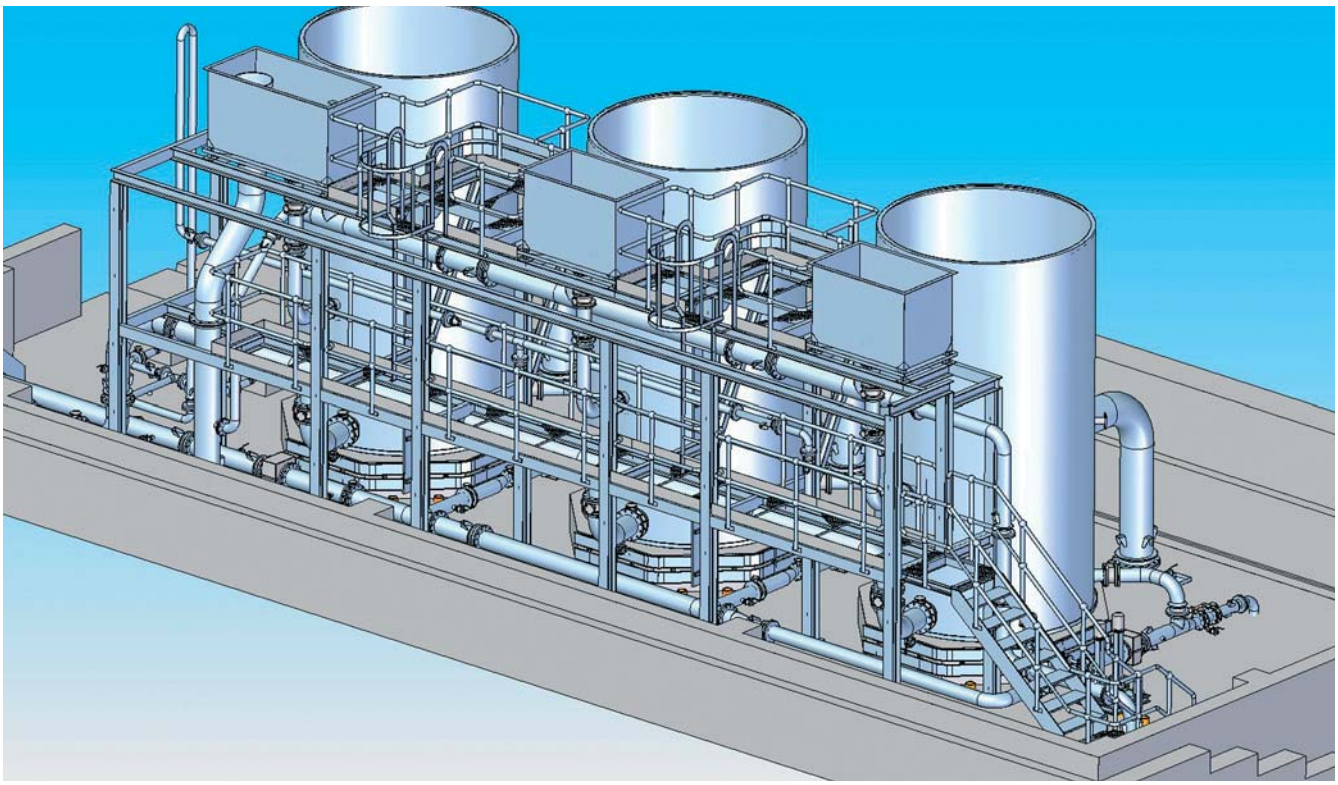
Wighton WTW - Nitrate Reduction

installation of new nitrate treatment plant

by Rachael Dobson, Glen Laxton & Nigel Brown

Wighton WTW serves a population of 1,600 properties in Wells-Next-Sea and the surrounding area which, with the influx of holidaymakers rises to 3,000 in the summer season. The groundwater for the treatment works has rising raw water nitrate levels and obligations have been agreed with Ofwat and the Drinking Water Inspectorate (DWI) to ensure that water into supply complies with maximum allowable nitrate concentrations and Anglian Water's operational standards. The Wighton plant will ensure both nitrate and turbidity compliance in the North Norfolk area by the installation of a new nitrate treatment plant.



