

Gowerton WwTW Sea Outfall

Dŵr Cymru Welsh Water outfall rehabilitation to alleviate pollution in a SSSI and designated shellfish water

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Burry Inlet is a large estuarine complex located between the Gower Peninsula and Llanelli in South Wales. It includes extensive areas of intertidal sand and mud-flats, together with large sand dune systems at the mouth of the estuary. The estuary experiences a wide tidal fluctuation (about 8m) which regularly expose a large extent of intertidal sediments. The Burry Inlet supports large numbers of overwintering wildfowl and waders that feed in the saltmarshes and on the intertidal areas. The site contains the largest continuous area of saltmarsh in Wales (2,200 ha). The Gowerton WwTW Sea Outfall is one of the continuous discharges to the inlet. Over the past decade the outfall has experienced localised collapses triggering sinkholes at ground level. In 2012/2013 Dŵr Cymru Welsh Water rehabilitated sections of the outfall at a cost of £2.25m as part of their AMP5 works to upgrade existing wastewater infrastructure.



Final exposed section of outfall to point of discharge at low tide - Courtesy of Arup

Environmental sensitivity

Gowerton Outfall falls within an area covered by a number of environmental designations including:

- Burry Inlet and Loughor Estuary Site of Special Scientific Interest (SSSI).
- Carmarthen Bay and Estuaries Special Area of Conservation (SAC) for the protection of certain habitats and species.
- Burry Inlet Special Protection Area (SPA) for the protection of certain wild bird species.
- Burry Inlet Ramsar for the conservation of wetlands.

Time for action

Gowerton Sea Outfall serves the continuous gravity discharge of treated effluent and intermittent storm discharge from Gowerton WwTW. It is consented to discharge UV treated effluent totalling 52,863m³/day (max rate 612l/s) and storm flows exceeding its Flow to Treatment consent.

The outfall is 3,828m long with the vast majority of it (3,693m) twin 1,280mm diameter pipe. The final partially exposed section across the sand/mud-flat is a single 2,000mm diameter precast concrete pipe. Approximately 2,000m of the outfall runs under the saltmarsh.

The make up of the twin 1,280mm diameter pipe was unfamiliar and not used elsewhere within Dŵr Cymru Welsh Water. The pipe consisted of a thin outer casing of GRP and a reduced inner thickness of concrete. It was reported to be manufactured by a company called *Dekkon*. Internet searches to advance the team's understanding on the *Dekkon* thin walled pipes proved fruitless.

A short section of the pipe collapsed in July 2004, with additional collapses occurring soon after due to a rippling effect from the initial collapse. In September 2008 sewage ponding was observed at ground level above the pipe within the saltmarsh. There were reports of bubbling at high tide and the conclusion was that the remaining thin-walled pipes were at risk of further failure. Replacement of 1km of twin pipe in the saltmarsh was included in Welsh Water's PR09 Business Case submission to OFWAT for AMP5.

A further collapse occurred late in 2009, this time on the section of pipe near to the WwTW, 1.8km from the saltmarsh. Prior to this collapse the aggressive nature of the saltmarsh was believed to be the cause and it was considered that the length within the saltmarsh was at the greatest risk. However, the 2009 failure brought into question the condition and potential for collapse along the whole of the outfall length.

The pipe collapsed again in July 2011 within the saltmarsh, during what was by now the AMP5 feasibility stage for the project. This gave the design team an opportunity to investigate the collapse mechanism directly.

Confirmation of risk and need

The entire length of the outfall was CCTV surveyed. The internal condition of the pipe was graded in accordance with the Manual of Sewer Condition Classification, WRC, 2004. Due to uncertainty over the structural integrity of the combined materials in the manufacture of the *Dekkon* pipe, a cautious approach was taken

with a recommendation that all structural defects graded 3 and above would require rehabilitation.

The structural defects above grade 3 were fairly evenly spaced out over the sections of outfall through the saltmarsh. However, a number of them fell outside of the 1km length that was initially earmarked for off-line replacement in the PR09 submission. The proposal taken forward was to locally rehabilitate sections using structural lining as this would allow a greater extent of outfall defects to be alleviated.

