Managed aquifer recharge (MAR) to enhance groundwater resources for irrigation in a coastal agricultural catchment in the Crag aquifer, Suffolk

Research Summary 1: MAR concept, construction and operation

Kevin Hiscock[1], Natalia Balashova[1], Paul Bradford[2], John Patrick[2], & Matt Hullis[3]

[1]School of Environmental Sciences, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ (email k.hiscock@uea.ac.uk)
[2]Felixstowe Hydrocycle Ltd, Unit 3b, Tuddenham Road Business Centre, Tuddenham Road, Grange Farm, Ipswich, IP4 3QN
[3]Growth, Highways and Infrastructure, Suffolk County Council, Endeavour House, Russell Road, Ipswich, IP1 2BX

Background

Water resources in East Anglia are under pressure due to population growth, demand for irrigated crops and climate change. It is predicted that the dry year annual average spray irrigation demand will increase by 59-220 x 10^3 m^3/day by 2050 from a baseline of 190 x 10^3 m^3/day[1]. Matching growth with enhanced environmental protection requires innovative solutions. Managed aquifer recharge (MAR) offers the possibility of storing excess surface winter high flows underground for later abstraction during periods of peak demand. The Crag aquifer at Bucklesham in Suffolk (**Fig. 1**) was selected for a demonstration MAR scheme (**Figs. 1-3**) with the purpose of supplying additional irrigation water during periods of high summer demand. The outputs of the study enable the scheme to sufficiently inform a roadmap for similar MAR initiatives in the UK.

1. Water Resources East (2022). *Draft regional water resources plan for eastern England*. Water Resources East (WRE) Ltd, Norwich, 91 pp.

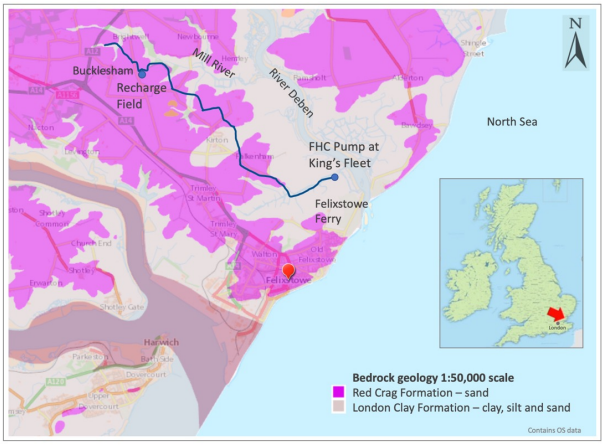

Fig. 1 Location map showing surface geology and the King's Fleet pumping station (FHC Pump) at Felixstowe Ferry and the MAR site at Bucklesham. The blue line shows the dual-pipeline to transfer water inland to farm reservoirs and the MAR site.

Methods of construction and operation

The FHC distribution system relies on two high-volume, low-head abstraction pumps located at King's Fleet at Felixstowe Ferry before it is otherwise discharged to the River Deben via an Internal Drainage Board pump. Each pump delivers 30 L s^{-1} and can operate individually or together. Water is transferred inland via two, 14-km length, 200 mm-diameter pipelines to supply surface storage irrigation reservoirs and the MAR scheme. The supply to the MAR site is discharged into a recharge header lagoon from which it drains to a buried pipe array. In the header lagoon (dimensions of 10 × 5 × 2.8 m), the water level is kept at 0.5 m below ground level (bgl) during operation (**Fig. 2**).

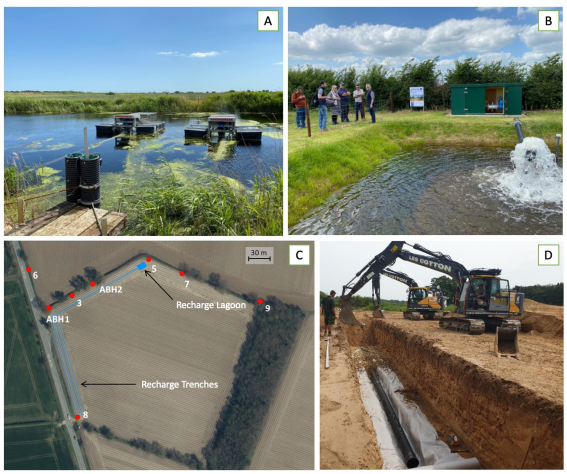

Fig. 2 A: Surface water abstraction location in the King's Fleet showing the eel-friendly, Riverscreen source-water pumps. B: Recharge lagoon at the Bucklesham MAR site in operation. C: Abstraction borehole (ABH1, ABH2) and observation borehole location plan, including the position of the recharge lagoon and layout of infiltration trenches. D: Recharge distribution trench under construction.

Type of recharge and recovery

Recharge at the Bucklesham MAR site is induced through the recharge lagoon connected to an array of backfilled infiltration trenches positioned in the Crag unsaturated zone, in which pipes are installed. The infiltration array (recharge field) comprises a main 225-mm diameter micro-perforated PVC pipe (laid in a 700-mm width trench) running adjacent to the northwest field boundary (approx. 10 m distant from the King's Fleet pipeline), which then splits into four, 125-mm diameter perforated pipes laid in 300-mm width trenches (**Fig. 3**). All the pipes are installed at a depth of around 2.7 m and are installed in a bed of gravel, with up to 0.7 m of gravel over the top.

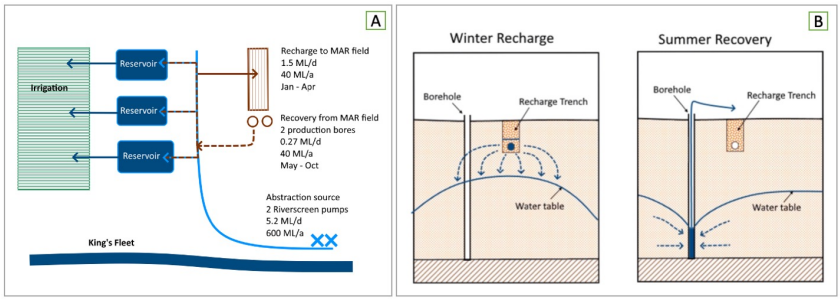

Fig. 3 A: Diagram of the design components of the MAR scheme, including abstraction of surface water from the King's Fleet and pumping of water 14 km inland to Bucklesham where the water is recharged to covered infiltration trenches for later abstraction. B: Concept of the MAR scheme showing winter recharge and summer recovery phases.

Summary

The outputs of the study enabled the scheme to sufficiently inform a roadmap for similar MAR initiatives in the UK, particularly in those aquifers with properties that enable the recharge and recovery of fresh groundwater. If implemented, these initiatives would contribute towards a range of goals set in the UK's 25 Year Environment Plan, such as ensuring interruptions to water supplies are minimised during prolonged dry weather and drought.

Further details

More information about the project is available at https://www.fresh4cs.eu. For specific enquires, contact Prof. Kevin Hiscock (email: k.hiscock@uea.ac.uk).