Layer to Langford Pipeline

20km pipeline to balance the water levels in both Abberton and Hanningfield Reservoirs and ensure resilience of supply in the Essex Resource Zone

by Daniel Wilson

Northumbrian Water and Essex & Suffolk Water are part of Northumbrian Water Limited. In the Essex & Suffolk operating areas, drinking water is supplied to 794,000 properties. Maintaining a supply of high-quality drinking water to those customers requires distributing up to 670 MLD from the company's water treatment works. In Essex, the two primary treatment works are Hanningfield WTW, a physio-chemical works near Chelmsford and Layer WTW, a biological works, near Colchester. These are supplied by raw water stored in two large reservoirs at Abberton and Hanningfield.

Directional drill chamber and pipeline for pulling through - Courtesy of Essex & Suffolk Water

Challenge

In 2016, and more recently in 2022, low levels of rainfall and hot weather compromised the raw water quality in Abberton Reservoir which led to significant challenges to the biological process at Layer WTW. This meant unprecedented demand was placed upon Essex & Suffolk Water's chemical works at Hanningfield WTW which in turn drew down the water level in Hanningfield Reservoir to levels not seen since the summer of 1996.

Whilst this low level in Hanningfield was observed, the level in Abberton was healthy due to the process constraints of the biological works at Layer. To mitigate the scenario of having two reservoirs, one relatively full, and another extremely low, occurring in the future, Northumbrian Water applied for enhancement funding in AMP7 to construct a 20km pipeline between the Layer and Langford WTWs, where water from Abberton could be reliably treated. This in turn would allow water from the River Chelmer and River Blackwater, that would normally be treated at Langford, to augment the water level in Hanningfield Reservoir by utilising existing transfer pumping facilities between Langford WTW and Hanningfield Reservoir.

Providing this connectivity, albeit by substitution, would allow Essex & Suffolk Water to balance the water levels in both Abberton Reservoir and Hanningfield Reservoir, and mitigate a potential scenario where no water is available to supply Hanningfield WTW.

The project

In 2019, Essex & Suffolk Water teams began to plan a route between Layer WTW and Langford WTW for a pipeline that could support flow rates up to 50 Ml/d. This figure was determined as the optimum flow rate to allow balancing of the reservoirs to take place and ensure security of supply when faced with long term drought conditions. The pipeline would take advantage of the capacity and capability of the existing pumping station at Abberton which can deliver up to 255 MLD of water to Layer WTW.

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The route would begin with a strategic connection into the existing raw water mains that deliver water from Abberton Reservoir into Layer WTW. From this point a route was sought that would allow water to run under gravity to Langford WTW, where it would be discharged into two existing bankside storage reservoirs each with a capacity of 35 ML.

Since summer 2023 NWG have been constructing the pipeline under their Permitted Development Rights and this commenced with road crossings along the route and a horizontal directional drill (HDD) beneath the River Blackwater and the Langford Cut; the two main rivers along the route. These were completed in Autumn 2023 with the express purpose of de-risking those activities from the main construction phase which was planned to being in 2024. At the time of writing (May 2025) the above work has been completed as well as substantial completion and testing of the pipeline.

Layer to Langford Pipeline Supply chain - key participants

Principal contractor & pipeline installation: Essex & Suffolk Water (Network Design & Construction)
Principal designer: Stantec UK
Planning consultation: Savills
Ground investigation: Igne Group
Archaeology: AECOM
Specialist horizontal directional drill contractor: Complete Moling Services (South East) Ltd
Temporary works/shoring: MGF Ltd
MEICA installation: Aquazone Ltd
Earthworks: Anglian Land Drainage
Ductile iron pipe: Electrosteel Castings (UK) Ltd
MDPE pipe: Aliaxis
Specialist fittings: UTS Engineering Ltd
Valves: DeZurick Valves
Actuators: Rotork Controls

Construction

One of the main components of construction work was the horizontal directional drilling (HDD) that was necessary to cross the two main rivers, the River Blackwater and the Langford Cut.

Northumbrian Water competitively tendered this package with a number of HDD contractors operating in the sector. After an assessment of both cost and quality, the project team awarded this package of work to Complete Moling Services (CMS) based in Rochester, Kent.

Horizontal directional drilling involves drilling beneath the ground between a drive/launch pit and a reception pit. The method can be used to install pipe diameters up to 710mm for distances of up to 600m. Utilising this technique allows for pipe installations to be completed where a traditional open cut method could pose significant environmental challenges or disruption. The technical information provided in advance of the works included an indicative cross section of the pipeline beneath the rivers and ground investigation information collected in early stages of the project.

