Cwellyn WTW
enhancement with DAF, RGF and Ultraviolet Disinfection

by
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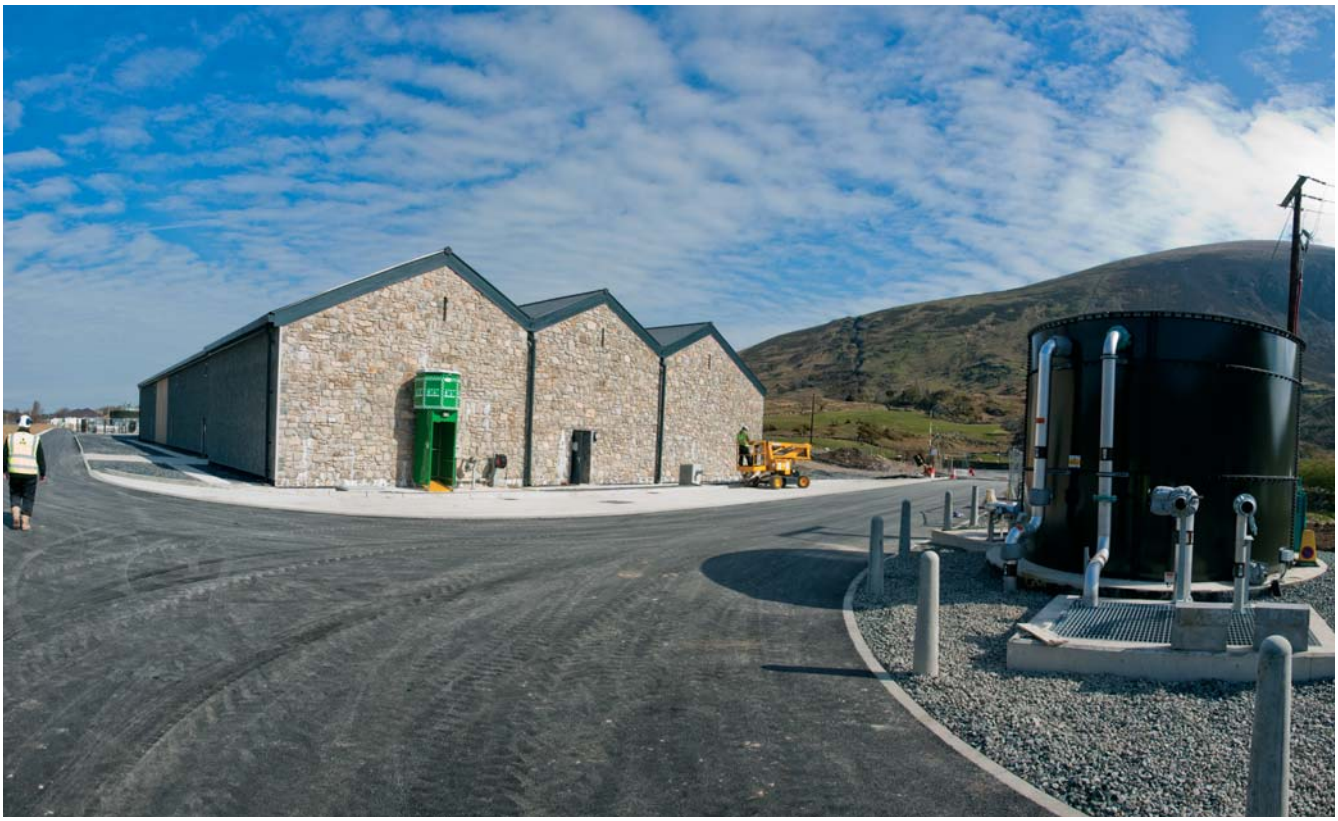
Cwellyn Water Treatment Works is situated near the town of Caernarfon and supplies drinking water to customers situated in a large area of north west Wales. Dwr Cymru Welsh Water, as part of its early Amp 5 Quality Investment Plan, has enhanced the existing works to meet the requirements of the Drinking Water Inspectorate (DWI) through undertaking a scheme to address the deterioration in raw water quality. The new process was sized to meet existing demand of 20Mld and was designed to address a number of specific requirements such as turbidity, bacteriological and cryptosporidium removal. The combined use of steel and concrete process tanks for Dissolved Air Flotation (DAF) and Rapid Gravity Filtration (RGF) along with a new Ultraviolet (UV) Disinfection system will provide a robust industry standard treatment process well into the future.



Cwellyn WTW *Dwr Cymru Welsh Water*

Existing works

Prior to the recent investment, the existing treatment process used pressure sand filters along with chemical dosing to clean and disinfect the water before distribution to the supply network. Over recent years the quality of the raw water source has deteriorated, leaving the existing process unable to maintain the required final water quality. At the end of 2005 an outbreak of cryptosporidiosis in the community, linked to water supplied by Cwellyn, focused attention on the treatment process and as a result of this investigation a UV disinfection plant was installed immediately as a short term mitigation.

