Trosley WTW & Borough Green WTW

£7 million upgrade to improve quality and meet increased demand

by
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South East Water (SEW) has recently invested £7 million to link and replace the ground water-fed Water Treatment Works (WTW) at Trosley (near Wrotham Heath, Kent) and Borough Green, Kent. The development is driven by a requirement to remove a water quality issue within the distribution system and provide water treatment facilities capable of meeting projected future water demands.

Aerator and access platform *Photograph by Ady Kerry, courtesy of South East Water*

Trosley WTW and Borough Green WTW previously fed treated water into the same distribution area. At one point in the system, the two water streams met and formed a section which experienced low turnover of flow. In the event of this column of water becoming motive again when customer demand became higher, discoloration occurred due to disturbance of settled particles. To remove this problem from the system, SEW devised a plan to stop Borough Green pumping directly into distribution and instead pump its raw borehole water 3.8km, via a new 250mm main, to Trosley WTW to be treated and deployed.

The original works

Borehole water abstracted at Borough Green was treated via an onsite GAC unit and disinfected by chlorine gas injection then fed into supply under the head of the borehole pump. These two treatment systems were removed as part of the scheme. The existing Trosley WTW was fed by seven boreholes which exhibit a variable range of iron (100µg/l – 4,200µg/l Fe) and manganese (15µg/l – 220µg/l Mn) concentrations. Treatment included two streams each comprising aeration, chlorine oxidation and 3 No. rapid gravity filters (RGFs). The filtered water then entered a chlorine contact tank which fed the high lift pumps. The output of the original works was limited to 16Ml/d.

The new works

A new treatment stream at Trosley WTW was required to treat a maximum of 24Ml/d from a blend of 8 No. boreholes including the source at Borough Green. The original outline design at contract tender stage called for the construction of aerators and a two cell detention tank for iron flocculation, followed by relift pumping and sand filtration within pressure filters. Disinfection was to occur in a final water two cell chlorine contact tank. The existing high lift pumping station would feed from this tank. An existing disused pump house, originally built to house beam engines in 1928 was to be used as the new filter house.

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Construction site *Photograph by Ady Kerry, courtesy of South East Water*

Works completion *Photograph by Ady Kerry, courtesy of South East Water*

Enpure Limited offered a proposal at tender stage that would significantly reduce operating costs by designing a process stream that would allow water to gravitate from the aeration stage to the existing high lift pump suction point. Relift pumping would not be required, therefore energy costs would be lowered and intermediate pump maintenance removed. The potential for relift pumps to breakup the newly formed floc would also be removed and an improved treatment process was envisaged. On consideration of this tender submission and other compliant bids, the NEC3, design and build contract was awarded to Enpure.

