Mersey Valley Sludge Main River Irwell Crossing

design and installation of a new sludge transfer main across the River Irwell

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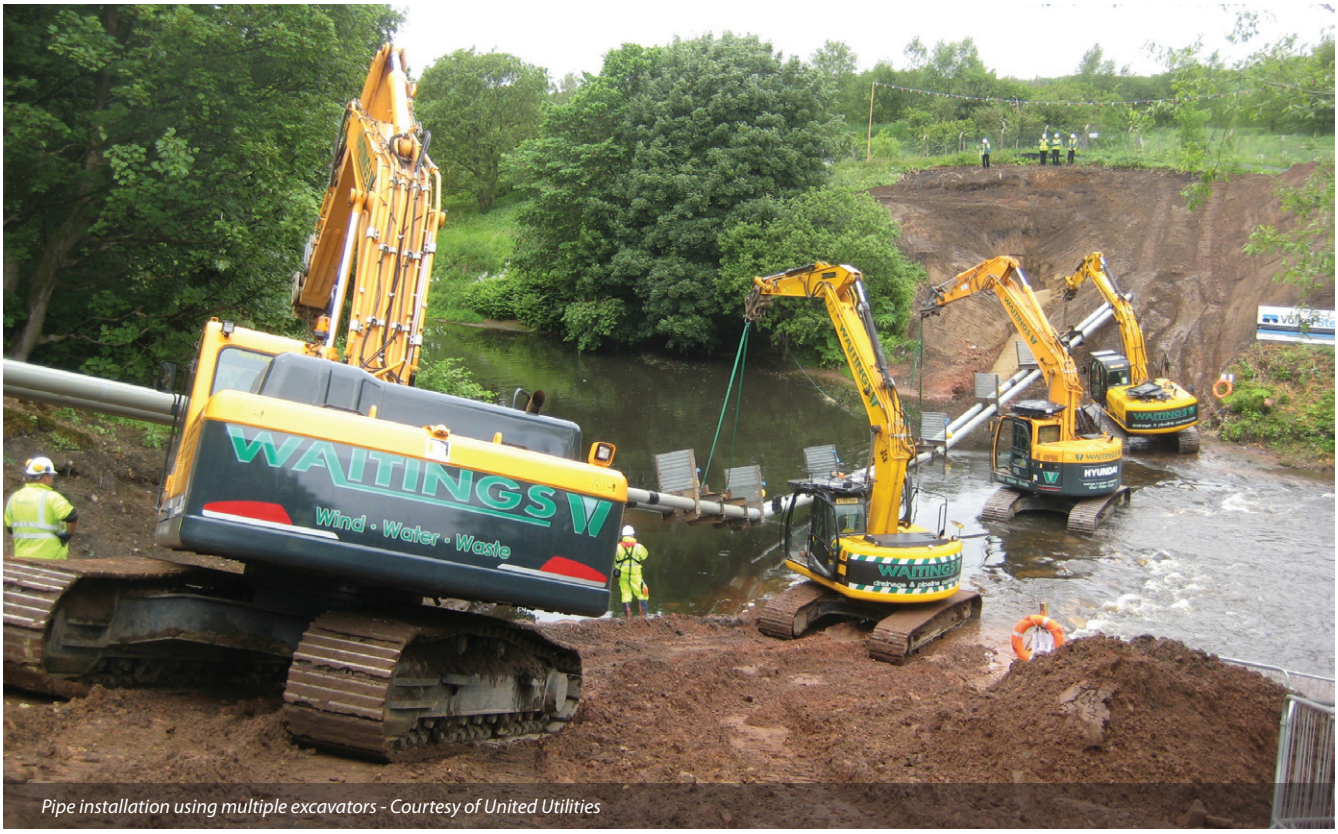
August 2013 saw the successful completion of a new twin steel pipe crossing the River Irwell to replace an aging existing asset. The installation required meticulous planning by the project team working for United Utilities (UU) on a £0.9m scheme to continue the company's vital work upgrading its pipeline network. This project was part of a £3.6bn investment programme by United Utilities across the North West to improve water quality and the environment by 2015.



