Saltney & Kinmel Bay Rising Main Replacements

securing long term operational performance and preventing pollution

by Gethin Jones MEng (Hons) & Aled Morgan BSc (Hons)

The Saltney rising main transfers sewage from the Chester Street SPS at Saltney to a gravity sewer leading to Chester WwTW. The Kinmel Bay rising main transfers sewage from Marine Lake SPS, Rhyl to Kinmel Bay WwTW. As a result of several bursts, mainly in GRP pipe, and performance issues in recent years on two major sewage rising mains in North Wales at Saltney and Kinmel Bay, Dŵr Cymru Welsh Water commissioned Waterco Consultants to produce System Assessment and Replacement Feasibility Study reports which led to replacement mains being installed immediately afterwards.

Saltney access chamber on South side of the railway - Courtesy of Waterco Consultants

Design

Following the submission of these reports, Waterco Consultants was commissioned by Dŵr Cymru Welsh Water to undertake the detailed design for replacement of both rising mains. The detailed designs were largely a development of the options recommended in the feasibility reports, extended to a point where competitive tenders could be obtained from a select list of three framework contractors.

O'Connor Utilities Ltd was selected by Welsh Water on a 60% quality and 40% price basis as a 'preferred contractor' with a target sum set. In order to reduce risks, improve the constructability and arrive at a fixed all risk price, a design development stage then took place with Welsh Water working collaboratively with Waterco and O'Connor Utilities.

It was agreed that directional drill should be the method of installation under the main rivers of the River Dee (Saltney) and the River Clwyd (Kinmel Bay) to minimise the potential environmental and ecological impacts. This also meant that flood embankments could be left undisturbed.

Polyethylene (PE) pipe was identified as providing the most cost effective solution based on whole life value and constructability. One advantage of using PE pipework is that it removes the requirement for thrust blocks at bends and fittings. Ductile Iron tee pieces were included to connect the air valves at either side of the river crossing to provide air traps. This would also allow access into the pipeline in future; the remainder of the air valves were specified using PE saddles for ease of construction and to provide a cost saving without compromising the design requirements.

Ground contamination was a concern on both projects due mainly to the proposed route passing through or very close to former tip sites. However ground investigation works did not identify any contamination issues of concern at Saltney or Kinmel Bay and ongoing monitoring during construction confirmed the decision not to specify any protection to the pipe, other than a clean imported bed and surround.

Saltney

One of the reasons for replacing the rising main at Saltney was that the dual 300mm diameter river crossing had suffered a burst. This meant that flows were running through a single 300mm diameter pipe under the River Dee at a reduced flow rate.

During feasibility, several options were considered including the rehabilitation of the existing crossing, and the addition of cross connections. Following peer review a new single directional drilled crossing was taken to detailed design.

The rising main at Saltney was sized for both the current flow rate (around 360l/s) with consideration also given to the projected future increased flow rate (430l/s) due to significant population growth anticipated in the area.

The pipe size was selected to provide relatively high velocities to minimise the risk of solids deposition and a 560mm O.D. SDR17 PE100 pipe was selected for the majority of the pipeline.

For the river crossing a 630mm O.D. SDR11 PE100 pipe was used to provide a thicker wall to accommodate the stresses resulting from the directional drill method used to install this section of pipe.

A key constraint to the design and construction process was that Chester Street Sewage Pumping Station did not have any significant storage available. This meant that shutting the pumping station down for any length of time would not be feasible. To be able to install the new pipework, an overland bypass was connected to temporary pumps installed in the wet well at the pumping station.

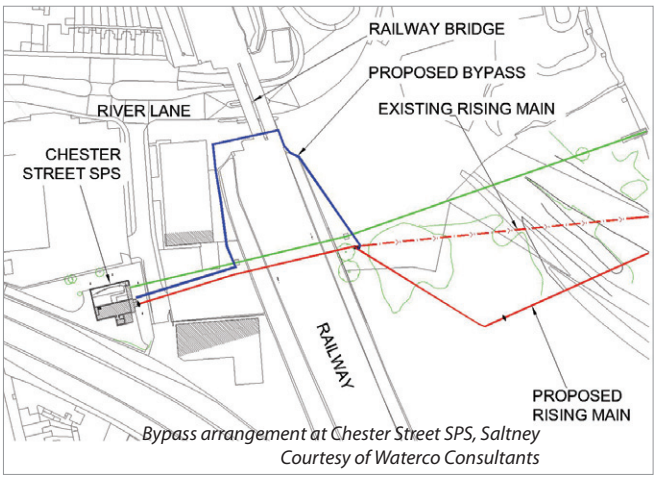
The overland bypass ran through the car parking area adjacent to the pumping station, passing under the railway bridge at the nearby River Lane and then back to the line of the existing rising main on the north side of the railway. The bypass pipe was buried under the car park and access road to avoid significant disruption to the car park and access road for the neighbouring shops.

