South Town Outfalls, Dartmouth

"completing the Jigsaw"

By David Elsdon, CEng, MICE, MBA

The communities of Dartmouth & Kingswear nestle either side of the Dart Estuary in the South Hams area of Devon. Neither catchment enjoyed any formal sewage treatment arrangements until the completion of works in Old Mill Creek in 2002. This comprehensive scheme for both communities was one of the last of South West Water's flagship Clean Sweep Programme, which required in excess of 1.5 billion pounds of capital investment to bring, for the first time, sewage treatment facilities to many West Country resorts.

Aerial photograph of Dartmouth *courtesy of South West Water*

A small part of Dartmouth could not be included in the main scheme, which left 9 public outfalls, serving just 35 properties along a river frontage of approximately 600 metres downstream of the Lower Ferry, continuing to discharge untreated sewage into the popular boating waters. The solution was always going to be a major technical challenge, but no one was prepared for the consequent financial costs.

South West Water (Project Manager Mike Court), working with their framework partners Pell Frischmann (Design Project Manager Dave Elsdon and Engineer Richard Wilson) providing consulting services and Black & Veatch (Construction Project Manager, John Reddington and Site Manager Paul Hunt) responsible for construction established a budget of 5.5 million pounds with which to undertake the work which commenced on site in November 2006.

The catchment is set between Bayard's Cove and Castle, used as a setting for the TV period drama The Onedin Line, and Warfleet Creek, also with historic associations. Though steep, the oldest houses on the hillside date back to the eighteenth century, while the later nineteenth century retaining walls and properties have become a major feature of the area. More recently these have been converted into flats with many of the open spaces now developed, leaving little scope to construct new sewerage infrastructure.

A local liaison group was established early on to facilitate the significant communication necessary with the residents and other bodies, such as the Harbour Master, at all stages of the scheme, as well as ensuring that all legal issues could be successfully resolved.

The chosen solution involved collection of sewage flows from the outfalls into two foreshore gravity collector sewers, approximately 200m and 250m long with sizes in the range 180 to 315mm outside diameter, connecting into a single pumping station on land adjacent to the foreshore. The pumping station was located centrally to provide approximately equidistant collector sewers, thus minimising the required depth of both sewers and station. Sewage could then be transferred by pumping to an existing public sewer in the road above. An emergency overflow 37m long, with protection mattresses near the discharge point, was constructed for use in the unlikely event of pump failure.

In order to undertake the marine works a FEPA licence was secured This involved significant consultation with Natural England, CEFAS, the local Harbour Authority and the Environment Agency.

An extensive ecological survey found a variety of benthic organisms in the foreshore area, which formed a very rare and important biotope. Mitigation measures were designed and implemented to minimise the impact upon this area.The works included the translocation of biota into temporary marine aquariums; designed to assist in the successful recolonisation of the area post construction.

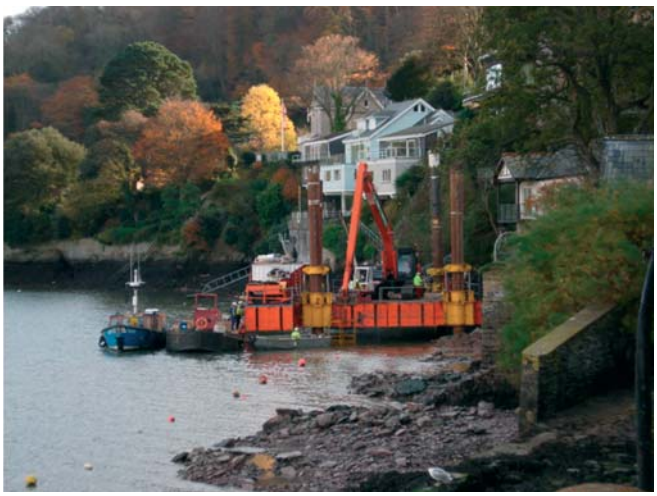
To avoid the ingress of saline water into the system it was necessary for the foreshore sewers and all lateral sewers and drains located below high tide level to be sealed. This was achieved by constructing the new pipelines in welded polyethylene and by testing and repairing existing on-shore pipes. The system was designed without the need for access chambers in the foreshore, to minimise both construction difficulties and the risk of saline intrusion, and with operational pipe maintenance activities being undertaken from the land. It was necessary to ensure relatively tight tolerances to provide a gravity sewer, not an easy task in the intertidal construction environment.

Because very little beach is exposed at Dartmouth, even at low spring tides, it was not possible to use land based equipment to lay the sewers. Heavy marine plant had to be utilised for excavation and for laying to accurate line and levels. This involved a jack-up barge, a spud leg barge and professional diving facilities provided by *Commercial Marine & Piling Limited.* Strings of welded pipe were floated into place and sunk, with the number of mechanical connections kept to a minimum. Weight coats were applied to prevent floatation.

The deeper sections proved to be very difficult to install with the equipment first employed, exacerbated by low underwater visibility, tidal stream conditions and the presence of rock. Additionally, it was only possible to get marine access during the winter period when yacht moorings were vacated, resulting in a delay from one winter working period to the next.

In order to be in keeping with the heritage of the locality and meet the planning requirements, the pumping station and MCC building were constructed as part of a stone clad quay, affording the owners of the land continued use of their boat access. This was the only undeveloped site available and came with some significant geotechnical and engineering challenges: near vertical buried rock cliffs and existing 8m high stone walls constructed at the works boundary atop the rock slopes. Slope stability measures were installed by Vertical Technology. Due to the topography and site location, access was primarily by sea: most materials, excavators and even a crane had to be brought in by this means, the only exception being concrete pumped from the road above.

A temporary cofferdam was constructed to facilitate construction of the shaft and the retaining walls. *Delta Construction* sank the 2.7m internal diameter shaft through rock to 7.5m below and raised to 3.3m above Ordnance Datum, utilising prefabricated sections installed by



Barge undertaking tidal construction. courtesy of Paul Hunt of Black & Veatch

underpinning methods. A short heading was required to connect to the collector sewers.

The main material involved in the construction was mass concrete, since this could be pumped in and the resultant weight provided stability to the base of this steep shoreline. The works were later finished in stone to allow it to blend in with the sea walls to north and south.

Independent rising mains for the individual pumps were provided in order to maximise the flexibility of pumped flow ranges and minimise retention. All pumps and connected pipework were designed using resilient mountings and without non return valves to minimise the potential for the transmission of noise or vibration through the pumping station sub-structure and the surrounding rock strata. To ensure long life and low maintenance, polyethylene was chosen for the buried pipes and grade 316 stainless steel for the exposed pipes in the pumping well. The detailed mechanical and electrical design and installation was undertaken by *May Gurney.*

Due to the design of the sewers and pumping station as a sealed system to exclude saline water, odour is not expected to present a problem. The sewers have self-cleansing flow velocities and retention times have been minimised. Access covers were specified with durable, long life odour seals. However, odour ducting and a passive odour control system has been installed as a precautionary measure, along with saline monitors to warn of any salt water ingress to the system.

The construction works have been challenging for all concerned, involving long working hours dictated by constraints such as tidal conditions and marine access confined to only the winter period. Works are now approaching completion and flows will soon be transferred into the new system.

Note: ***The Editor & Publishers wish to thank David Elsdon, Technical Director, Pell Frischmann Consulting Engineers, for providing the above article.***■

Temporary cofferdam at pumping station site Photos courtesy Paul Hunt of Black & Veatch Construction of pumping station shaft

Construction on Estuary showing challenging site constraints *courtesy of Paul Hunt of Black & Veatch*