

Clifton Rising Main

replacement of a failing rising main through an ecologically sensitive and environmentally rich area

by Mark Ewen MEng CEng MICE

Clifton Rising Main in York conveys combined sewer flows over 1.3km from Clifton Hospital Sewage Pumping Station to the inlet works at Rawcliffe STW. The route of the pipe passes through Clifton Ings, Rawcliffe Ings and Rawcliffe Meadow. The Ings and Meadow incorporate over 180 different types of wildflowers and grasses, with the grassland, wetland and copses being home to many birds, mammals and invertebrates. This includes numerous protected species, such as Tansy Beetles, whose only residence in the UK is along a 30km stretch of the River Ouse. Replacement of the existing main was necessary because there had been thirteen bursts since 2004 and the new pipe would significantly reduce the risk of pollution to the surrounding area. Design and build contractor Mott MacDonald Bentley (MMB) was contracted by Yorkshire Water (YW) to install approximately 1.7km of 280mm HDPE rising main together with its associated ancillaries such as washout, air valve and bypass chambers.



Installation of the new rising main - Courtesy of Mott MacDonald Bentley Ltd

Engineering challenges

During the design and construction of the project several challenges were presented, which included (i) interaction with the Environment Agency's (EA) flood bund which had been constructed over the existing rising main (ii) working adjacent to the River Ouse; (iii) crossing beneath the EA's flood basin and (iv) establishing a connection into the discharge point of the rising main within the highly congested Rawcliffe STW. Engaging the construction team at an early stage was vital to ensure all of these potential difficulties were overcome.

Due to the unknown construction of the flood bund the decision was taken to avoid any crossings, which also ensures any future bursts will not discharge directly into the river.

The construction work was programmed for summertime – this generally being a period when groundwater levels are at their lowest, and although more frequent, storm flows subside quicker. This greatly reduced the risk involved in crossing beneath the flood basin, particularly as the new rising main was twinned at this point to mitigate future pollution incidents in this area.

Detailed ground penetrating radar surveys of Rawcliffe STW allowed a corridor of certainty to be established for the new main. Also, by proving the condition of a section of the existing rising main within the STW's grounds, the intrusive work required within this area was greatly reduced.

Innovation

Importantly, at the commencement of the scheme, the project team considered why the existing rising main was failing, rather than simply undertaking a like-for-like replacement. To do this, several innovative techniques were used including analysis of failed pipe sections, state-of-the-art surge modelling techniques and a ground laser topographical survey.

Surge analysis demonstrated negative pressures acting on the main were a major contributing factor to the failures of the existing main. This was remedied by provision of a surge vessel to allow the negative surge to be discharged without causing damage to the pipe.

Following the surge assessment, the profile of the new main was reconsidered to rationalise the number of high and low points along its length. This also reduced the number of washouts and air valves that were required; the locations of which were chosen to make them readily accessible and to avoid the need for provision of new maintenance access.

The potential impact of constructing a new 280mm diameter main in this sensitive area was significant and it was therefore imperative that Mott MacDonald Bentley reduced its impact on all fronts to a minimum wherever possible. Close collaboration between designers, the site team and no-dig specialists allowed an early decision to be made to install the new main by directional drilling. This would significantly reduce the footprint of the works and minimise the environmental impact.

The YW asset standard design for rising main ancillaries was challenged for this site, which led to the development of an optimised air valve and washout chambers product, reducing the footprint of these structures by 40%.

Community engagement

From the outset of the project, MMB collaborated with the YW Community Engagement Team, as full engagement of landowners, statutory bodies and stakeholders, was vital for the delivery of a sustainable outcome.

This included forming and maintaining close relationships with the Friends of Rawcliffe Meadow (FRM) who are a group of volunteers who protect, conserve and enhance the area; the City of York Council; the Environment Agency (EA); and Natural England.

Ecological improvements

This approach identified numerous opportunities for ecological improvements that could be included within the scheme:

- New Tansy Beetle habitats which would be secure from summer flooding were established.
- Vandal proof interpretation boards were provided to help promote the rich fauna, flora and ecological value of the area.
- The project team contributed to the creation of a 'sand bank' habitat outside of the flood zone for the local colony of Sand Martins on the River Ouse, which had previously been washed out several times.
- Additional cells within the EA flood basin were designed and constructed to encourage the development of emerging and indigenous species for which the basin provides a habitat.
- Drainage grips were provided to improve the irrigation of areas affected by the previous bursts.



Main photograph: Route of the new rising main - Inset: Directional drilling to minimise environmental impact - Courtesy of MMB Ltd

- Working proactively with the EA to ensure that the scheme addressed all outstanding issues from previous incidents.

During construction, 98% of waste material generated was diverted from landfill, further enhancing the scheme's sustainable credentials. The use of prefabricated units and standard products for washout chambers, air-valves and valve chambers also decreased site programme compared to in situ concrete methods, ensuring the natural environment could be restored as quickly as possible.

Health, safety and welfare

An interdependent attitude towards health and safety, where the entire project team took ownership for this, helped achieve high standards, reflected by the Accident Frequency Rate (AFR) of 0.0 over a three month construction period (whilst completing the scheme three weeks ahead of programme).

Adopting no-dig construction techniques for provision of the new main helped minimise temporary ground support and reduced work within confined spaces by over 90%.

Moreover, the need for confined space entry during future operation has been minimised by making all plant maintainable from the surface, a specific example being the new washout and air-valve arrangements, which were designed to be 'fail-safe' and buried.

Interaction with the public

Yorkshire Water's Clifton Rising Main scheme has ensured the risk of pollution incidents in this highly valued ecological area has been significantly reduced. By adopting the most considerate means of construction, coupled with a significant programme of short and long term ecological enhancements, we have left a positive legacy, which will be to the benefit and enjoyment of many future generations.

Moreover, this work is assisting the Friends of Rawcliffe Meadow to achieve their desire to have the area designated as a Site of Specific Scientific Interest (SSSI) – something which Natural England is now in the process of considering.

The scheme has benefitted Yorkshire Water's customer relations by boosting their media score and enhancing their reputation within the community, as well as supporting YW in achieving their Trusted Company Strategic Business Objective.

The scheme has turned a negative into a positive, and has received several commendations. This included Dr Mick Phythian of FRM who stated:

"The Friends are grateful to Yorkshire Water along with their contractors MMB for the additional works and funding towards Rawcliffe Meadows, and for their constant liaison and consultation with us before, during and after the work to replace the rising main".

Conclusion

This project is an excellent example of civil engineers leaving a positive environmental legacy. Early engagement with statutory bodies and stakeholders ensured numerous challenges were overcome, delivering a successful scheme in a sensitive and highly valued environmental habitat. .

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