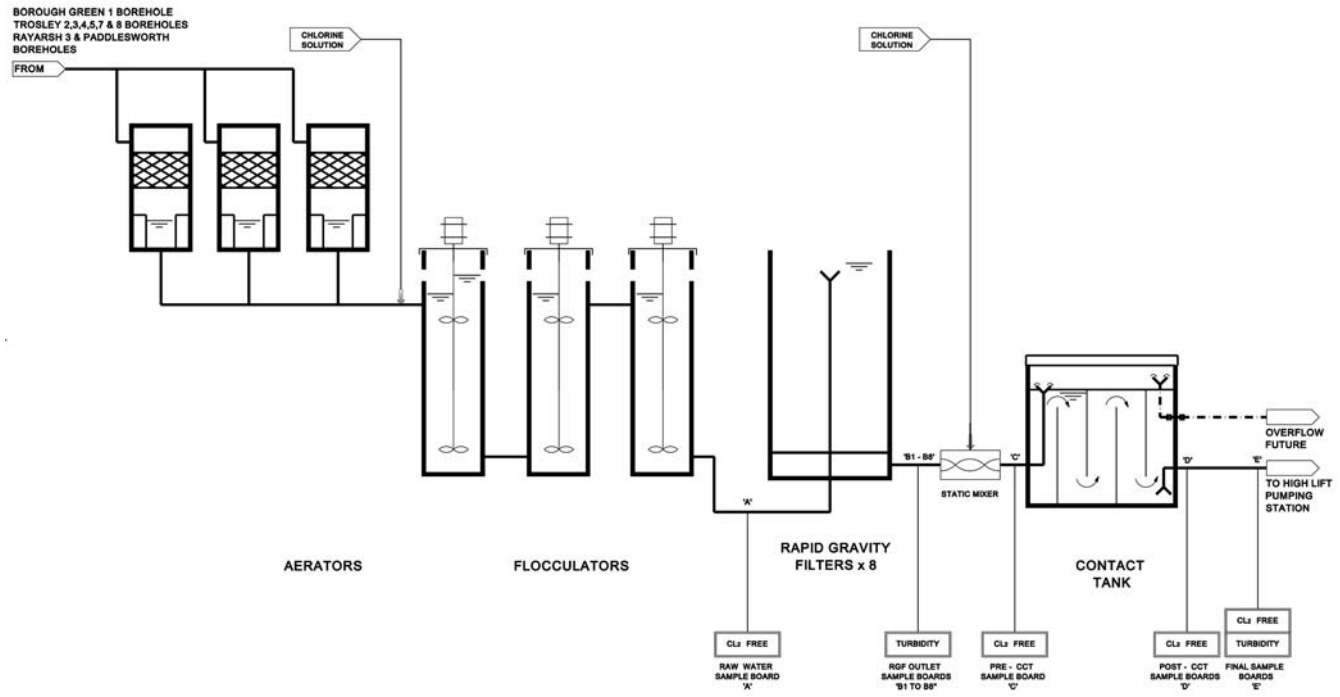
Processes

The new Trosley WTW stream incorporates the following unit processes. Initial carbon dioxide stripping, iron and manganese oxidation and flocculation occurs in 3 No. packed towers with forced aeration (running in a duty, duty, standby configuration), chlorine injection, and 3 No. flocculation towers running in series. This part of the WTW has been constructed outside, adjacent to the main building. Flocculated water feeds into a 700mm main which runs below a reinforced concrete mezzanine floor built within the disused pump house.

Associated Rapid Gravity Filter pipework under construction *Photograph by Ady Kerry, courtesy of South East Water*

Rapid Gravity Filters under construction *Photograph by Ady Kerry, courtesy of South East Water*

Completed Rapid Gravity Filters *Photograph by Ady Kerry, courtesy of South East Water*



Dosing & sampling overview *Courtesy of South East Water*

Each of the 8 No. 4.3m diameter rapid gravity filters (RGFs) are then fed by vertical pipes up to their individual inlet bell-mouth. The cylindrical RGFs have been constructed from stainless steel panels bolted together, to allow them to be brought into the building. Within the filter, water passes through a dual filtration media of anthracite (600mm) and 14/25 grade sand (600mm). Additional catalytic oxidation of manganese is to occur within the bed once manganese dioxide levels have matured. The header and lateral underdrain system from each filter feeds into a common 700mm filtered water main. Filtered water quality and filter state is monitored at each individual filter in terms of head loss across the filter bed, filter level, outlet turbidity and outlet flow. Iron and manganese levels at this point in the process have been reduced to less than 25µg/l and 5µg/l respectively.

A secondary chlorine dose is injected for final and residual disinfection; a static mixer ensures good mixing. Treated water is then split between 2 No. chlorine contact cells, providing 30 minutes retention at full flow. Plug flow is aided by curtain baffles. High level weirs within each tank fill 2 No. clean washwater tanks, so as to not vary the level within the contact tank, nor the contact time, during a filter backwash. The existing highlift pumping system then feeds from the low level outlets of the two tanks.

Dirty backwash water and sample water is collected within a balance tank before being dosed with polymer and fed through a flocculation unit and lamella separator. The separated sludge is thickened and tankered offsite. The supernatant produced is fed back into the process (post-aeration) at approximately 10l/s.

Contact and backwash tanks during construction *Photograph by Ady Kerry, courtesy of South East Water*

Contact and backwash tanks during construction *Photograph by Ady Kerry, courtesy of South East Water*

Water from the new treatment stream was pumped into supply in December 2009. Final water quality is excellent, rarely observing turbidity values above 0.03 NTU, iron values above 20µg/l Fe and manganese values above 2µg/l Mn.

The Raw Water Transfer Main

Alongside the construction at Trosley, the company carried out a second phase of work to build a 3.8 km long, 250mm MOpvc (10") pipeline to transfer raw water from the Borough Green borehole source.

The borehole at Borough Green is capable of supplying up to 2.5Ml/d, however under normal operational conditions the transfer on average will deliver 1.3Ml/d. The works timing was to ensure the full benefit of the investment was available to meet peak demand for summer 2010.

Significant time and effort had been expended on identifying a suitable route to avoid impacting on highways wherever possible. Once the route had been identified the necessary ecological surveys were undertaken which led to approximately 1.9 km of Great Crested Newt fencing being installed and the construction of two dormice bridges through a coppice area. In addition a watching brief was employed along the total pipeline route by a qualified ecologist.

The pipeline route meant negotiating three major highway corridors that intersect close to Borough Green; the M26, A20 and M20. A significant proportion of the pipeline was laid parallel to the M26 motorway in private land. The crossing under the M26 utilises an existing road underpass. At Junction 2a where the M26 meets the A20, traffic management was installed to enable each of the four lanes of the A20 to be open cut separately to minimise disruption to traffic.