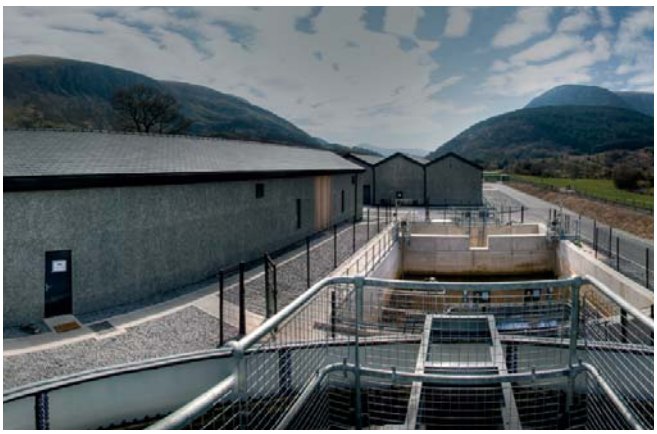
Welsh Water worked to complete the scheme to address long-term water quality issues and this was complete by 31 March 2010.

The preferred option

Black & Veatch, Welsh Water's Asset Management Alliance (AMA) Water Process Partner for AMP 4 investigated options and decided to implement DAF, RGF and newer, fully validated, low power UV disinfection system. A wash water recovery system, using WRc standard thickeners was also provided along with a chemical dosing plant for coagulation, pH control and sludge thickening.

As the site is located within the Snowdonia National Park (SNP), early consultation with the planning department, the local council and community was instigated. Key stakeholders were informed that the two new buildings along with an external process plant would need to be constructed and would use materials and practices that would not be detrimental to the local environment and that would blend into the local area once complete.

The selected option utilised the existing raw water main from Llyn Cwellyn reservoir, two kilometres from the existing works. The new process plant is gravity fed using the existing available head. This provided challenges to the design team when calculating hydraulics for the new works. Following the RGF stage all the available head has been used so an interstage pumping station then pumps from the new to the existing works. The upgrade to the existing DCS control system allowed both old and new parts of the water treatment works to be run as one. All work was required to be completed whilst Welsh Water continued to provide potable water to the network without disruption.



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Construction

Construction and enabling works commenced on 16 February 2009, on snow covered ground steel process tanks for the DAF were constructed offsite to enable completion within the short construction programme. While the RGFs were constructed in reinforced concrete, construction of all the process tanks in this way would not have been achievable in the programme time available.

Deliveries to the site of the large process tanks required the input of, and communication with, each affected local authority; and interested parties including North Wales Police, Gwynedd Highways, the Welsh Assembly Government, A55 Trunk Road Agency, emergency services, local communities, Scottish Power, British Telecom, Snowdonia National Parks Authority and the Welsh Highland Railways. General deliveries were kept to a minimum as the main route to the site is the only route and is also a tourist route.

Royal Air Force jets often buzz through the valley in which Cwellyn water treatment works is located and consultation between the site team and the RAF in Anglesey was carried out due to the use of cranes during construction.

The civil programme for each building, DAF and RGF was staggered allowing M&E works to start early for a limited time before civil works would then continue. This method of programming was used to maximise the time available whilst the weather was good; it was critical to achieve the programme and allowed the civil team to provide a weather proof building in which the M&E installation teams to continue. Large items such as process tanks were installed on the building slab before the portal frame and roof were installed.

Innovative methods used during construction

Temporary works such as battering back could not be used due to proximity of structures and a railway line. Sheet piling and the provision of a cofferdam whilst excavating were not used due to the locality of the railway and because of the impact on the local community and the roads. Gabion baskets filled with on site excavated materials provided a near vertical wall in which the excavation would be made. This saved money on transport costs, reduced carbon emissions and was of benefit to the local population and environment.

Ground water in the region was between 1.5 and 2.2 metres and the site is paralleled by a river, the Afon Gwyrfai which runs from Llyn Cwellyn. The river which has SAC and SSSI status could not be used to discharge ground water into and at its closest point is just 10 metres from the construction site. The temporary works dewatering used wells to remove the water at a level lower than the required excavation depth. The water was them returned via settlement tanks to the ground elsewhere on the site via several other wells and a large soak away. The temporary works was effectively recycling the ground water long enough to allow the construction of the below reinforced concrete tanks.

The highway drainage from the main tourist route, the A4086, was diverted into the dewatering system and the rain water and ground water drainage system was designed appropriately to use the soak away once the construction was complete.

Team work

The multidisciplinary team worked with each other including the operations team that needed to keep the existing works running through all parts of the construction work and commissioning of the plant. Civil, mechanical and electrical contractors worked simultaneously on many work faces whilst the software specialist re-wrote a code that would operate both plants as one single water treatment works with minimal shutdowns. The project was also executed to high health and safety standards without any injuries and delivered within the agreed timeframes and below budget.

Commissioning

The commissioning process began in December 2009 allowing the team time to commission the new works whilst running to waste before running to the new works. This enabled process engineers to achieve the desired water quality outputs of the new works before switching flows through the existing works.

IT and communications for SCADA and Telemetry were extended to a new operations control room above the inlet works in the new DAF building for Welsh Water operations staff.

The plant went into full service, with both water treatment units working as one process plant, on 25 March 2010 and has been operating well ever since.

Note: ***The Editor & Publishers thank David Taylor, Team Leader North Wales with Black & Veatch for providing the above article for publication.***■