Pipe installation using multiple excavators - Courtesy of United Utilities

Background

The Mersey Valley Sludge Pipeline (MVSP) is a key strategic asset to United Utilities which transports sludge from the Pennine area in the east and the Liverpool area in the west to the Mersey Valley Processing Centre (MVPC). Once received at the MVPC sludge is dewatered and either incinerated or recycled to agricultural land. The sludge pipeline enables UU to dispose of sludge in the most cost effective way possible.

The MVSP pipeline was starting to indicate degradation of condition suggesting that the existing pipeline had reached the end of its serviceable asset life. The pipeline has suffered bursts in several different locations which were repaired locally. The frequency of these bursts started to increase and, due to the proximity of the River Irwell and the risk of pollution, a longer term permanent solution was required.

Existing pipeline

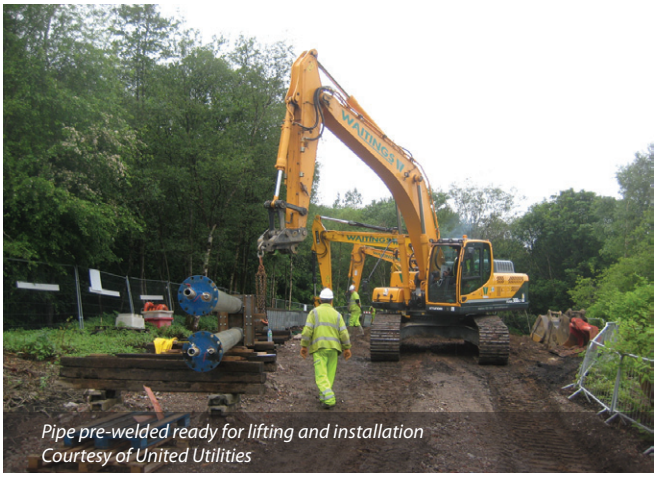
The section of the MVSP under consideration as part of this project is an existing single 250mm ductile iron pipe which connects the Rhodes Farm Pumping Station at Bolton WwTW to the Davyhulme WwTW to the west of Manchester. This normally operates at a maximum capacity of 2,000m^3 per day but due to the deterioration of its condition was operating at reduced flows and pressures. This operating restriction resulted in knock on impacts on the operational inefficiency of the sludge treatment.

The pipeline crosses through the existing Rhodes Farm site along the river banks before crossing under the River Irwell and through Clifton Country Park. The existing cast iron pipe was understood to have a wall thickness of 8mm when constructed, however pipe sections retained following historical bursts indicated only 2mm remaining typically. This reduction in wall thickness appeared to be both internal and external corrosion. The internal corrosion was believed to be caused by abrasion from the high grit content of the sludge and this would be of concern to the proposed solution.

Solution

The outline design phase was undertaken in 2012 and considered and technically assessed a number of options including directional drilling, internal lining and full offline replacement. The process identified a preferred solution to construct an offline replacement twin pipeline parallel to the existing. The installation offline allowed the existing pipeline to remain operational during construction. Twin pipes ensured availability of a standby line to cater for any future maintenance requirements.

Pipe crossing trench prepared - Courtesy of United Utilities



Pipe pre-welded ready for lifting and installation
Courtesy of United Utilities

Pipe installed within trench - Courtesy of United Utilities

Concrete backfilling of the trench within the river
Courtesy of Volker Stevin

Consideration was also given to the preferred pipe material which needed to be resistant to the abrasion internally from the sludge. The selected material was circa 125m length of 273mm steel pipe 9.3 thick grade P235 GH. The wall thickness was increased above that required for structural and pressure loadings to incorporate some sacrificial wall thickness should the internal coatings fail and abrasion/corrosion occur. The pipe would be coated internally to with a 1mm epoxy coating and externally with a multi-layer plastic type coating.

The new pipeline would be buried along its entire length including under the river bed where an additional concrete surround would be provided. The final profile of the works could not impact on the existing river profile. A preliminary route for the replacement pipeline was developed which minimised the impact on the existing main and ecological constraints for the location.

Connection to the existing main would be via two connections at the top of the adjacent river banks. A switch over chamber was included at these locations to allow for the transition between the two mains using pipework modifications. A system of valves to divert the flows was not considered acceptable due to the pressures and nature of the sludge.

