Ecohydrological impact assessment, Greywell Fen, Hampshire

Longevity of calcareous fen communities under adverse hydro-environmental supporting conditions

Rob Low (Rigare Ltd), Sue Morris, Adrian Hutchings & Helen Harfoot (Jacobs), Emma Goddard (South East Water)

Background

Jacobs and Rigare Ltd were commissioned by South East Water, under the National Environment Programme, to investigate whether their groundwater abstraction at Greywell is having an adverse impact on Greywell Fen SSSI, and if so to assess the options available to reduce the impact.

Study Area

Greywell Fen (Odiham, Hampshire) is an elongate valley bottom fen which supports vegetation communities dependent on base-rich groundwater discharge from the underlying Chalk aquifer, most notably NVC M9b *Carex diandra-Calliergon giganteum*. The site has a long history of nature conservation having been included in Rothschild's list of the 283 most important conservation sites in the UK in 1913.

The fen is split into northern and southern areas by higher ground on which is located South East Water's Greywell pumping station which has abstracted Chalk groundwater at a rate of 6-7 Ml/d since the early 1900s.

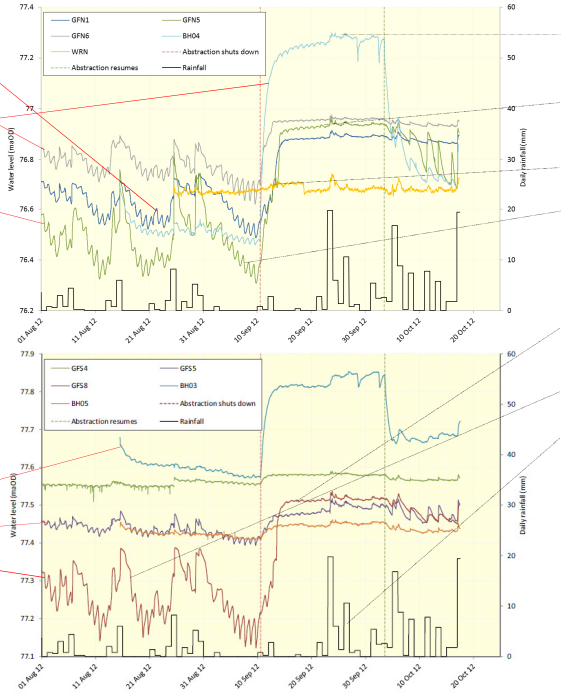
Dense woodland has recently been removed from an extensive area of the southern fen by Hampshire Wildlife Trust; this has revealed some areas of high quality rheo-topgenous, quaking conditions (see photo below).

Groundwater recovery test, summer 2012

To assess the impact of the groundwater abstraction on the hydrological conditions within the fen a 20-day shut-down test was undertaken. Before the test the following monitoring equipment was installed:

- 14 shallow (1 m deep) dipwells to monitor the fen water table, 9 of which were monitored with pressure transducers (Solinst Leveloggers, 2 m range) at 15 minute intervals.
- 2 stilling wells in the adjacent River Whitewater, monitored with Leveloggers.
- 3 Leveloggers in existing deeper (4-15 m) boreholes.
- A raingauge within the grounds of the pumping station, recording at 15 minute intervals.

Left to right: Borehole 4 extended with re-enforced PVC tubing to contain artesian groundwater levels; a 'fixed and floating' dipwell pair in a quaking area of the fen, designed to detect the vertical movement of any floating surface raft within the fen.



Left to right: Recently de-wooded, rheo-topogenous, quaking area; installation of dipwell in quaking area; a common Darter (*Sympetrum striolatum*) carries out a routine inspection of a water level dipper.

Conclusions

It is likely that under non-pumping conditions, near- or above-surface water levels could be maintained, certainly for the larger part of the year and perhaps continuously over large areas of the fen. These revised conditions are recognised as the hydro-environmental supporting conditions for M9b and M22 vegetation communities. Options to reduce or cease groundwater abstraction will be assessed by South East Water.

M9b *Carex diandra-Calliergon giganteum* vegetation community has persisted at the site for over 100 years, despite apparently highly sub-optimal hydrological conditions, since groundwater abstraction at Greywell commenced. This has implications for the concept of hydro-environmental supporting conditions, suggesting at least that the M9b community can tolerate a wide range of water level conditions over the very long-term.

Results

Recovery of Chalk Gravel piezometric level in BH 4 to artesian levels (+0.4 magl), suggesting local confinement beneath poorly permeable fen sediments.

In some cases fen water table continues to rise for 11 days before first rainfall, demonstrating continued re-saturation of the fen basin.

No detectable change in river stage level after shut-down of abstraction.

Diurnal variation in water levels; real variation or measurement artefact?

Fortunate coincidence of 11 day mainly dry period with shut-down test, allowing more straightforward interpretation of results.

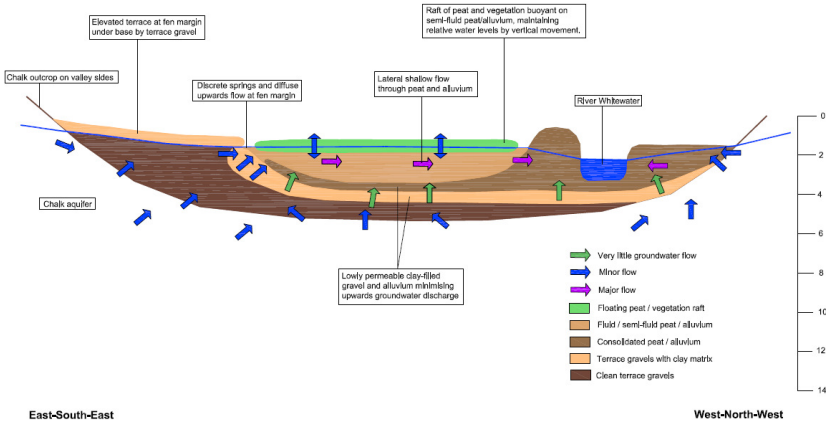
Rate of water level recovery alters when fen water table rises above the ground surface and specific yield tends to 100%.

Verification of monitoring system; demonstrable sensitivity of fen water table to rainfall.

Significant rainfall during the latter half of the test, causing groundwater levels universally to rise and complicating interpretation of the drawdown response on resumption of pumping.

Recovery (m) during 2012 test:

Southern Fen		Northern Fen	
BH 4	0.785	BH 3	0.240
GFN 1	0.365	GFS 3	0.030
GFN 5	0.582	GFS 4	0.025
GFN 6	0.287	GFS 5	0.075
		GFS 8	0.343



Schematic transverse cross-section showing the conceptual understanding of the hydrological functioning of the fen. This conforms to a classic model of groundwater-fed fen hydrology, with poorly permeable alluvium and peat fen infill overlying the aquifer. Groundwater discharge tends to occur at the margin of the poorly permeable fill, with rheo-topogenous conditionswithin the fen between its margin and a central water course.

Corresponding author: Rob Low (Rigare Ltd); rob@rigare.co.uk, 00 44 7866 552926