Heswall WwTW Shellfish Waters Scheme

£6.8m underground storage tank aimed at improving the plant's performance and reducing the number of spills into the Dee Estuary

Heswall WwTW, operated by Dŵr Cymru Welsh Water (DCWW) is situated on the eastern (English) coast of the Dee Estuary within the Metropolitan Borough of Wirral. The town spans the boundary between DCWW and United Utilities with approximately 50% of the town draining to the Heswall WwTW in DCWW's ownership. Heswall has a residential population of 8,943. The Dee Estuary is, along both of its banks, the habitat and harvesting location for shellfish which are currently failing the standards required for consumption under The Shellfish Waters Directive. As such, harvesting in the area has been suspended pending an improvement in the water quality.

Aerial photograph of the new Heswall WwTW shaft - Courtesy of DCWW/Costain Ltd

Studies and modelling

A study of the water quality in the Dee estuary has identified a number of sources which contribute to the lowering of water quality within the estuary. These originate from agriculture, surface water runoff, CSO discharges and the outfalls from the WwTW. Within the sources for which Dŵr Cymru Welsh Water has responsibility, a study identified the WwTW and the CSO close by Riverbank Road as the major contributors to the cause of the poor water quality within the estuary.

A verified InfoWorks hydraulic model for the Heswall catchment was used to confirm the existing performance and to identify the upgrading required to achieve the proposed performance level. The accepted performance criteria being; spills from both the two outfalls at the WwTW and Riverbank CSO are aggregated to ensure no more than an average of 10 spills per annum are experienced.

The hydraulic model of the sewerage system showed that the number of spills from the sewerage system under storm conditions could be reduced by the provision of additional storm storage, increasing the rate of flow through the treatment system at Heswall WwTW, and reduction of surface water entering the combined sewerage system.

The following works were proposed to reduce the number of spills:

Heswall WwTW

The proposed storm storage tank at Heswall WwTW would comprise a 25m internal diameter shaft, 16m deep, which would provide 5,750m^3 of storage volume.

The new storm tank would contain 4 (No.) return pumps, each with its own rising main that discharges into a common chamber in the top of the centre column of the open air tank. The chamber will drain through a new pipe by gravity back to the inlet works. The return pumps each have a capacity of 28l/s and will operate as well as being controlled to maximise the return flow that the treatment works can accept through intelligent balancing and mobilisation of unused existing storage capacity. This will be determined by the level in the inlet works wet well. When the return pumps are running mixers will operate in the storm tank to ensure that any solids also get returned.

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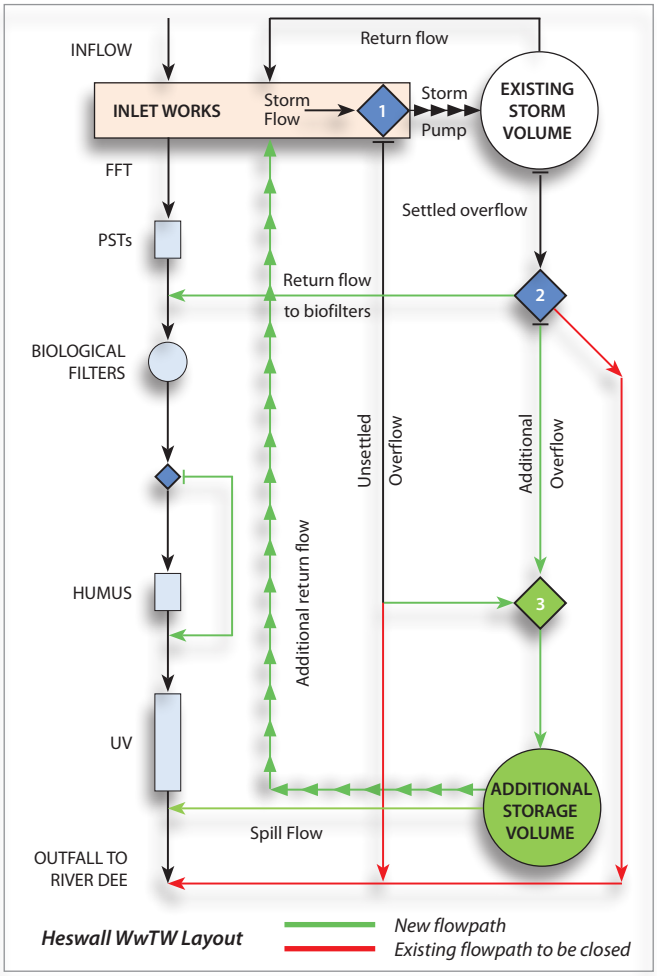


An overview of Heswall WwTW during construction
Courtesy of DCWW/Costain Ltd

Heswall WwTW main tank during construction
Courtesy of DCWW/Costain Ltd

As there was spare treatment capacity of 28l/s in the biological filters at Heswall WwTW and the existing storm tank had been constructed in the same way as a primary settlement tank, it was proposed that once the existing storm tank was full, the first 28l/s of the settled storm spill would be directed towards the biological filters. This additional 28l/s is then passed from the biological filters to the humus tanks. However, the humus tanks did not have sufficient capacity for the additional 28l/s and subsequently a flow diversion chamber was required to be constructed upstream of this in order to divert this 28l/s straight to the UV channel (with no extra UV capacity required for the extra flow), and then for onwards discharge to the Dee Estuary.

