# Royal Oak & Longsight Park Tunnel

## enhancing water quality of the River Irwell through innovative wastewater storage at combined sewer overflow sites across Bolton

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Located in Bolton, in north-west England, this project addressed the issue of combined sewer overflows (CSOs) at Royal Oak Park and Longsight Park in Bolton. Situated approximately 100m apart on opposite sides of Bradshaw Brook, these two separate CSOs had outfalls that regularly discharged screened wastewater into the river. Driven by the Environment Agency's Water Industry National Environmental Programme (WINEP), United Utilities initiated a project to mitigate these spills and enhance the quality of the River Irwell. The chosen solution involved the innovative use of a 900m long microtunnel to provide combined wastewater storage, offering a less disruptive and more environmentally sensitive alternative to traditional local detention storage tanks.

*The Royal Oak (top of picture) and Longsight Park (bottom) sites, separated by Bradshaw Brook. The third location, Firwood, to which the detention tunnel is linked, is situated 900m to the south - Courtesy of Ward & Burke*

### Objectives

The primary objective of the project was to connect the Royal Oak and Longsight Park CSOs and then provide a combined wastewater storage volume of 2900m$^3$. This stored screened wastewater would then be returned to the network at a fixed rate of 50 litres per second. The storage volume and return rate were the main project objectives and these had both been verified through network modelling by United Utilities.

### Project scope

Key components of the project included:

- A 900m long wastewater storage tunnel, 1.829m internal diameter (ID) connecting the two CSOs to the Firwood Industrial Estate, where flows would be returned back to the network.
- A 90m curved tunnel, 1.2m ID linking Longsight Park to the Royal Oak CSO.
- A 9.8m ID shaft at Firwood.
- A 7m ID shaft at Royal Oak.
- A 4m ID shaft at Longsight Park.
- The existing CSOs were connected to the new tunnel system through a series of new manholes and associated pipework.
- A new precast outfall headwall replaced the old brick structure at Royal Oak.

### Microtunnelling

Construction of the tunnels utilised the slurry microtunnelling technique, employing two Herrenknecht AVN TBM machines. This methodology was chosen due to the sensitive nature of the two CSO locations (both CSOs are within parks and Royal Oak was located within an arboretum) and because of the presence of shallow rock and artesian groundwater at Royal Oak. Local detention tanks would have involved lengthy rock breaking activities close to residential properties and dewatering posed a large programme risk due to the need for an abstraction licence from the Environment Agency.

By providing the required storage volume with a tunnel, the Ward & Burke team was able to move the majority of the construction activity away from these locations to the Firwood Industrial Estate; greatly reducing the rock breaking activities in the parks. It also

removed the need for an abstraction licence due to the smaller size of the shafts. The shafts at Firwood and Royal Oak were constructed using the caisson sinking method, while the shaft at Longsight Park was underpinned due to the high rock level.

### Engineering challenges

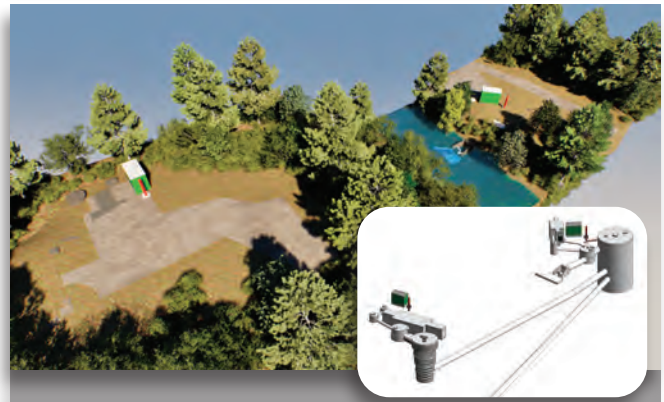
A notable engineering challenge was the 10m height difference between Longsight Park and Royal Oak, necessitating a 90m tunnel drive which curved vertically upwards. Additionally, Royal Oak was 10m higher than Firwood, requiring the design of a reinforced-concrete shaft at Firwood capable of withstanding 1 bar of pressure on the roof. The 9.8m ID shaft features a 1m thick central dividing wall, creating a sealed wet well and dry well arrangement.

Rebar couplers and waterbar were used to ensure a robust and watertight joint between the dividing wall and the shaft which would not leak when pressurised. All access covers on the wet well at Firwood are pressure-rated.

*The Firwood site, where stored wastewater from the CSOs will be returned to the network - Courtesy of Ward & Burke*

### Royal Oak & Longsight Park Tunnel: Supply chain - key participants

- **Principal contractor**: Ward & Burke
- **DSEAR assessment**: PDA Consulting
- **Ecological consulting**: Tyrer Ecological Consultants
- **Systems integration**: Actemium
- **MCC panel**: Lostock Electrical Projects Company Ltd
- **Tunnel boring machine**: Herrenknecht
- **Tunnel guidance**: VMT Gmbh Gesellschaft
- **Precast roof slab design & precast concrete**: Shay Murtagh
- **RC jacking pipes & manhole rings**: Tracey Concrete
- **Tunnelling polymers**: Tunnelling Accessories
- **Tunnelling polymers**: Mudtech Ltd
- **Return & mixer pumps**: Xylem Water Solutions
- **Actuators**: Rotork Controls
- **Dropper pipes**: PMJ Mechanical Ltd
- **Kiosks**: Morgan Marine
- **Security covers**: Technocover
- **GRP ladders & flooring**: Chemglass
- **General steel fabrication**: C&D Engineering
- **Mobile cranes**: Cork Crane Hire Ltd
- **Gantry crane**: Bramley Engineering (Lifting Gear) Ltd
- **Concrete cutting services**: Access Drilling Services Ltd
- **Vegetation clearance**: Treefellers Ltd
- **Scaffolding services**: NewGen Scaffolding
- **Tarmacing**: Tarways
- **Muck removal**: Armstrongs Group
- **Concrete supply**: Breedon Group
- **Concrete pumps**: Camfaud Concrete Pumps Ltd
- **Concrete washout tanks**: Kelly Tanks Ltd
- **Reinforcing steel supplier**: Dominic Lydons Steel
- **Lime**: Bolshaw Industrial Powders
- **Plant supplier**: Nixon Hire



