# Covenham to Boston Pipeline

## investing in a secure and futureproof water supply

by Oxana Latypova

The population of Lincolnshire is growing. The rate of growth remains higher than the East Midlands average and the county's urban centres in particular are subject to further anticipated growth over the next few years. Providing a clean, safe and sustainable water supply to Lincolnshire falls within the responsibilities of Anglian Water Services and the company is working proactively to ensure security of supply for current and future needs in areas where population increase is set to be a continuing trend. It was identified in Anglian Water's AMP5 business plan that there was a need to provide resilience to the West Pinchbeck Water Treatment Works (WTW) and additional resources were needed to meet the forecast water requirements of Boston and the surrounding area. The population of Boston is expected to rise significantly over the next 25 years, putting pressure on existing supplies. Anglian Water want to meet that growth in demand and ensure that supplies are resilient in the unlikely event of a major problem with the water treatment works supplying customers in the area.

*The 63km pipeline is part of the £40m Anglian Water scheme to secure water supplies for the growing population - Courtesy of JN Bentley*

### Solution

The 200 acre reservoir and water treatment works at Covenham, which opened in 1972, has ample capacity to serve both the local population's requirements and other areas of the county. Anglian Water's business plan solution was to provide a new pipeline with the capacity to transfer 27MLD of treated water from Covenham WTW, near Louth, in the north of the county, to Minningsby Reservoir in central Lincolnshire and then on to the town of Boston in the south of the county. The estimated cost of delivering the scheme was £40m.

### Tough targets

As part of its Special Projects framework, Anglian Water has set challenging targets for reducing the capital costs, embodied $CO_2$ emissions and operational $CO_2$ emissions for this project. The project brief aligns with Anglian Water's *'Love Every Drop'* campaign, a leadership platform designed to highlight the importance water plays in all our lives.

### Project planning

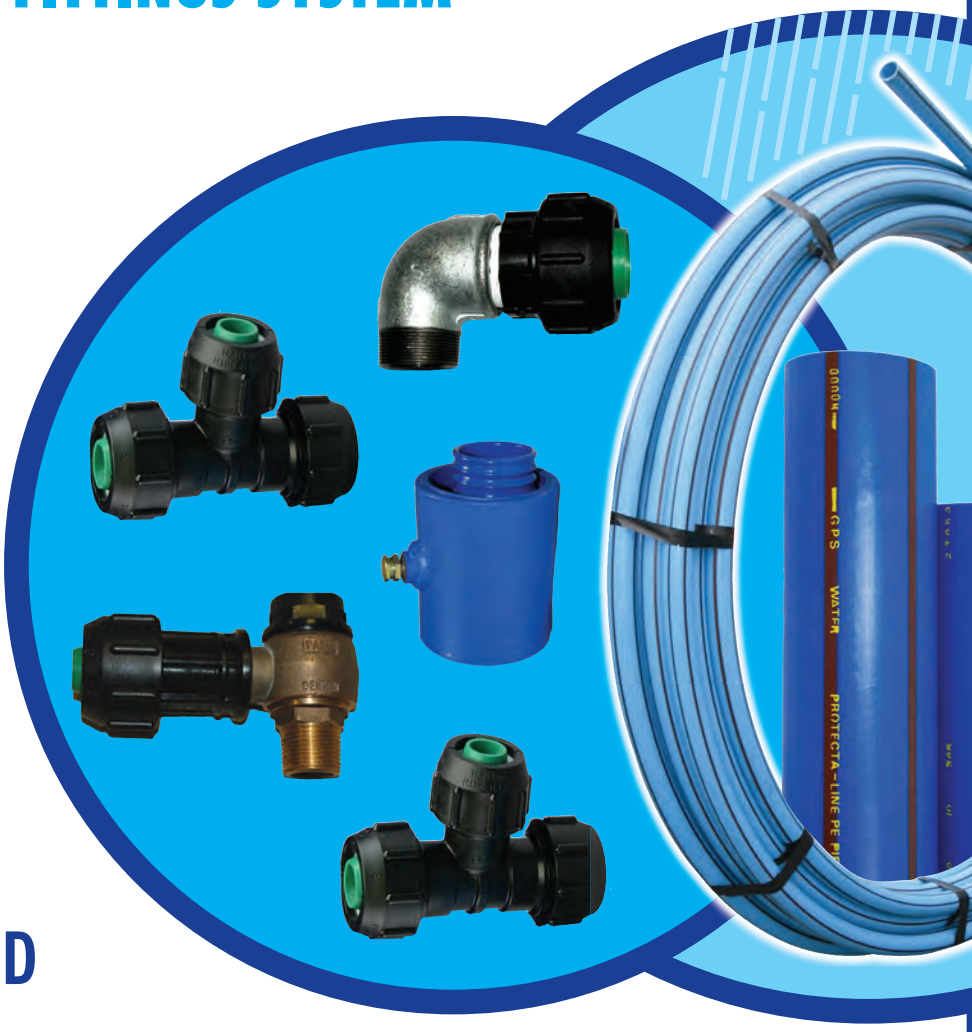
The joint project team comprises contractor JN Bentley, consultant Mott MacDonald and client Anglian Water. Initially they focused on meeting the targets by utilising existing assets where possible. The Business Plan solution envisaged a new 60km of 600mm pipeline supplying all the additional water needs direct from Covenham WTW. Analysis of the existing water supply network identified some unused capacity and opportunities to deliver more water to Boston, from the south, without a significant impact on how the current system operates.