Essex & Suffolk Water obtained an exemption from flood risk activities by following the Environment Agency guidelines. This included designing the HDD such that it was within 10° of perpendicular to the river flow, the drill depth was greater than 1.5m beneath the riverbed and the location of the launch and reception pits were greater than 8m from the riverbank.

The HDD began in early September 2023 with NWG excavating the launch and reception pits either side of the two rivers. Each of the pits was approximately 7m x 6.5m x 1.5m; large enough to site the directional drill rig. Drilling work began with a 165mm pilot bore entering the ground at -15° to horizontal and proceeding on this trajectory for 45.5m. The drill angle was then 'steered' to a flat trajectory for a further 100m before being 'steered' upwards at +15° to horizontal to exit within the reception pit. The pilot drill, now in the reception pit, had its head changed to a 250mm reamer which is then rotated and pulled back through the alignment created by the pilot bore and into the launch pit.

The process was repeated, increasing the diameter of the reamer each time to 350mm, 500mm, 600mm and finally 800mm.

Throughout the course of the drilling work, drilling muds were used to keep open the annulus of the drill and remove all cuttings from the reamed bore annulus. Once the bore was completed and stabilised a 630mm OD, MDPE pipe was drawn through the bore between the reception pit and the launch pit creating a pipeline beneath the two rivers. The whole process was completed twice meaning two 630mm OD MDPE pipe crossings were achieved providing resilience to the overall pipeline should one line become damaged. During the course of the work, the drilling team encountered

Butt fusion operation underway - Courtesy of Essex & Suffolk Water

Directional drilling - Courtesy of Essex & Suffolk Water

Pipe stringing between Rectory Road and Barnhall Road Courtesy of Essex & Suffolk Water

ground conditions that were not expected and this increased the duration and cost of the work; albeit marginally. Even so, the cost of directional drilling the river crossings was significantly less than the alternative open cut method. This activity on the project was completed in late 2023.

During 2024, with the strategic crossings outlined above completed, the project team could focus on the delivery of the 20km pipeline between Layer WTW in Colchester, and Langford WTW in Maldon. Topsoil stripping began in January 2024 and took place along a reduced width corridor of 25m with further reductions at ecologically sensitive areas (such as hedge row crossings) and small watercourse crossings (such as ditches). Adopting this approach limited the environmental impact of the scheme and the post construction compensation provided to landowners.

Deliveries of ductile iron pipework from Electrosteel Castings (UK) Ltd began to arrive at various compounds along the route from February 2024. Pipes were received on site and then strung out along the route of pipeline. The careful coordination of pipeline deliveries and installation meant a rolling installation programme that maintained a reasonably constant installation rate of 60m per pipelaying gang per day. Using two gangs through the construction programme, with a late summer peak of three gangs, enabled the installation of the 20km of pipe to be completed between April and November 2024. The installation technique was a traditional open cut method using trench boxes in excavations where gasket installation and jointing could be undertaken safely.

During the construction phase, the site team implemented both pre and post-land drainage schemes to mitigate the impact of water ingress into excavations and ensure that the downstream impacts of the construction activity did not impact on existing drainage schemes within impacted land parcels which primarily comprised arable fields.

Innovations

Perhaps the most innovative approach adopted by the project team was not regards to technology, but the approach the team took to planning the scheme.

The route was deliberately designed to avoid designated areas such as SSSIs and SPAs and this, combined with a robust approach to mitigating any significant lasting impact allowed the team to work with the local planning authorities to agree the project could be delivered through Permitted Development. This created an opportunity to reduce the programme duration to omit EIA scoping and planning application submission and approvals with the associated cost reduction.

Essex & Suffolk Water believe that this is perhaps the first time a 900mm diameter, 20km trunk main extends across multiple planning authorities, which has been delivered using Permitted Development Rights.

Summary

The pipeline delivered a flow rate of 20 MLD into the bankside storage reservoirs at Langford in March 2025. The flow rate was deliberately restricted to 20 MLD rather than full flow design of 50 MLD due to operational constraints at the time.

Remaining work to complete the integration of the flow control system into the existing site-wide SCADA system and the chemical dosing system to control Invasive Non-Native Species (INNS). This work will be completed in late spring/summer 2025. The project was delivered for less than the business plan allowance and within the Regulatory Deadline.

The editor and publishers would like to thank Daniel Wilson, Project Manager with Northumbrian Water, for providing the above article for publication.

Pipe installation between Rectory Road and Barnhall Road
Courtesy of Essex & Suffolk Water

Raw water discharge into Langford Bankside Reservoir
Courtesy of Essex & Suffolk Water