3D graphic showing completed works *graphic by @one Alliance*

Project need & choice of treatment

With rising nitrate and turbidity in the area, Anglian Water decided to mandate the building of a new treatment plant and satellite borehole at Wighton, North Norfolk. The scheme would include the drilling of a new borehole to give low nitrate water to then blend with a higher nitrate source, after it was treated to remove iron and manganese via a new rapid gravity filter (RGF) plant. This would then ensure compliance to DWI limits until at least 2015.

The existing site at Wighton consisted of two boreholes, one with high iron and lower nitrate and the other with high nitrate and lower iron. At the moment the blend of these is within DWI limits and is chlorinated and pumped to a service reservoir at Wells-Next-Sea. This will not be the case in the near future so a source of low nitrate will be needed to make sure the blend stays within limits.

Once the new satellite borehole has been drilled, it became apparent that the concentration of nitrate was not low enough for the process that was proposed. At this point the decision was made to not use the new borehole, but instead to treat the existing high nitrate borehole, through an Ion Exchange (IX) plant before blending and treating for iron.

Undertakings

The work is being undertaken by the @one Alliance, a collaborative organisation comprising Anglian Water Engineering, Balfour Beatty Utility Solutions, Barhale, Biwater Treatment Ltd, Black & Veatch, Grontmij and Skanska-Aker Solutions, which was set up in 2005 to deliver a large part of Anglian Water's AMP4 capital investment programme.

The union of these companies brings together a wealth of experience which is being used to enhance and increase Anglian Water's assets and infrastructure, providing innovative and sustainable solutions and the best value for its customers. By doing so, the @oneAlliance is helping Anglian Water fulfil its current supply and treatment obligations as well as make provisions for the increase in demand expected in the future.

Scope of Works

The IX plant will treat approximately two thirds of the flow from the high nitrate borehole and then blend back with the remaining water to give the low nitrate water required. The lX plant will consist of two 100% vessels, running in duty/standby operation, each filled with strong base ion exchange resin which once exhausted uses a brine