Through Anglian Water's Risk & Value process and operational field trials, the use of existing assets was adopted; resulting in the flow required from Covenham reducing to 15MLD and the pipeline diameter reducing to 400mm. This lowered the embodied carbon by 1/3; however, the solution did not reduce the operational carbon impact as this solution required an intermediate booster pumping station in addition to a new pumping station at Covenham WTW.

# PROTECTA-LINE

## BARRIER PIPE AND FITTINGS SYSTEM

THE LEADING BARRIER PIPE AND FITTINGS SYSTEM




## FOR SAFE TRANSPORTATION OF DRINKING WATER THROUGH CONTAMINATED LAND

### The most complete range of compatible pipe and fittings

- Pipe in sizes 25mm to 355mm
- The largest range of compatible mechanical, fluid compression, electrofusion and mitred fittings

### Full system is independently approved

- The **whole system** is Kitemarked to WIS 4-32-19, the only industry standard for barrier pipe systems
- WRAS and the Secretary of State (Reg 31/27) approvals
- BS 6572 and EN 12201

### Ease of installation

- Large choice of jointing options: compression, butt-fusion, electrofusion, ferrule off-takes
- No wrapping required

**!** Only Protecta-Line fittings shall be used with Protecta-Line pipe.

**www.gpsuk.com/protecta-line**

GPS
PE PIPE SYSTEMS

*18m sections of piping were butt fused by the JN Bentley team to create long strings, which were then laid out in trenches, ensuring that fewer joints were required- Courtesy of JN Bentley*

Not satisfied, the project team revisited the solution to see if operational carbon could also be reduced. They realised that by removing the booster pumping station the operational carbon target could be achieved, but this slightly increased the embodied carbon as the pipe diameter increased to 450mm.

To assist in pipeline routing a computer analysis was carried out, ensuring that the pipeline would avoid features such as population centres and sites of ecological and archaeological importance. Once a proposed route had been agreed by the delivery partners, this was refined in consultation with ecologists, archaeologists, planners and landowners, a process which involved numerous reports and site visits.

### Pipeline material options

To mitigate the slight increase in embodied carbon due to the 450mm diameter pipeline, the team, using the construction expertise of contractors JN Bentley, started to look for construction innovations to reduce the embodied carbon within the solution without compromising the saving made to operational carbon, and started with pipeline material selection.

Under consideration was ductile iron, steel and plastic. They not only considered the technical suitability of each material for transferring potable water and their embodied carbon, but also the ease and method of installation including; the size of pipe trench, the pipe jointing and bedding materials; the management of the necessary materials and machinery along the easement; methods for crossing rivers, roads and railways; and the final commissioning of the completed pipeline.

They drew on their own experience and also collaborated with Anglian Water's @One Alliance partners to share experience and best practice. This ensured that when the pipeline material was finally selected, all factors were taken into account in the commercial package.

### Final solution

The final solution is to pump a reduced amount of water (15.6MLD) from a new pumping station, located within the existing works at Covenham, via a 40km pipeline to the existing Minningsby Service Reservoir which will provide storage for the Boston system. The water will gravitate through the second 20km section of the pipeline to Boston.

The remaining 11.4MLD required for resilience to West Pinchbeck, will be transferred from the Wing WTW, near Rutland Water through existing infrastructure; some enhancements to the existing infrastructure will be made to ensure a robust solution.

The challenges laid down by Anglian Water helped to generate the right culture for exploring the best ways to meet the cost

*Northern section of the pipeline, near the Covenham Reservoir control centre - Courtesy of JN Bentley*

and carbon targets, and engendered healthy competition in the design team to actively seek savings. The result was a powerful collaboration between designer, contractor, suppliers and client.

### Delivering carbon reductions

The project team's starting point was to consider the embodied carbon of the various materials needed to carry out the project. They challenged traditional designs and needs for items such as wash outs and air valves; they reviewed pipe specifications and the need for bed and surround to the pipework.

They concluded that minimising the requirement for concrete across the installation would have the most significant impact on carbon reduction. The majority of concrete components were replaced with less $CO_2$ hungry alternatives: for example, plastic manholes instead of concrete.

### Polyethylene pipe

This $CO_2$ material comparison methodology was a factor in the decision to specify polyethylene pipe. Pipe supplier GPS PE Pipe Systems worked closely with the project team to help respond to the carbon challenge. The selected pipeline material was Excel New Blue high performance PE100 pipework, a new PE pipe which combines a blue outer pipe with a black PE core.