To negotiate the M20 motorway, SEW sort the agreement of the Highway Agency to directionally drill under the motorway. Permission was only obtained after the necessary geotechnical surveys had been completed and a design had been approved. The M20 motorway was successfully directionally drilled in January 2010 despite the heavy snow which hit Kent during the winter.

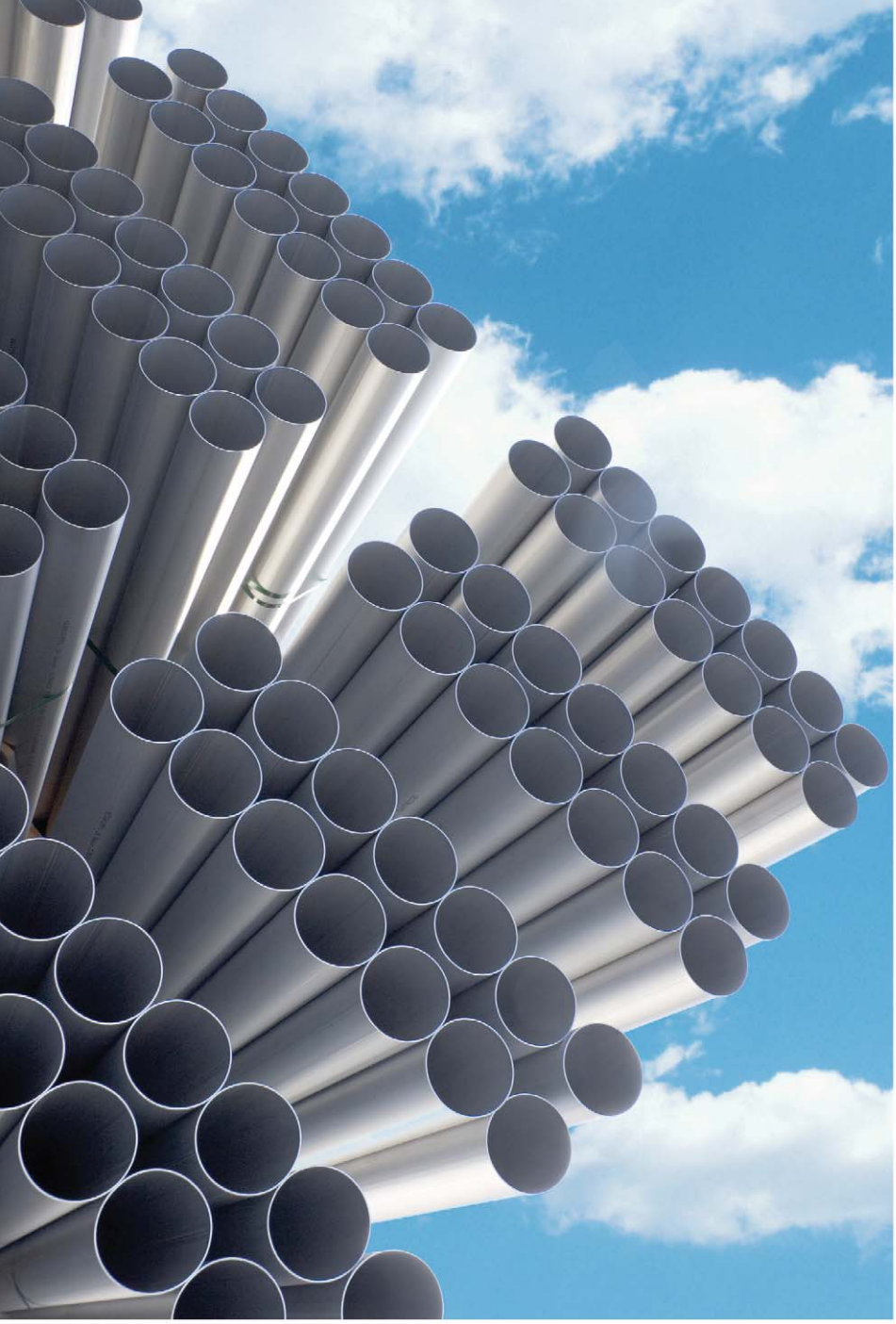
There was one road closure on the scheme, this was Ford Lane Trosley, the approach road to Trosley WTW. At this particular location 500m of the highway is restricted in width, so closing the road was necessary to provide a safe environment for the operatives and vehicle traffic. With agreement of Kent Highway Services a suitable road diversion was put in place.

The pipeline work was carried out by our period contractor Clancy Docwra and the main was successfully commissioned in February 2010.

Note: ***The Editor & Publishers thank the Project Engineers, Daniel Warnock, Rea Taylor, and Brendan MacLellan, with South East Water, and Craig Ferrier of Enpure Ltd, for providing the above article for publication.***■

Directional drilling under M20 during the snow

Photograph by Ady Kerry, courtesy of South East Water



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