

Birmingham Resilience Project

Client:	Severn Trent Water
Location:	Stourport-on-Severn to Frankley
Value:	£83m
Duration:	3 Years

In Brief...

Birmingham is served by a single source of potable water; from Wales, via the 110 year old Elan Valley Aqueduct (EVA) and Frankley Water Treatment Works (WTW). The aim of this collaborative project was to work with Severn Trent Water to provide resilience for this primary clean water supply. The Birmingham Resilience Project (BRP) will provide an alternative water supply for periods of up to 50 days every two years. This will enable a full shut down of the EVA allowing STW to carry out essential maintenance on the Aqueduct. Barhale were engaged by STW to deliver a new 26km, cross country steel pipeline, as well as all associated pump stations and implementations for 'Operational Readiness'. Overall, the project spanned 20 individual sites and employed 220 personnel at its peak.



Drive Shaft for 430m-long Tunnel

Technical Features...

Barhale were engaged as Principle Contractor and Principal Designer to install:

- 26km of cross country pipeline, 1067mm diameter in welded steel
- 1 no. pumping station. This included four of the biggest pumps on Severn Trent Water's network, working at a capacity of 50ml/d each

The team constructed a new intake on the River Severn to extract up to 140ml/d. This flows 320m through an intake tunnel into the new Lickhill Pumping Station. The water is then pumped cross country for 22km, through a 1067mm diameter steel pipe, lifting across a total elevation of 260m to a Break Pressure Tank at Romsley Village, with a capacity of 1.5ML. From here, the water gravitates the additional 4km to Frankley WTW and the water pressure reduces from 36 bar (from the pumping station) to 16 bar. Of the 26km of pipe laid, 22.5km was installed utilising open cut techniques, with the remaining 3.5km being laid through trenchless techniques.



Wet Well of 7.5MVA High Lift Pumping Station

Innovative Delivery...

The original plan had been for a straight intake tunnel connecting the river to the pumping station. However, the pumping station was relocated once the intake structure had been excavated. The team therefore worked collaboratively with the pump manufacturer to ensure that each of the 4 pumps (which were some of the biggest ever installed by STW on their network, circa 50ml/d each) could be incorporated into the pump station design effectively. To compensate for the relocated pumping station, Barhale utilised their tunnelling expertise to construct a curved tunnel, which would enable flows to approach the pumping station wet well at the correct angle. If the angle was incorrect, the pumps would not have been guaranteed to work at full capacity.

Several tests were undertaken prior to construction to ensure this method would work effectively. These included the construction of a full scale model of the pump station in a research laboratory, during which the teams were able to utilise dye tests to ensure the pumps would operate as required.

Welded steel pipes were utilised in place of ductile iron. This not only provided an upfront saving in procurement, it also proved to be the safest and most efficient way of delivering the pipeline. The pipework came in 17.5m lengths. Barhale utilised coded welders to weld two lengths of pipe above ground to form a 35m length. These were then lifted into the excavation. Using this method removed the need to install full shoring solutions to the entire excavation, instead it was suitably battered back and the team only had to install 5m trench boxes at each weld point (every 35m). As well as reducing time and cost, this method was actually safer due to the fact that sections could be welded before installation, meaning fewer men needed to be in the trench.

Coded welders were trained and engaged to ensure consistent, high quality welding

A combination of open cut and trenchless techniques were utilised to install the pipeline. Trenchless technology was implemented to cross under the M5 motorway, railway lines, roads, a canal and a river.



Pipeline welding

Innovative Delivery Cont...

Barhale collaborated closely with two associates providing specialist design capability. Barhale's in-house tunnelling expertise was utilised, and 8 no. tunnel drives were launched, all with a diameter of 1.8m. In total, 3.5km of tunnel was installed and 18 no caisson ringed shafts were constructed, through a combination of jacking and underpinning. A combination of secant piles and spray concrete lining (SCL) was used for the Pump Station at Lickhill in order to combat the water table.

Open cut excavation was carried out using GPS controlled excavators, meaning the line and level of the dig could be pre-programmed in the Designer's computer and transferred to the excavators. This ensured a perfect line and level was provided for each excavator. It also sped up the setting out process and reduced risk by removing the need for engineers to carry out on site measurements. Furthermore, all excavation was carried out using a specially designed 'V' bucket, which had been fabricated to suit the shape of the trench. This innovative design ensured a perfectly graded excavation was delivered 'right first time' and reduced the amount of muck away; subsequently lowering carbon emissions.

Operational Readiness...

Barhale's scope increased to provide 'Operational Readiness' to ensure the new pipeline could be integrated successfully into the existing network. The Environment Agency would not allow more than 140ml/d to be taken from the River Severn. This meant the remaining 160ml/d would have to be made up from elsewhere. Barhale therefore worked in close collaboration with STW operations and their key delivery partners. Our team carried out trials and minor works to evaluate where the extra water could be extracted from. Operational Readiness was provided by installing new pipework, meters and carrying out upgrades along the existing network to ultimately ensure that the BRP provided both volume and quality of water required by Ofwat.

Constraints and Customer Benefits...

The original planned location of the pumping station would have required excavating a significant amount of contaminated land. This was problematic as the Environment Agency did not want any new preferential pathways through which contaminated water would reach the river. To resolve this issue, Barhale liaised with STW and the EA to relocate the pumping station 150m downhill. This design revision resulted in a cost saving of £6m for the Client, as well as removing the need to excavate potentially harmful material.

There were a number of environmental challenges which the team overcame. Firstly, all excavated spoil was reused as backfill. Imported stone which was used to form access roads and hardstanding had originally come from a locally recycled source, and was returned to the local recycling plant upon completion. Dust was also a constant issue. Non-potable water was used to dampen sites and prevent excess dust. Throughout the project, there were natural habitats that either had to be avoided or observed and sealed off by a qualified specialist, for example, birds' nests and badger sets.

The route of the pipeline passed through the property of 110 private landowners. If any were not satisfied with plans or progress, there could have been significant delays to the programme. Barhale utilised an Agricultural Liaison Officer to provide interface with the landowners. Due to the resounding success of Barhale's Agricultural Liaison Officer, no warrants needed to be issued to gain access to any of the 110 land owners and a large amount of praise has been received from satisfied customers.

Close collaboration with the Client and other contractor's ensured progress and efficiency. For example, liaising with the specialist designers regarding crossings meant that Worcester County Council highways were very satisfied with all of the crossings. Furthermore, through careful planning and close communication with the EA and STW, Barhale saved the Client circa £9.6m



Preparation of the Spread for the 26km-long cross-country Transmission Main