According to the manufacturers, PE pipe offers improved embodied $CO_2$ if compared to traditional pipe materials due to the reduced energy consumption required for its manufacture, its longer service life, and its ease of recycling. The use of PE piping also reduces the cost of the pipe by varying the pipe thickness of the pipeline in line with the pressure profile required at specific points.

As a result the amount of raw material is reduced still further, which brings about savings in both capital outlay and embodied $CO_2$. Excel New Blue reduces the number of different polymers used and stored during the manufacturing process, as well as the amount of waste material created with a lower energy manufacturing process.

*A 30m construction corridor was created for the full length of the pipeline - Courtesy of JN Bentley*

Further carbon reductions were achieved by:

- Manufacturing 18m lengths reduces the number of deliveries required by 30%, and the number of joints needed, which in turn reduces the construction programme for the welding machine and the energy needed to run it.
- Using 'as-dug' material, where possible to reduce installation cost and environmental impact of importing and exporting material, which in turn reduces vehicle movement, quarry activity and waste.
- Utilising the flexibility of the PE pipe to follow the natural terrain, avoiding the need for any extra joints to accommodate bends or local route diversions and minimising the number of thrust blocks.

*The use of trenching machines increased the speed of laying and reduced disturbance to the land - Courtesy of JN Bentley*

### Embodied carbon reductions

Through this structured challenging approach and by adopting products and lessons learned from work carried out by other Anglian Water delivery partners, the final solution reduced the embodied carbon from a business plan impact of 28,950 tonnes of $CO_2$ to 12,644 tonnes of $CO_2$. The forecast capital cost of the scheme has also been reduced, demonstrating that reducing carbon can deliver capital efficiencies.

The team has adopted the Lean principle of collaborative programming and has involved the supply chain as soon as possible. As a result, the scheme has scored a provisional 'Excellent' rating from the CEEQUAL assessment scheme (the evidence-based sustainability assessment and awards scheme for civil engineering) for the design phase of the project. The site team is challenged to reduce its carbon impact further. They are using additional Lean tools and CEEQUAL process to focus their environmental delivery of this project. They have already identified further opportunities and they are working with the wider project delivery team to turn these opportunities into reality.

### Keeping to schedule

The installation process involved the provision of a 30m construction corridor, which narrowed to 10m near hedges and road locations, for the full length of the pipeline. Top soil stripping was done at a 28m width to mitigate the impact of the excavation on soil structure and ensure that the land can be returned back to its original state following installation of the pipeline. After pre-construction, land drainage was installed and welded pipe strings were laid out along the easement.

*The new pipeline will provide sufficient capacity to transport 27 million litres of water from the north of Lincolnshire to the south of the county every day - Courtesy of Chris Belton*

The pipeline is being laid in an open trench installation, as the route passes largely through farmland. The use of PE has again allowed traditional methods to be challenged, and after successful trials, excavation is being carried out using a rock trenching machine converted to operate in clay.

### Trenching machine

A further innovation was in arranging the trencher's cutting teeth and guidance mechanism to give optimum graded backfill for immediate reuse, hence further reducing the carbon impact. This has allowed up to 650m of trench excavation, pipe installation and backfill to be completed in a day.

Utilising the trencher has had additional advantages of:

- Narrower reduced disturbance to the land.
- The construction team has been better able to keep to schedule due to the speed of laying, reducing the delays which would otherwise have been caused by the heavy rainfall in April, May and June.

Where it has been necessary to lay sections using a trenchless method for safety or environmental reasons or to meet the requirements of statutory authorities, directional drilling has also been used.

### Weather conditions

Excavation of the pipe trench began in May and the installation continued at an average rate of 1,500m/week, which was slower than originally envisaged due to the combination of heavy clay soil conditions and unseasonably wet weather throughout the spring and summer.

Though the extent of the exceptionally inclement weather during April, May and June could not have been predicted, measures had been outlined at design stage to address bad weather conditions should it occur, and while the excessive rainfall did cause some delays, the installation programme was able to progress in line with the Anglian Water's requirements for completion and commissioning.

### Long-term legacy

The project team expects to have completed the first 40km section of pipeline by the end of 2012, compared with the original target of autumn 2013. The shorter second 20km section will be installed directly afterwards with the first water arriving in Boston taps from Covenham WTW early in 2014.

Once the project has been completed there will be little evidence above ground that anything has changed. However, there will be a substantial increase in drinking water availability and resilience to customers in Boston and, thanks to the 100-plus year service life of the pipeline, it will be an investment that will continue to benefit the people of south Lincolnshire for generations.

*The editor & publishers would like to thank Oxana Latypova, Marketing Coordinator with GPS PE Pipe Systems, for providing the above article for publication.*

*The author would like to thank the following for their contribution to this article: Ian Turner, Special Projects Delivery Manager with Anglian Water; Ian Austin, General Manager with JN Bentley; and Luis Henriques, Lead Design Engineer with Mott MacDonald.*