Upton Scudamore WTW

a £1.4m cryptosporidium treatment scheme to safeguard drinking water quality

by Hugh Thomas MSc, CSci, FCIWEM

Upton Scudamore Water Treatment Works (WTW) is a groundwater treatment works located near Warminster in Wiltshire. The works has a maximum daily output of 15Ml/d and the water can supply over 100,000 customers in Trowbridge, Westbury, Warminster and surrounding areas. Upton Scudamore WTW is supplied with raw water from three distinct sources and the treatment process is tailored to suit. Upton Scudamore springs (4.5Ml/d) has chlorine disinfection only; Divers Bridge springs (4.5Ml/d) also has chlorine disinfection only, and the Upton Scudamore boreholes (6Ml/d) utilise iron oxidation, then filtration and chlorine disinfection

Upton Scudamore WTW *Courtesy of Wessex Water*

Scheme overview

Treatment of the Divers Bridge source with ultraviolet light (UV) for cryptosporidium inactivation was supported by the Drinking Water Inspectorate (DWI) and a scheme was included in Wessex Water's AMP 5 business plan. This was agreed with Ofwat and the project is being delivered as a named capital maintenance scheme.

The scope of the project at Upton Scudamore WTW includes:

- Treatment of Divers Bridge spring raw water source for cryptosporidium inactivation.
- Review of the disinfection process to ensure compliance with company policy.
- Refurbishment or replacement of life expired plant & equipment.

Cryptosporidium inactivation

Spring water collection systems are relatively close to ground level and as such are sometimes vulnerable to surface water intrusion during heavy rainfall. The raw water quality is continuously monitored and not passed forward for treatment if it falls outside specification.

Divers Bridge spring source has been assessed and is considered to be at risk of contamination by cryptosporidium (a chlorine resistant micro-organism). For groundwater sources deemed to be at risk, Wessex Water employ strict operating rules to prevent poor quality water entering the treatment process. This reduces the availability of the source and can impact on the supply balance in the area. When cryptosporidium treatment is installed, the availability of the spring water will be increased.

The DWI has recently revised the wording of the Water Supply (Water Quality) Regulations to accommodate the use of UV for cryptosporidium treatment. Wessex Water has identified UV treatment to be most appropriate for inactivation of cryptosporidium at groundwater treatment works.

The decision was taken early on in the project to treat both spring sources (at Divers Bridge and Upton Scudamore) with the new UV plant. The proposed location of the UV plant at Upton Scudamore was hydraulically favourable for treating the combined flow from the two sources in an existing rising main. This provides additional treatment security for Upton Scudamore springs and reduces the chlorine contact time required to meet disinfection standards.

UV treatment plant

Wessex Water has 6 (No.) WTW's highlighted for installation of UV treatment for cryptosporidium inactivation. At the start of AMP5 a tendering process was conducted to select a framework supplier of the UV treatment process. This procurement process was employed in order to:

- Compare the UV systems in terms of the whole life costs.
- Ensure competitive prices across a series of projects and secure savings on the basis of a programme of work for suppliers.
- Reduce design time – standard design for UV treatment building developed for first plant and transferred to later sites.
- Familiarity of equipment for operational & maintenance staff.
- Commonality of spares.

All systems required third party validation to confirm the application of the specified UV dose for cryptosporidium inactivation. The framework contract for supply of the UV equipment was awarded to Trojan UV Technologies.

During the design of the UV treatment system and building, care was taken to consider operation and maintenance of the equipment. Lessons learnt from an existing UV system were incorporated such as height of UV reactors, pre-screening, sampling, condensation drainage and operating philosophy.

Chlorine disinfection

The Wessex Water disinfection policy was updated in 2010 to incorporate the use of UV treatment as a contribution to the overall disinfection strategy of a WTW. A thorough review of the disinfection process was undertaken and the benefit of applying UV was taken into account.

The disinfection requirements for a particular source of water is defined following a detailed review of historical water quality and a risk assessment of the catchment from which the water is taken. Water taken from a well protected catchment with very low concentrations of micro-organisms requires a less intensive disinfection process.