An existing above ground sluice valve chamber provided a suitable connection point at Chester Street SPS. The sluice valve was removed and an air valve installed in its place which will provide easy access for any maintenance work/air release necessary in the future.

The existing rising main crosses underneath the Chester to Holyhead railway near Chester Street SPS through a 1,200mm diameter precast concrete tunnel. Several options were considered for replacing this section of pipe including: keeping the existing tunnel and pipe; installing a new tunnel and new pipe; extending the directional drilling to include the railway crossing as well as the river crossing; and replacing the pipe within the existing tunnel.

It was decided that the most suitable option would be to replace the existing pipe with a new pipe within the existing tunnel. This option did not require an Asset Management Plan from Network Rail as there would be no disruption to the operation of the railway. A further benefit following consultations with Network Rail was that there was no requirement for a new wayleave, or easement agreement.

Selecting this option however, presented a potential problem for construction during the removal of the existing pipe within the



Bypass arrangement at Chester Street SPS, Saltney
Courtesy of Waterco Consultants


Saltney River Dee crossing- Courtesy of Waterco Consultants


Saltney directional drilling rig - Courtesy of Waterco Consultants


560mm OD PE100 SDR17 pipe being prepared for installation on the north side of the River Dee at Saltney - Courtesy of Waterco Consultants


Kinmel Bay WwTW to River Clwyd - Courtesy of Dŵr Cymru Welsh Water


Pipe welding machine at Kinmel Bay
Courtesy of Waterco Consultants


Railway crossing near Marine Lake, Kinmel Bay
Courtesy of Waterco Consultants


Directional drilling rig at the River Clwyd crossing, Kinmel Bay
Courtesy of O'Connor Utilities

tunnel as the existing main was leaking within the tunnel and the inspection chambers on either side of the railway were flooded. This limited access to the tunnel for inspection and there were no as-built details for the existing asset indicating how the pipe had been laid within the tunnel; i.e. had it been grouted in?

The route for the replacement of the remainder of the rising main followed alongside the route of the existing rising main on the north side of the river (in agricultural fields and alongside a former tip site) before connecting to an existing discharge chamber. Here the system allows flows to continue to Chester WwTW via a gravity sewer network.

Due to the lack of storage at Chester Street SPS, the connection was planned to be made whilst the existing rising main was live. In order to achieve this, a new 2,100mm diameter chamber was designed around the existing rising main with a 1,500mm sump to allow for overpumping to the next existing manhole downstream.

In terms of ecology, significant tree clearance on the Saltney side of the River Dee was a potential threat to nesting birds. Tree clearance was therefore scheduled to occur before the nesting season. The disturbance of badgers was also a concern and a licence to disturb their habitat was obtained.

Directional drilling has been completed and the river crossing has been installed successfully. The Saltney rising main project is on schedule to meet planned completion date of July 2014.

Kinmel Bay

The existing 3.9km rising main installed in the 1990s contains a total of 2.8km of GRP pipe (mostly 700mm diameter). Four bursts have occurred in the last five years and replacement was recommended following a system assessment which included some vibration complaints near the pumping station.

The existing flow rate was used for Kinmel Bay as no significant population growth was forecast and it was concluded that any additional flows due to nominal future growth could be accommodated by removing surface water from the sewerage network. A 710mm O.D. SDR17 PE100 pipe was specified for the entire length of PE pipework. A thinner walled pipe was also considered; however as this only provided a limited structural factor of safety it was discounted on a cost/risk basis.

Six different options were considered when selecting the route of the replacement rising main at Kinmel Bay:

1. Retaining the existing route – burst / relining existing rising main and retaining the existing river and railway crossings.
2. Following the existing route with a new offline replacement and retaining the existing river and railway crossings.
3. Diversion around the urban area of Kinmel Bay following the southern boundary.
4. Following the existing route with a new offline replacement and utilising the bridge crossing.
5. Following the railway line west on a new route then turning south to the WwTW.
6. Diversion well away from the urban area across rural land to the south and east.