Ground conditions

Geological records of historical ground investigations indicated that the natural deposits comprise mainly of soft sandy organic clay and loose clayey sand (alluvium), overlying sandstone. The sandstone was exposed in the bed of the River Irwell within the vicinity of the proposed pipeline crossing. In addition the Irwell Valley Fault passed close by the western bank of the river and marked the western boundary of the sandstone. The location also has historical mine working upstream on the Westphalian B Coal Measures.

Ecological

The Rhodes Farm site to the north of the works contained a significant population of Great Crested Newts. In order to minimise the potential impact on this protected species the working area on the north river bank was minimised and there was no direct access traffic route via the farm. Temporary amphibian fencing was installed in this location.

Surveys of the river banks identified the presence of Japanese Knotweed, Himalayan Balsam and Giant Hogweed which are all classified as invasive weeds. Working methods had to be developed for treatment and temporary storage to ensure spreading was prevented. There was also a site adjacent to one of the access tracks which contained common spotted orchid, a protected species which had to be avoided.

The southern river bank and working area/access routes were within Clifton Country Park which is a local nature reserve and Site of Biological Interest. Works within the River Irwell were governed by both temporary and permanent EA watercourse consents and could not be undertaken during the migratory fish (brown trout/ bullhead) period.

Design progression

Following completion of the outline design by United Utilities Engineering, Volker Stevin successfully bid and was appointed as principal contractor by United Utilities to undertake the works in 2013. GHA Livigunn was subsequently appointed by Volker Stevin to provide detailed design services.

The first activity undertaken by Volker Stevin was to undertake a topographic survey of the location including the river channels. This allowed the most suitable location for the pipeline crossing to be agreed and a detailed river profile produced. The route of the new pipeline was constrained by local ecology, invasive species, existing land drainage discharges and the depth of the river channel. The

parties worked in close cooperation to produce a final design which reduced the quantities of excavation therefore limiting any impact on the location. The connection chambers were located at the top of the river bank and designed as segmental shafts.

Access

Access to the working area was only possible via an existing tile factory access road and the Clifton Country Park. The route through the country park included a crossing under the M60 motorway and was adjacent to a live railway line. No access was available via the Rhodes Farm site and therefore a shallow causeway was required within the river. Should river levels rise then pontoons were available to facilitate access across the river as a contingency. The Rhodes Farm side of the river was also in proximity to a disused canal and underneath National Grid pylons. Due to the public visibility of the construction works within the country park, a third party management plan was implemented.

Installation

The first activities undertaken were the installation of two silt traps across the river downstream which allowed the causeway to be constructed. A system for monitoring river levels upstream was established to provide an early warning of any potential river levels increases or flash floods. Turbidity measurements in the river were also undertaken regularly during the works. The trench excavation was undertaken using 30 tonne excavators with the option of using a rock tool for areas where harder sandstone were encountered. No additional trench support was required.

The steel pipe selected was supplied by FT Pipeline Systems Ltd and incorporated their E-Type jointing system to eliminate damage to the internal coating during welding. The pipe was delivered by road and then welded into a single 55m length incorporating 13 and 16 degree bends. This section matched the profile of the excavated trench in the river and would be installed in a single operation. A temporary spacer arrangement was used to provide the required separation for the twin pipes as well as provide lifting locations for the installation. Temporary formwork panels were also attached to these lifting frames to allow the concrete backfill to the pipe to be undertaken in stages.

The installation of the pipe in the river was successfully undertaken with sub-contractor Waitings during a single day shift in June 2013. Four excavators were used to lift and track the pipe through the river and lower the pipe into the trench. A bespoke temporary working platform was fabricated to sit on the pipe within the trench in the river to facilitate the pouring of the mass concrete surround. Due to difficult site access and the distance of the trench to the river bank pumping of the concrete was not feasible, so a tremmie hopper supplied with concrete by skips was used to undertake the concrete works.

Two further sections of the pipe were installed to connect the river crossing to the new connection chambers and existing pipeline. Following the required testing and commissioning of the new pipeline the existing pipe was flushed and capped.

Conclusions

The successful completion of the Mersey Valley Sludge Pipeline project without incident and in a sensitive location is a reflection of the ingenuity and commitment of the project team.

It will provide long term security to a key strategic asset transporting sludge for processing.

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