Torquay Bathing Waters

Fleet Walk overflow improvements

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South West Water Delivery Alliance H5O has recently completed a £5m sewer network upgrade in Torbay to improve bathing water quality in the resort. The project, which will reduce the frequency of storm spills to the environment from a number of combined sewer overflows (CSOs) in the town, will help to ensure the protection of public health, by meeting the requirements of the European Union revised Bathing Water Directive ready for the 2015 bathing season.

Abbey Park site during construction, with Tor Bay behind - Courtesy of H5O

Project background

Two overflows, known as 'Fleet Walk' CSOs, were identified for improvement as part of the Torquay upgrade. Serving an upstream catchment of 80,000 people and a contributing area of 1,230 hectares, Fleet Walk CSOs provide an overflow on the combined sewer system if the downstream sewer capacity is exceeded during storm events. The CSOs, located in chambers below the main shopping street in Torquay, discharge in close proximity to Torquay Outer Harbour. A previous field survey had shown a detectable impact at the nearby Torre Abbey bathing water and, as a result, improvement works were needed to meet the EU directive. The project objective was twofold:

- To achieve a CSO spill frequency of no more than three spills greater than 50m^3 per bathing season.
- To upgrade the overflow screens to meet predicted increases in flow by the 2045 project design horizon.

South West Water Delivery Alliance H5O was responsible for delivery of the *Even Cleaner Seas* bathing water improvement project in Torbay.

The solution

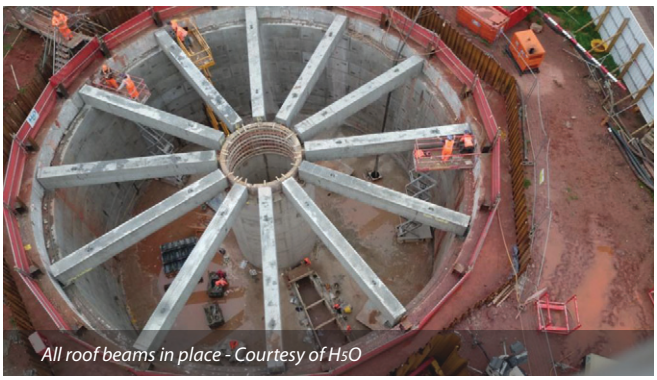
The trunk sewer draining past the CSOs receives both gravity flow from the main part of Torquay and pumped flow from Fleet Walk Sewage Pumping Station (SPS). Any solution to achieve the required spill performance needed to consider the interaction of flows from two distinct sub-catchments at the CSO location.

H5O utilised a verified hydraulic model to simulate existing and future performance of the sewer network and to develop an outline solution to meet the CSO spill criteria. The aim was to create a future proofed solution for the 30-year design horizon, taking account of flow increases predicted from climate change and urban creep (increased impermeable areas) to 2045.

Third ring of total of 11 in position , 23T excavator excavating for next ring , long reach excavator removing spoil - Courtesy of H5O


Tank excavation in progress with shaft jacks in position - Courtesy of H5O


First roof beam being lifted into place - Courtesy of H5O


All roof beams in place - Courtesy of H5O


Roof beams in position , roof slabs in the process of being installed Courtesy of H5O

The selected solution, agreed in consultation with the EA as environmental regulator, comprised:

- A new 2,000m³ underground attenuation tank in Abbey Park Gardens, upstream of Fleet Walk SPS. This would store storm flows within the sub-catchment and prevent them being passed forward to Fleet Walk SPS and the CSOs during rainfall events.
- Optimisation of Fleet Walk SPS operation by adjusting intermediate and storm pump operating levels. This would smooth delivery of pumped flows to the gravity system draining past the CSOs during storms, and make an overflow event less likely.
- Upgraded screens at Fleet Walk CSOs to remove sewage debris for all storm overflows up to a five-year return period event.

Abbey Park Gardens attenuation - Design and construction

Abbey Park, located on Torquay seafront, was identified as the most suitable location for the catchment attenuation, providing good access and a large area of open space for construction. However with the park being a formal garden and popular local amenity in a tourist destination, early and regular engagement with a number of local stakeholders was essential to gain agreement for it as the tank location.