Design and construction

The key project participants were:

Client	Dŵr Cymru Welsh Water
Principal Contractor	Morgan Sindall plc
Technical Consultant	Arup
Commercial Consultant	EC Harris
Re-lining Contractor	iLine (part of iGroup)

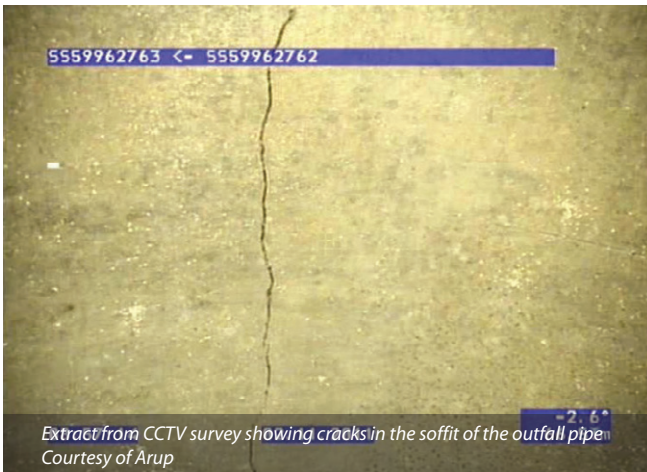
Pipe rehabilitation operation

Methods of working were discussed and agreed with the Countryside Council for Wales (CCW) and all necessary environmental consents were obtained prior to the start of works.

To minimise disturbance to the SSSI during construction, an existing farm stone access track was used to gain access to the outfall. Each work area was demarcated using stock proof fencing installed to ensure segregation from livestock sharing the saltmarsh. Once site areas were established, heavy duty timber bog mats were used for access from the track to the excavation locations and to provide a stable working platform for undertaking the rehabilitation work and to further help minimise damage to the SSSI.



July 2011 collapse showing cracking of the inner concrete pipe crown - Courtesy of Arup



Extract from CCTV survey showing cracks in the soffit of the outfall pipe
Courtesy of Arup



Gowerton Outfall - Courtesy of Morgan Sindall



Lining process - Courtesy of iGroup

The site is subject to occasional tidal inundation when high tides flood the area. Careful planning was required to ensure the workforce was not put at risk and plant and materials were not lost or damaged.

To enable sewer lining to be undertaken without being affected by all but the highest tide and to provide long term protection to the sewer, 2 (No.) new 1,250mm square flap valves were installed within an existing bifurcation chamber close to the end of the outfall. Within this chamber 2 (No.) redundant penstocks had to be removed with the work carried out at low tides within a two hour working window. In order to work on either one of the existing sewers, a safe system of work was implemented that allowed either of the twin outfall pipes to be isolated at Gowerton WwTW at any time.

With distances between existing chambers of 400m, lining of the sewer was undertaken from both existing chambers and new access excavations. To access the existing pipes mid run, steel sheet piled cofferdams were designed to support the excavation sides of each pit. These were 8m by 6m in plan spanning over both pipes. Where the cofferdams were installed the existing saltmarsh turf was stripped and carefully placed on lined timber pallets for safe storage. These pallets were transported to an area that was not tidally inundated.

The depth of the excavations did not exceed 5m, but due to the ground conditions varying from soft silty clay to coarse granular gravels and the high ground water pressures, the design comprised Larssen L602 sheet piles, three levels of waler frames with the lowest being Super Tank Braces and a tension frame externally at ground level around the top of the structure.

Sheet piles were pre-driven using a 25T excavator and piling hammer to minimise ground loss during installation and provide stability. All excavated material from the pits was taken to a temporary store that was not tidally affected to await re-use as backfill. Care was taken during excavation to ensure that the existing pipes were not damaged further. Localised support to the existing pipes was provided using timber forms and steel tie bars to help ensure collapses were avoided.

Groundwater was a major issue during excavation and particularly once at formation level with water following bed and surround of the existing pipes. Hydraulic submersible pumps were set up in sumps within each cofferdam which were discharged to approved locations on the saltmarsh.

Lining process

With flows being controlled within the live sewer, the isolated Dekkon pipes were cut into to enable access for the lining work. Lining of the 1,280mm diameter pipes was carried out by iLine using their EnviroCIPP high performance ultra violet cured liner in lengths up to 106m with the liner being sourced from Germany. This is the first time in the UK that a liner above 1,200mm diameter has been cured by this method.

