to be supported by river flows during drought conditions, via a leaky river bed. Based on river bed leakage assessments undertaken under different hydrological conditions, it was found that a certain proportion of the total river flow can recharge the unconfined chalk aquifer via the leaky river bed in a 2-3 km stretch of river.

Therefore, the idea of capturing high river flows above a certain trigger at a downstream location through the urban areas where the river is in a concrete channel and refilling the currently disused reservoir storage, has been explored. Instead of then having to treat this water as surface water before using it for public water supply, by releasing this water back into the river at the head of the catchment during times of low flows it could support both river flows and also the output of the groundwater sources via artificial leakage. This unconventional type of Managed Aquifer Recharge has been tested under various hydrological conditions and could also prove a cost-effective

scheme due to the lack of additional treatment needed for the surface-derived water.

This study demonstrates that enhanced understanding of the natural processes in a river catchment can provide alternative ways of managing the effects arising from both flood and drought events, whilst creating a resilient water supply in a changing climate.