Falmouth CSO Improvements

South West Water invest £5.5m to meet EC Shelllfish Directive

by

Andy Dawe BSc, CEng, MICE

The town of Falmouth is situated at the western edge of the Fal Estuary which contains a number of designated Shellfish and Bathing Waters. Between 1993 and 2000, South West Water made substantial investments to improve the quality of intermittent and continuous discharges from Falmouth wastewater system. During AMP1, compliance with EC Bathing Water Directive was achieved by the interception of a number of crude outfalls and their redirection to a new WwTW, located on reclaimed land adjacent to Falmouth Docks, which provided preliminary treatment of flows and a new deep water outfall into the estuary. Flows were attenuated in a 3600mm^3 storage tunnel before being pumped to treatment. During AMP2 the WwTW was upgraded to provide secondary treatment and tertiary treatment including UV disinfection for flows up to 259 l/s.

Falmouth CSO improvements - Raising the roof on the 6000m^3 storage tank *(photo: Still Imaging, Chudleigh , Devon; courtesy S.W. Water)*

AMP 3 'drivers'

The national Environment Programme (NEP) for AMP3 identified 20 CSOs to be upgraded in the Falmouth catchment. The driver of these CSOs is the EC Shellfish Water Directive which requires the average significant (>50m^3) spill frequency to be limited to 10 spills per year. The EA grouped the CSOs into agglomerations based on their likely impact on adjacent shellfish waters and required that their combined average significant spill frequency should be limited.

Catchment

The Falmouth sewerage system is predominantly a combined system, especially the town centre area. There are a number of existing attenuation tanks and pumping stations within the catchment providing a total storage volume, including the Bar Road Tunnel of 6500m^3. The system suffers from high levels of ground water infiltration up to 190 l/s in winter and saline infiltration throughout the year.

Strategies
Four main strategies for improving the CSOs were evaluated.

* sealing of CSOs;
* reduction in storm related flows through the re-routing of run-off to separate surface water sewers;
* in catchment attenuation and storage;
* increase in pass forward flows and end catchment attenuation and storage.

The final scheme was based on a combination of these strategies due to the constraints associated with each of the CSOs, namely, availability of land to construct local storage, ground conditions, planning constraints, public opinion and capital cost. The amount of storage required was optimised by identifying areas of infiltration which could be removed readily and cost effectively.

Hydraulic modelling
Extensive hydraulic modelling studies were carried out to determine storage volumes and sewer sizes required by each option and to check that no deterioration in hydraulic performance of the sewer system was predicted.

The high levels of infiltration relative to flow through the WwTW result in prolonged drain-down times for the tunnel storage. This increases the frequency of spills from the associated CSOs resulting from 'back to back' storms. Drain-down time for the existing system was approximately 24 hours and with the additional storage required for the proposed system this increased to 48 hours. This required the use of historic rainfall event with an event separation of 48 hours and duration of up to 28 days. As the EA also define a spill as the cumulative volume of spill occurring from a CSO agglomeration within 12 hours from the start of an event and thereafter every 24 hour period, each event had the potential to generate several spills.

Preferred option
The final scheme, valued at £5.5 million, which was developed in conjunction with South West Water's Partners *(Pell Frischman, Alfred McAlpine and Purac)*, commenced in October 2000 and comprised the following main elements:

* provision of 500m^3 off-line storage at Commercial Road PS, together with surface water and separation and infiltration reduction measures;
* provision of 500m^3 of storage using on-line tank sewers;
* upsizing of 150m of existing sewers laid in open-cut and 300m in tunnel heading;
* construction of 375m of new 675mm dia and 700mm dia sewer in open-cut;
* provision of a 6000m^3 above ground storage tank at the WwTW, with associated storm and return pump stations, 6mm screening and rising mains;
* two 500mm dia directionally drilled pipelines between the existing WwTW CSO outfall tunnel and the new storm PS;
* sealing of five CSOs;
* provision of 25m^3 of emergency storage at Old Hill PS.

Other options evaluated
To improve the CSOs around the town centre area three other options were evaluated:

* construction of a low level tunnel running along the foreshore to intercept the CSO outfalls and attenuate their discharges. This was rejected on capital cost grounds and the lack of suitable shaft locations for construction access;
* construction of a 3000m^3 attenuation tank below The Moor, which is the main open space in the town centre. This was rejected on the grounds of disruption to traders during construction and the lack of suitable access for maintenance in such a sensitive location;
* construction of a 2000m^3 attenuation tank located on the foreshore adjacent to Prince of Wales Pier and a 500mm dia by 700m long directionally drilled rising main. This was rejected because the tank would have been located within a Special Area of Conservation necessitating long planned lead-in times and risks associated with the construction of the rising main.

Design & construction
The partnering team for this scheme had worked together on several previous schemes, including the Falmouth WwTW scheme and were keen to utilise similar construction methods where appropriate. Precast concrete elements were used wherever possible to reduce construction times, as much of the works was concentrated within Falmouth town itself. Culvert units were generally used for buried storage tanks and *A-Consult* wall panels fixed to in situ base slabs founded on mini piles. Value engineering was used to optimise design solutions. To comply with planning requirements for odour control, a geodesic aluminium dome was used to provide a roof over the 36m dia storm tank to contain potential odours.

An existing 300m length of 450mm pipeline had to be upgraded to 700mm in a hand dug tunnel heading 16 metres underground. The final 20m of this section ran along a narrow lane below the foundation level but with decreasing ground cover. Due to the very poor ground conditions along this section a heading could not be excavated safely and the pipe was laid in open cut. Prior to excavating the trench, bored contiguous piles were installed to support the ground and prevent settlement of the building foundations.

Phased completion was achieved throughout the 18 month construction programme as each section that was completed helped reduce the frequency of CSO spills in the estuary. The overall project timescale from initial optioneering to Take-Over was 24 months. ■

Note: *Andy Dawe is Programme Leader with South West Water; associated with him in producing this article were: Mike Fletcher, Design Manager with Pell Frischmann Water; Alastair Hegarty, Construction Manager with Alfred McAlpine Construction; George Handley, Project Manager with Purac Ltd.*