Throwley & Kettle Hill
groundwater sources in Area of Natural Beauty

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Throwley and Kettle Hill are two separate groundwater sources (UGSs) located in an Area of Outstanding Natural Beauty within the Chalk of the North Downs in north Kent. At Throwley UGS a raw water supply of up to 10 Ml/d is abstracted from three abstraction boreholes constructed in the 1960s and 1970s. The supply is normally transferred through a raw water main to Eastling water treatment works (WTW), although a second raw water main provides a connection to Selling WTW. The Kettle Hill UGS consists of a single abstraction borehole and provides a 5 Ml/d raw water supply to the Eastling WTW only.

Throwley & Kettle Hill: Pump Installation *photo 4Delivery Ltd*

Water quality issues
In 2000 and 2001, the turbidity of the pumped raw water at the Throwley and Kettle Hill sources deteriorated markedly resulting in more than a 50% reduction in the deployable output of both sources that also coincided with an increase in demand. Prior to 2000, the sites were managed by curtailing abstraction during periods of high turbidity, but after 2000 this mode of operation was no longer viable.

Process improvements
Southern Water included the Throwley and Kettle Hill sources in their AMP4 improvement scheme and issued a water quality brief to their contractor 4Delivery (4D) to provide a design to ensure the abstracted water from the Throwley and Kettle Hill UGSs do not exceed turbidity levels of 1 NTU.

Review of treatment options
4D reviewed three main options. An ***"In-hole solution"*** was considered that entailed sealing off sections of the chalk boreholes yielding high turbidity groundwater. However, packer testing showed that this option was not feasible.

A ***Filtration Plant*** was seen as the most robust solution. A simple pressure sand filter system was considered the most appropriate filter solution, but the visual intrusion, noise and vehicle movements to support the plant in an AoNB were strongly opposed by a powerful well connected and highly influential environmental lobby. Waste water management, regular maintenance and lack of winter access and significant capital and operational costs were also unfavourable considerations.

Finally a ***Hydrogeological Solution*** was considered that utilised MWH's recent ground breaking research into the origin and mobilisation of turbidity (Anderson et al 2005) that identified the natural filtration capacity of Chalk for the first time. The feasibility of this option was confirmed by a specifically targeted investigation of source pumping tests, physical chemistry measurements, turbidity monitoring and aquifer hydraulics, The hydrogeological solution entailed managing the source pumping so that turbidity events are avoided.

High turbidity water that follows pump switch-on is diverted to a full flow capacity soakaway until the sediment causing the turbidity is immobilised by the natural filtration of the chalk, at which point the pumped water is automatically diverted into supply. This option has

Kettle Hill completed site *photo 4Delivery Ltd*

significant advantages over the filtration solution as a) visual impact is negligible. b) there is no waste (the soakaway discharges recharge back into the aquifer), c) maintenance is minimal and d) both capital and operational costs are significantly reduced.

Following completion of the pumping trials the data was presented to Southern Water and a joint agreement was reached on the implementation of a **Hydrogeological source management solution.**

Design

The detailed design required to implement the hydrogeological source management solution involved the following key activities:

a) The installation of below ground soakaways on adjacent farm land capable of sustaining 10Ml/d at Throwley and 5 Ml/d at Kettle Hill for the duration of an anticipated turbidity event. The design required the permeable section to be of sufficient distance from the point of abstraction to avoid circulation of turbid water and minimise impact to farm land and usage.

b) A below ground valve chamber automatically diverts flows from the supply main to the soakaway arrangement at times of high turbidity.

c) New borehole pumps were also installed and particular attention was paid to duty selection in order to maximise yield under various turbidity conditions based on test pumping data analysis.

d) a new power control and instrumentation system was also required, including the implementation of more efficient variable speed drives to manage the different head characteristics when diverting from the soakaway to supply. More importantly this system would assist in mitigating turbidity events as the site yield is varied. The site is remotely monitored via telemetry with the capability of changing individual boreholes on demand.

Final solution

Commissioning at both sites is now complete and performance testing is ongoing. Both the Throwley and Kettle Hill sites are operating according to the design, and whereas turbidity is within the design limits the source yields have been improved. As a result the solutions have proved to be very well received on all sides. The additional yield from these sites (not seen for some years) alongside the remote operation capability of the sources are very welcome improvements for Southern Water's operations department. Equally from an environmental perspective, the benefits of a predominantly below ground solution with minimal visual impact, insignificant noise, and minimal site operation and maintenance visits has been appreciated by the local community who were very supportive of the final solution. ■

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