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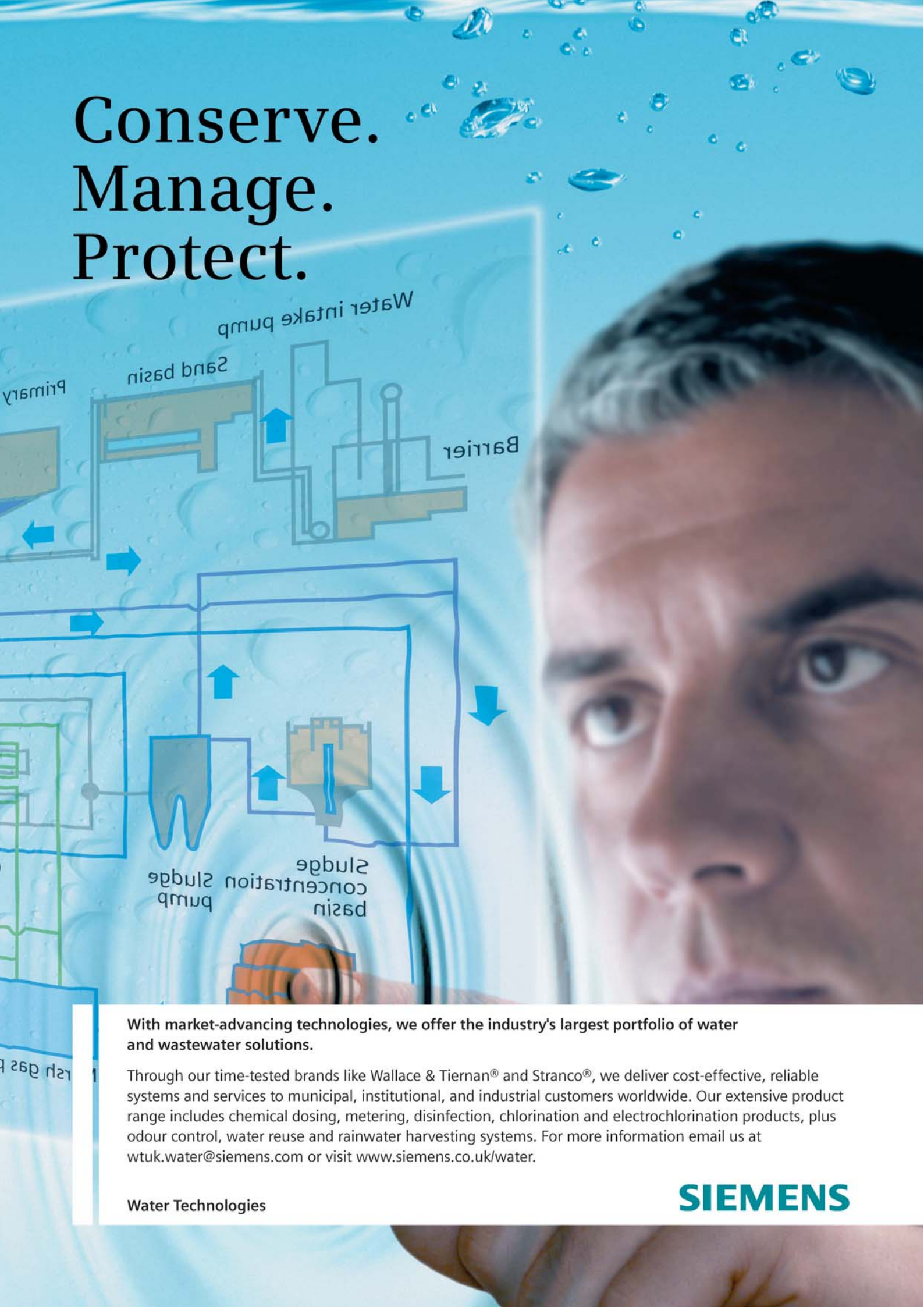

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solution for regeneration. The waste brine solution from regeneration is transferred to a storage tank and then pumped to a local water course under an existing Environment Agency approved discharge consent. The plant requires capacity to produce soft water for regeneration and other ancillary equipment therefore it will be purchased as a stand-alone package plant, saving design and construction time.

The low nitrate water is then blended with the borehole and fed to the RGF plant via an aeration step to help oxidise the iron. The filter plant has a maximum throughput of 2.273 megalitres per day (M/ld) and consists of three stainless steel filter vessels.

The plant is designed to take full flow through two vessels therefore keeping up the demand while one vessel is in the backwashing sequence. During backwashing, a volume of dirty wash water is produced - this is transferred to a storage tank and then pumped away to a nearby Wastewater Treatment Works.

After being filtered, the water flows into a pair of contact tanks so as to guarantee a chlorine contact time of thirty minutes. These tanks are not of concrete construction, as typically used - but made by *Asset International,* using a spiral wound high density polyethylene (HDPE) process. This was not only a more cost effective option, but also gives a safer and quicker construction method. Once the contact time has been achieved in the tanks, the water is pumped up to the existing service reservoir at Wells-Next-Sea using the existing pipeline.

The plant is to be built on newly purchased land at the rear of the existing works and consists of three buildings and a bunded area for the salt saturator and brine waste tank. The style of contact tanks used are positioned below ground and covered with a landscaped earth mound. As this area of North Norfolk is within an Area of Outstanding Natural Beauty, planning restrictions have been imposed on the appearance of the building. which must be constructed to fit in the surroundings, making the filter and pump buildings look like a typical Norfolk barn arrangement of brick and terracotta roof tile construction.