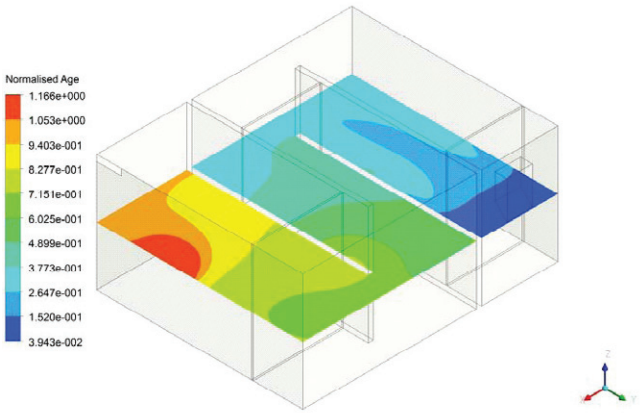
The existing site combined all three sources of water in a single contact tank which also acted as a balancing tank for pumping the water up to the service reservoir for supply. In order to ensure the site met the disinfection policy, it was agreed that a dedicated contact tank was required for the spring water.

The option to construct a new contact tank and balancing tank was evaluated but would have required a very large capital investment and there was no ideally suited location due to site constraints. It was decided to sub-divide the existing tank into two compartments (one for chlorine contact, one for flow balancing) and employ computational fluid dynamics (CFD) modelling to ensure the disinfection contact time was achieved under all conditions.

Due to the internal geometry of the existing tank, the CFD modelling highlighted some 'streaming' within the tank at high flow conditions. In order to meet the contact time required a number of solutions were modelled before deciding to provide a perforated baffle at the inlet to each channel. The new internal arrangement and the predicted effect on the flow path is shown in the diagram on the next page.

Project planning

During the design phase, a review of all potential third party issues was undertaken by Wessex Engineering and Construction Services (WECS). This included environmental constraints (archaeology, ecology, flooding etc.), planning authority and environment



CFD model showing optimised flow conditions using perforated baffles Courtesy of MMI Engineering Ltd.

agency requirements. Detailed surveys revealed no protected sites or species in the area of the works although there are trees that require protection from damage during construction. A public right of way has been diverted for the duration of the works.

Planning permission was required for the development and this was gained in January 2011 after an application was made by WECS supported by drawings produced by design consultants Grontmij. The planning application included a landscaping plan identifying planting proposals and these for conditions of the planning permission.

During the modifications to the contact tank the works output has been significantly reduced. This meant that the contact tank modifications had to be undertaken in winter and then returned to service prior to the peak summer demand period.

Construction

The scheme required isolation of the existing balancing tank so that it could be modified to create a separate contact and balancing tank. In order to isolate the tank, the pumping station was modified to provide variable speed pumps to maintain a reduced site output during the tank modifications. This was undertaken in late 2010.

Construction of the contact tank modifications started in January 2011. A new division wall was cast within the existing tank to create two compartments – this necessitated the use of small (1m x 1m) shuttering sections to be lifted through the access man-ways and the concrete was pumped through a series of cores drilled through the existing tank roof slab. The perforated baffles, which had been identified by the CFD modelling as required for good flow conditions, were constructed in sections using 3mm stainless steel plate *(see photograph on right)*.

The internal surfaces of the tank were repaired as required and sealed with a DWI approved waterproof coating (Thoroseal FX100) to ensure a long asset life. The opportunity was also taken to improve the access and security facilities. The modifications were completed in early May 2011 to meet the summer high demand period.

The UV treatment building was sited to minimise diversions of the many cross site services, including a number of large diameter treated water mains. The existing combined spring water rising main has been intercepted to feed the new UV plant. The combined flow from the two spring sources receives a validated UV dose though a duty/standby reactor system before being transferred to the modified and refurbished contact tank. Construction of the UV building commenced in January 2011 and the civil construction phase was completed in May 2011. At the time of writing, the M&E installation work is underway and it is planned that the UV treatment will be operating by July 2011.

Project delivery team

Wessex Water's AMP 5 capital programme is being managed by its in-house business Wessex Engineering and Construction Services, which is delivering the programme using six parallel work-streams, each incorporating a design consultant, civil contractor and M&E contractor.

Upton Scudamore WTW Project Delivery Team	
Detailed design consultants	Grontmij Engineering Consultants
CFD modelling	MMI Engineering Ltd
Civil engineering contractor	Wessex Engineering & Construction Services (WECS)
M&E Contractor	Trant Construction Ltd
Supply of UV equipment	Trojan UV Technologies

Conclusion

The close working relationships encouraged through this partnering approach have allowed WECS to deliver this scheme according to their four key principles of safety, quality, time and cost. The modification and re-use of the existing tank negated the need for a new contact tank saving Wessex Water a significant capital investment.

The editor and publishers wish to thank Hugh Thomas, Water Treatment Technical Manager with Wessex Engineering & Construction Services (part of Wessex Water), for preparing the above article for publication.

One of the perforated plate baffles complete with integral door to allow future cleaning and maintenance of the tank - Courtesy of Wessex Water