Option 6 was selected. Although it was the longest route at around 4km, it limited work and disruption within the urban areas. A new route provided the opportunity to remove the rising main sewer from within a residential street that had experienced difficulty with noise and vibration. Furthermore, the new route reduces the risk of diversion in the future as it is outside the current development plan.

However, as a result of diverting the rising main away from the urban area, it was necessary to divert flows from an existing

Sewage Pumping Station which pumped into the existing rising main. Several options were considered including the construction of a treatment facility to allow for discharge to a local watercourse. The selected option was to modify the SPS to pump to the nearest gravity sewer system. This required the construction of a 90mm O.D. SDR17 PE100 rising main approximately 400m to the nearest manhole on the gravity sewer. The pumps were also replaced with 2 (No.) Flygt FP3068LT chopper pumps.

As the new route for the rising main required a new under track crossing (UTX) of the Holyhead to Chester railway, Network Rail was consulted in order to understand their requirements to ensure that the proposed rising main would not compromise the structural integrity and stability of the railway embankment.

Several options were considered including directional drilling and utilising existing crossings. However, as Network Rail had confirmed that a sleeve was required, it was decided that a tunnel installed by auger bore would be the most cost effective option.

In order to ensure that the works did not compromise the railway embankment, Network Rail specified an exclusion zone which was defined by taking lines at 45° in the vertical direction at 3m offsets from each edge of the railway.

The proposed route of the new rising main passed very close to an amenity lake (Marine Lake) and passed under a 'Miniature Railway' which runs alongside the lake. It was considered at one stage to fill in one corner of the lake to allow for the installation of the rising main, however it was decided that if the rising main was kept away from the lake as much as possible, this would not be necessary. The Miniature Railway had to be temporarily removed and reinstated after construction of the pipeline. Scheduling was important in this respect in order to complete this work during the winter off-peak period and minimise any disruption.

A main access road into Kinmel Bay (St Asaph Avenue) required crossing. To minimise disruption and obviate the safety implications of traffic management on this busy road, auger bore was selected for this road crossing.

To facilitate continued access to the WwTW and the construction of the rising main at the inlet to the works, a second access road was constructed. The additional site road has been left in place, to allow for the implementation of a one-way system at the WwTW.

A surge analysis was undertaken on the proposed rising main prior to construction to assess whether any performance issues were likely or if any improvements could be made. The surge analysis also confirmed the specification of the air valves including surge suppression and optimised their positioning.

During the feasibility study a desk based ecology survey was carried out to give an indication of any key ecological issues that may be present. Once commissioned to carry out detailed design, the desk study was enhanced to meet Full Phase One requirements.

The Full Phase One led to specific mitigation methods, techniques and timings being incorporated into the construction programme in accordance with ecological guidelines. A typical approach was applied to badgers, water voles, otters, and hedgerow and tree clearance (e.g. before March for nesting season).

The results of the ecology survey also highlighted that Great Crested Newts, a European Protected Species (EPS) could be present. The traditional approach and timing of full Great Crested Newt Survey, Application for EPS licence and 30 days of trapping would have caused the construction programme significant delay.

The scheme ecologist in conjunction with Natural Resources Wales offered an alternative solution: as the project was considered "temporary disturbance", and the time of year was favourable for topsoil stripping, the use of a novel Great Crested Newt computational model replaced a full survey.

The Amphibian & Reptile Conservation Trust (ARC) used recorded data from previous extensive surveys of North Wales to create a model that predicted newt pathways and the likelihood of their being present. The results formed the basis of the EPS licence application. This approach enabled trapping to commence once temperatures at night were consistently above five degrees C; and brought the programme forward by approximately two months.

The planned completion date for the rising main at Kinmel Bay is March 2015, however the river crossing was completed in May 2014 and so early completion is expected.

The Editor & Publishers would like to thank Gethin Jones, Assistant Engineer with Waterco Consultants, and Aled Morgan, Project Manager with Dwr Cymru Welsh Water, for providing the above article for publication.

Kinmel Bay - River Clwyd to Pumping Station - Courtesy of Dŵr Cymru Welsh Water