A regular dialogue with Torbay Council and *Friends of Abbey Park* resulted in early construction access in April 2014. To mitigate the loss of amenity during the11-month construction period, the park reinstatement design was developed to meet the requirements of both Torbay Council Parks Department and South West Water Operations, taking into account the wishes of resident businesses and local action groups. Improvements included new pedestrian access from the seafront, enlarged hard standing areas for maintenance and new park furniture.

The attenuation design consists of an overflow chamber on the trunk sewer crossing the park, with screened overflow weirs discharging to the attenuation tank. The tank incorporates a pumped return to transfer effluent from the tank to the trunk sewer.

This is designed to operate as soon as the tank is being utilised, thus passing attenuated flow to the downstream sewer system at the earliest opportunity and keeping the maximum volume of storage available for storm flows.

To help clean the tank floor once emptied, the design incorporates a Hydrok Storm Flush system. This provides an automatic, self regulated flushing flow using screened effluent stored in two flushing bells bolted to the tank floor; these operate using a non powered siphon system.

Abbey Park shaft

The attenuation tank was formed as a 20m internal diameter, 11m deep shaft, with a 4m diameter central core to act as a dedicated pump sump; this provides an area that can be safely isolated in case of the need for pump maintenance. The central core wall also provided support for the shaft roof beams, which were formed as spokes spanning from the core to the outer walls. These in turn supported the roof slabs.

The tank walls were constructed from 220 precast concrete smoothbore segments each weighing 3.6 tonnes and were installed by the 'dig and push' method using hydraulic rams to sink the shaft 1m at a time from the top down. On completion of the precast shaft lining, an under-reamed base was constructed as part of measures to resist tank flotation. This reduced the volume of mass concrete needed as additional dead weight against flotation. The base was constructed by pumping approximately 1,100m³ of ready mixed concrete.

The final stages of the build included the construction of the central core to support the 12 (No.) precast concrete roof beams each weighing 13 tonnes. These in turn supported 36 (No.) cover slab sections ranging in weight from 4 tonnes to 13 tonnes.

Abbey Park overflow chamber

The overflow chamber incorporates a pair of 6mm 2D Huber Rok screens mounted either side of the 1,425mm diameter trunk sewer. These reduce the risk of sewage debris entering the tank during an overflow event and are mounted on bespoke lifting frames, designed so the screens can be removed from the chamber for maintenance, thus avoiding confined space working.

The screens are located on weirs just above the peak dry weather flow level in the sewer. This low weir setting ensures the tank is being utilised in the majority of rainfall events and was a hydraulic modelling requirement to achieve the desired spill frequency at the downstream Fleet Walk CSOs.

A chamber, 7m long by 4.5m wide by 4m deep, was needed to accommodate the overflow and screening arrangement, with an online construction around the existing trunk sewer preferred for operational reasons.

The principal challenge for the delivery team was to produce an online solution that was safe to construct, in line with budget and programme constraints, and maintained the ability of the existing trunk sewer to pass forward a large range of sewer flows (100-1,500l/s) during construction. This was necessary to ensure operation of the existing system was not compromised during construction and the solution involved building the new chamber around the existing 1,425mm concrete pipe within a sheet piled excavation and a number of measures were deployed to manage live flows.

The pipe soffit was removed to allow a temporary 600mm plastic flume pipe to be inserted into the sewer invert; this transferred dry weather and low storm flows across the excavation during construction. Over-pumping was used to provide extra capacity.

Temporary over flow notches were also cut in the existing pipe upstream of the new structure to allow the works to pass higher storm flows if they occurred, by providing a route for effluent to overflow through the excavation and into the downstream pipe. A safe system of work was devised by H5O to ensure the safety of operatives during construction of the chamber; this included weather and sewer level monitoring to ensure operatives were not working if there was the risk of an overflow occurring.

Once these measures were in place, the existing concrete pipe was broken out to allow construction of the reinforced concrete structure, fitting of screens and benching. Finally the flume pipe was removed and the overflow notches were reinstated.