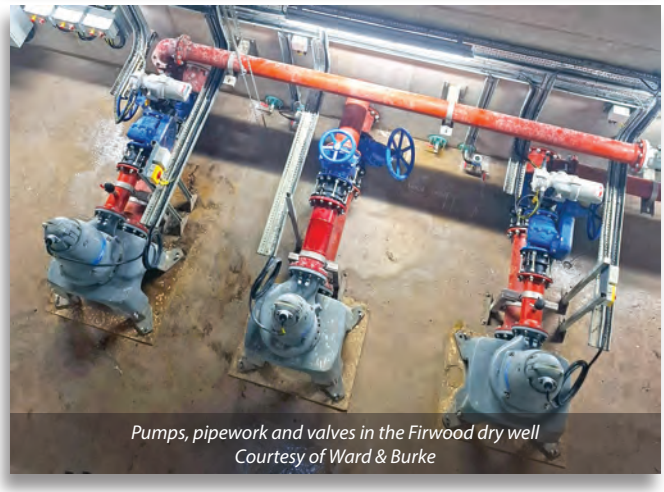
*Render of the two CSOs and (inset) the 1.2m ID connecting tunnel and 1.829m ID detention tunnel below - Courtesy of Ward & Burke*

*Pipejacking underway at the Firwood launch shaft Courtesy of Ward & Burke*

### Screening, pumping & flow control

The existing Royal Oak and Longsight Park CSOs were already equipped with 6mm powered screens, which were retained as part of the project. The intercepted spill flows are now directed into the new tunnel system first, whereas previously spill flows went straight to the river.

When the 900m detention tunnel fills during a storm event, the return pumps at Firwood are initially inactive; however, once pressure instruments in the Firwood shaft detect that the water level has stabilised, indicating the storm event has passed, and there is sufficient capacity in a downstream network manhole, the duty pump is activated. This dry well-mounted pump from Xylem Water Solutions returns the stored wastewater back to the network at a fixed rate of 50 l/s. The flow rate is controlled by a flow meter, with the pumps being VSD units that adjust their frequency to maintain the desired flow.



*Pumps, pipework and valves in the Firwood dry well Courtesy of Ward & Burke*

To manage the high head in the system when the tunnel is full, a plug valve with a Rotork Controls actuator was installed to initially provide artificial head, before fully opening and allowing the VSD pump to regulate the flow once the head has reduced sufficiently. For tank cleaning, a mixer pump from Xylem Water Solutions is also located in the dry well, ejecting flow into the wet well via two venturi nozzles to place solids into suspension for removal.

Double-acting air valves are installed at the top of the wet well to vent trapped air during filling and allow air back in during emptying, sealing shut to prevent water passage. The pumps at Firwood are controlled by a new MCC from Lostock Electrical Projects Company Ltd located at the site.

## Innovations & carbon reduction

This project incorporated several noteworthy innovations. The use of a tunnel to provide wastewater storage, rather than traditional local circular detention tanks, minimised construction activity in sensitive areas and reduced noise which benefited the local community during the works. Combining the storage requirements for two separate CSOs into a single system allowed for the decommissioning and riverbank restoration of the redundant Longsight Park CSO, reducing the number of outfalls into the river from two to one. The design of a pressurised wet well at Firwood was an innovative solution to address the large changes in elevation between the three sites.

While the overall project cost was comparable to constructing two separate detention tanks, the tunnel solution offered significant operational advantages, a shorter construction time-frame leading to less disruption for local residents, and the benefit of relocating the majority of construction activities to the Firwood Industrial Estate. The project team also established their compound on an existing hardstanding in Firwood; eliminating the need for a temporary stone working platform to be constructed.

Furthermore, the use of a tunnel for wastewater storage resulted in substantial embodied carbon savings. Tunnels are neutrally buoyant, whereas large diameter tanks can require up to 40% more concrete in order to provide self-weight to resist uplift forces. By opting for a tunnel, the project significantly reduced its embodied carbon compared to a traditional tank-based solution.

The reduction in the number of outfalls also offers a clear environmental benefit; making it easier for the Environment Agency to monitor sewage discharge into the river.

## Conclusion

The £13m Royal Oak & Longsight Park Tunnel Project was delivered in a remarkably short time-frame, with the contract awarded in April 2024, civils completed by December 2024, and commissioning finalised by April 2025.

The innovative design and construction of the tunnel represents a significant investment in the local environment and demonstrates an ongoing commitment by United Utilities to meeting stringent environmental standards. The project marks a significant step forward in improving the river quality in Bolton.

Key successes include achieving the required wastewater storage capacity by the regulatory target date and receiving positive feedback from stakeholders associated with the scheme. In the first three months since the asset has been in operation, the tunnel has already completely filled three times, preventing approximately nine million litres of wastewater from entering the River Irwell.

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*Dropper pipe being installed at Longsight Park to direct spill flows from the CSO down a 90m curved tunnel to Royal Oak - Courtesy of Ward & Burke*

*New headwall with flap valve and baffle walls installed at Royal Oak Courtesy of Ward & Burke*