Challenges

The Wighton project was chosen to be a Pathfinder project - this meant that the team had to approach it differently to past schemes. Two main challenges faced the team, the first being the inclusion of the *Weholite® contact tanks.* Even though these tanks are proven and hold all the relevant DWI 'material in contact' certification, it is the first time that they have been used on an Anglian Water scheme of this type. This meant that the full engagement of the supplier and their design team was needed very early in the design process. Due to this, the design and inclusion into the scheme have proceeded very smoothly.

The second challenge the design team faced was to use a three-dimensional (3D) modelling package to generate a model that could be used to include operational and commissioning staff earlier in the scheme's life. This model has been produced to such detail that very early in the design process operational staff could see the plant they would have to operate once construction is complete. This proved invaluable, as at first viewing the Operations staff identified some access issues with regard to a chlorine static mixer. These concerns were passed to the CAD technician and within a very short time they were resolved and again being reviewed by Operations. Even though this meant a small amount of rework at the time, it saved a lot more time later on in the process.

The model not only shows above ground pipes, cable trays, vessels and instruments, it goes as far as under slab pipes and ducts within the

Filter installation at Wighton WTW *courtesy of the @one Alliance*

building. This again gives valuable information to sub-contractors and specialist installers, it is built up as far as possible in the order of the actual construction of the works and this sequence can be made into a presentation to show to the site team and provide it with an accurate construction sequence.

Implementation

The scheme will be delivered using purchase and framework agreements in place with Anglian Water, Biwater Treatment Ltd and the @one Alliance.

Biwater is the main contractor for Wighton, and before engaging the supply chain, established a procurement strategy outlining the plan for executing procurement activities, ensuring good quality and value for money is provided at all levels.

The nitrate treatment process will be supplied as a package by Christ Kennicott Water Technology Ltd. The package itself has been designed as a modular unit, assembled and tested off-site followed by delivery to site, final termination and commissioning.

The iron and manganese treatment process will be supplied as a number of components, using the best selection of materials, products and services the supply chain can offer. The selection of these materials, products, and services was a result of measuring the performance of key suppliers on previously delivered iron and manganese treatment processes. The stainless steel filter tanks, inlet boxes and interconnecting coated steel pipe work will be supplied by MMP Fabrications Ltd. The filter media and underdrain system will be supplied by AMT Systems Ltd.The air scour blowers will be supplied by Howden Process Compressors. The aeration system and static mixers will be supplied by Statiflo International Ltd.

The contact/balance tank will be supplied as a package by Asset International Ltd. The tank itself has also been designed as a modular HDPE plastic unit with a view to assembling off-site and offloading into a pre-prepared excavation on site. Other chambers such as dirty wash water tanks will be delivered as modular HDPE units.

The MCC will be supplied by Cema Ltd. Mechanical installation will be supplied by Saviour Engineering both of which are Anglian Water MEICA framework contractors. All concrete works will be supplied by Bells Formwork Ltd, a framework contractor of Biwater Treatment Ltd. The main building structures will be supplied by Balsham Buildings Ltd and Eurobrick Systems Ltd. Other items of plant such as chlorine dosing, pumps, valves, pipework have been procured through frameworks held between Anglian Water, Biwater Treatment Ltd and @one Alliance.

Conclusion

The project moved to site in April 2008, the construction team was provided with the model created through design and undertook daily production management meetings.

Utilising production management throughout design, including the development of a new design process, has significantly benefited the project. Despite challenges presented by Town & Country Planning and a delayed start on site, the team still aims to deliver ahead of schedule “in supply” date of December 2008.

The use of the 3D model has provided the construction team with significantly better quality and quantity of data enable an improved delivery and has enabled an ability to produce a bill of materials straight from the model.

Note: ***The Editor & Publishers wish to thank Rachael Dobson, Glen Laxton and Nigel Brown of the @one Alliance for preparing the above article.***■