The remaining settled storm spill, together with any unsettled spill would pass to new storage tanks which would be sized to spill at the required frequency. A proportion of the return flow from the additional storage tanks would continue to be diverted into the biological filters to assist in a more rapid emptying of the storm tanks. The initial diversion together with the faster emptying of the storm tanks would both contribute to a reduction in the additional volume required.

Riverbank Road CSO

Additional stormwater storage will also be provided at the Riverbank Road CSO, where it was proposed to provide additional off-line storage with an operational volume of 1,600m^3. This would be provided in a shaft below ground which would fill by gravity. The tank will be provided with pumps to return the contents to the foul sewerage system after the storm event. Mixers will also be provided to prevent settlement of solids within the tank.

Sewer diversion

A surface water sewer in Riverbank Rd is connected into the combined sewerage system downstream of the CSO. The surface water sewer would be diverted into the existing surface water outfall in Riverbank Rd, thereby reducing the new storage requirement.

Construction

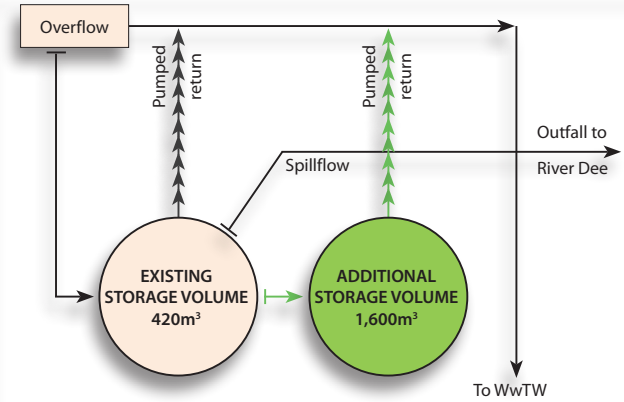
Due to anticipated ground conditions and a high water table the construction of an 5,750m^3 underground storm water storage tank at Heswall WwTW required a reliable temporary works solution. Due to existing site constraints and required capacity, the underground tank temporary works was designed to be 27m diameter and 23m deep secant pile shaft, with the 25m diameter segment shaft built 'bottom up' as an internal lining.

The technique involved large diameter rotary bored piles, constructed with heavy duty temporary casings. This was used for the ability to produce large diameter deep piles able to overcome underground obstructions, including rock strata.

Rotary piling rigs have large torque capability and are able to change between coring or digging tools and augers. The advantage of cased rotary bored piles is that they can be drilled to significant depths with high verticality tolerance, essential for ensuring the pile to pile inter-lock required to prevent water and soil ingress, and also to maintain the hoop stress required by the design. Cased rotary bored piles also allow the reinforcement cage to be installed into the open bore prior to concreting, meaning that long cages can be installed to the full depth of the pile, allowing for deeper secant pile solutions than are feasible with other piling techniques.

The solution provided by Bachy Soletanche was a hard/hard secant piled wall with every second pile reinforced full depth. At 27m in diameter, with each pile bored at 1.18m diameter and 23m deep, this is believed to be the largest cased rotary bored hard/hard pile solution used in wastewater treatment in the UK.

In terms of technique, secant pile shafts have been constructed in previous wastewater treatment applications using a variety of



Riverbank Road CSO *- Green denotes new flowpath*

piling methods but the shaft diameter and depth of pile involved at Heswall WwTW is in excess of previously constructed storm water storage schemes nationwide.

At Riverbank Road CSO, Donegan Civil Engineering Ltd were contracted to install a 15m internal diameter tank 13m deep adjacent to the existing buried storm water storage in Riverbank Road. This will provide 1,600m³ of storage below the spill level of the existing system. The tank will be constructed as a driven caisson with a thick reinforced concrete base slab which will include a 'toe' beyond the tank wall to prevent flotation of the tank. The tank will have a reinforced concrete collar at ground level, a concrete centre column, sloping concrete benching and cover slab. The weight of all of these elements will also be used to prevent flotation.

A galvanised steel ladder and intermediate platform will provide access to the bottom of the tank. A concrete footpath will give access and provide an area for a fall-arrest tripod.

Groundwater

At both sites there was a requirement to temporarily control groundwater levels during the construction period until such time that the permanent works were constructed, thus resisting the uplift exerted by the groundwater pressures. Following pump testing at Heswall WwTW to ascertain the hydro-geological conditions, it was determined that in order to control groundwater levels around the shaft during construction 7 (No.) wells were required.

The wells which had to be located around the shaft perimeter were 35m deep and 17m apart. The pumping system maintained a drawdown of groundwater of approximately 20m (1m below formation level) throughout the construction period.

Undertakings

The schemes at Heswall WwTW and Riverbank Road have contract value of £6.8m and a project duration of 16 months. The projects are expected to be completed by August 2013.

Key participants:	
Client	Dŵr Cymru Welsh Water
Project Delivery	Costain Ltd
Design	Aecom Celtic Process Control Ltd Whitland Engineering
Main sub-contractors	Bachy Soletanche Donegan Civil Engineering Ltd D Morgan PLC W J Groundwater Ltd Cummins Civil Engineering Ltd

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