Fleet Walk CSOs - Upgraded screens

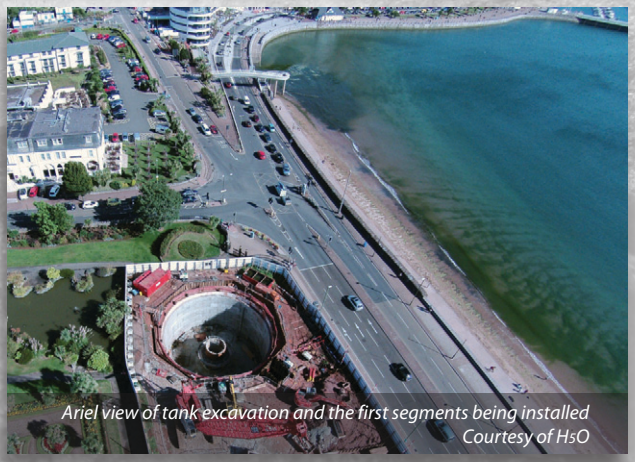
With the Fleet Walk CSO chambers situated below a busy shopping street, the H5O delivery team needed a screen solution that minimised both the disruption to the town and traders during construction, and the need for future operational attendance. To reduce the construction cost, programme and disruption, the team's aim was to utilise the existing chambers to house the upgraded screens.

However to accommodate the higher design horizon flows, the new screens needed to be significantly bigger than the existing units. The main challenge for the team was to engineer a solution to fit these into the complex below ground chambers. A 3D laser survey of the existing chambers was commissioned to confirm their exact layout and dimensions. Using the hydraulic parameters provided

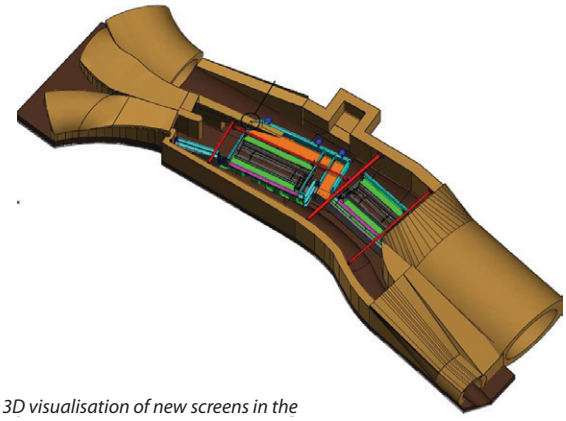
Aerial view prior to roof installation
Courtesy of H5O

Aerial view of site at the commencement of shaft construction
Courtesy of H5O

Ariel view of fully hoarded site set up
Courtesy of H5O



Ariel view of tank excavation and the first segments being installed
Courtesy of H5O



3D visualisation of new screens in the existing chambers - Courtesy of Hydrok

2.0m Mecmex Screen Installed CSO Fleet Street Courtesy of H5O

by the hydraulic model, H5O developed 3D drawings for the screen arrangement. These drawings provided two main benefits.

- They demonstrated that new Mecmex screens could be accommodated within the existing chambers without structural clashes.
- They allowed an accurate visual representation of the proposed installation which was used to obtain feedback from South West Water Operations into the design.

Fabrication drawings were then developed in conjunction with the proposed construction sequence, producing a 'build off site' solution that enabled quick, safe screen installation. This collaborative approach to design and construction proved very successful with each of the three screens mechanically installed in less than two working shifts. As a result of this planning, and the work of a designated customer liaison officer in daily contact with businesses, the work was completed with minimum disruption.

Conclusion

The improvement works at Abbey Park, Fleet Walk SPS and Fleet Walk CSOs, were complete and operational in time for the 31 March 2015 deadline. Final reinstatement in Abbey Park is due to complete by the end of May 2015.

South West Water and the H5O delivery team would like to thank all the project stakeholders, particularly the Environment Agency and Torbay Council, for their collaborative approach during this scheme.

Collaboration between client, contractor, designer and the wider supply chain has been a key factor in delivering a successful project that both meets the requirements of the revised Bathing Water Directive and a challenging delivery programme.

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