Prior to lining, CCTV survey was undertaken and debris was removed by a recycling vacuum tanker. An electric winch was set up at one end of the lining section and the wire pulled through the sewer to the pit where the liner weighing up to 10T was located. Using a spreader beam and supporting ramp the liner was lowered into the excavation where it was attached to the winch wire and pulled back through the pipe.

On locations where the existing pipes were in particularly poor condition, where water ingress or potential sharp edges of pipe may have resulted in damaging the liner, a plastic pre-liner was installed. Once the liner was in place, packers were installed to seal the ends and the whole liner was inflated to 250 millibar to achieve

the profile of the existing pipes. A further CCTV survey was carried out to check for deformations or creases in the liner before the UV light train was introduced to carry out the curing process.

Challenges

The works were originally programmed to be completed in a short timescale to reduce the length of time that the salt marsh vegetation was covered. However, due to various unexpected issues the construction period was longer than anticipated.

Throughout the project the site team faced tough challenges due to working in and around the tidal conditions of the Loughor Estuary. Very wet and windy weather prevailed throughout the majority of the construction and made site conditions difficult for maintaining access tracks and minimising damage and disturbance to the sensitive environment.

One particular section towards the end of the outfall proved extremely difficult due to the extent of degradation of the existing pipes and the subsequent high level of groundwater inflow. In addressing the inflow, some tidal windows were missed resulting in prolongation of this element of work.

A number of dewatering pits and holes were cut into the invert of the existing pipe to ensure water flows were sufficiently low to avoid damaging the uncured liner as it was installed. A total of 18 (No.) hydraulic and electric submersible pumps with approximately 2.5km of hose were used to complete this lining process.

Reinstatement

On completion of the liner installation, the sections of existing pipe removed within the excavations were replaced with 1,350mm diameter Asset International Weholite HDPE pipe. The new pipe sections were connected to existing 'sound' pipe using Teekay couplers prior to being backfilled.

The original turf that had been stripped from each pit was replaced in the same location to ensure that species of grass were returned to their point of origin to maintain the varying ecological conditions across the site. Under the licence from CCW, no topsoil was imported onto the site.

On removal of the timber matting from the working areas the condition of the remaining topsoil and grass varied considerably.

Further discussions and site visits with the Countryside Council for Wales (now Natural Resources Wales) and the landowner have enabled a reinstatement plan to be developed that meets the requirements of all parties. This is now being put in to place and the working areas are starting to recover.

A long term plan has been implemented and the areas shall remain free from grazing with regular reference point photography to monitor the progress of natural re-establishment.

Conclusion

The successful completion of this complex scheme sees a significant improvement in the integrity, performance and longevity of this critical asset.

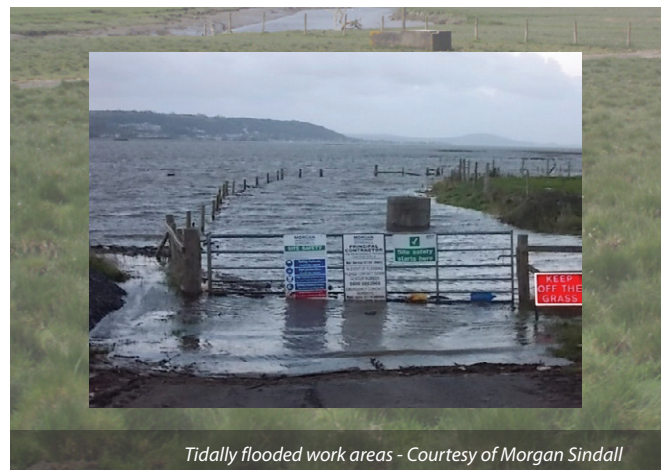
This investment by Dŵr Cymru Welsh Water will protect the long term ecological value of the area and help safeguard the quality of the surrounding waters.

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UV CIPP Light Train - Courtesy of iGroup



Tidally flooded work areas - Courtesy of Morgan Sindall



View across the saltmarsh - Courtesy of Arup