Harlow Network Upgrade

new wastewater pumping station and storage shaft allows for future growth east of Harlow

by Mark Cooper, Alun Roberts & Neil Marples

Harlow is located off the M11, just south of Stansted Airport and is a post war development which was built by the Harlow Development Corporation. All existing foul sewers drain to the Rye Meads Sewage Treatment Works (STW) north west of the town. Harlow is in the process of expanding in line with local development plans, particularly between the town and the M11 motorway to the east. Development is well underway, with the Newhall development partially complete and the Gilden Way development having been recently granted planning permission. As part of the Thames Water (TW) AMP5 programme of works, Optimise was instructed to increase capacity in East Harlow's foul water sewer network to enable growth in the area. The solution comprised of a new foul water pumping station with 1000m^3 of storage, as well as a 2km rising main and 450m of connecting gravity sewers.

400mm SDR 11 HPPE pipeline ready to be laid by HDD - Courtesy of Optimise

A phased solution

Optimise is a joint venture made up of four companies MWH, Murphy, Barhale and Clancy Docwra formed to deliver AMP5 for TW. The designer on this scheme was MWH and the main contractor was Barhale.

The design solution is in two phases to allow for staggered growth within the area over the next 20 years. The first phase caters for 4,100 properties which include both the Newhall and Gilden Way developments. The second phase caters for a further 5,000 properties which Harlow Town Council Planning Department has confirmed will be built over the next 20 years. However, the exact details of this development are yet to be defined.

As well as accepting flows from new housing developments, the new pumping station also takes flows from existing properties in the Churchgate Street area of the town, upstream of the new station. By doing this, spare capacity created in the network can be utilised by 1,200 of the new properties without the need for providing additional capacity to the sewer network.

Rather than waiting for new developments to connect, accepting flows from the Churchgate catchment allowed the new pumping station to operate as soon as it was completed. Waiting for significant development to take place before commissioning would have potentially caused issues with septicity and low flows in the rising main requiring regular maintenance.

The solution was devised using a verified model of the existing catchment and modelling expected flow rates from the future developments. The design will provide 1,000m³ of storage at the new pumping station and ensure a minimum level of protection to the new developments of 1 in 30 years.

The storage is designed to hold back flows until there is capacity in the receiving trunk sewer, which surcharges during storm events. On and offline storage options were offered to TW at the new pumping station. Based on ease of maintenance, they opted for online storage in the form of a combined pumping station and storage shaft with a dry weather flow channel.

The new pumping station and the closest point of the receiving trunk sewer are approximately 3km apart and three barriers lie in the last km: the A414, the main railway line to Stansted Airport and the River Stort. An existing similar sized rising main was identified which discharges to the same trunk sewer and already crosses the three barriers.

Surge analysis carried out on the existing rising main determined that a connection could be made upstream of the crossings. The connection point was then carefully selected to ensure that the two rising mains would remain hydraulically independent on connection, even after sustained periods of pumping. This made an extensive saving to the project, allowing the length of the new rising main to be shortened by approximately 1km and avoided the requirement for three costly sections of work.

Rising main details

The 2km rising main has an undulating profile from the new pumping station to the connection point with the existing rising main. This undulating nature means that sections of it will drain down between pumping periods and re-fill when pumping resumes. The rising 'pipe full' sections consist of 315mm OD SDR17 High Performance Polyethylene (HPPE). The falling, 'initially drained' sections of the rising main consist of 400mm OD SDR 17 HPPE. This change in diameters takes place at high and low points, allowing air to leave the pipeline effectively through the air valves stopping unstable flow conditions from developing.

The new rising main crosses a variety of different terrains such as the highway, highway verge, parkland and industrial areas. There were also number of main road intersections and high risk service crossings including a 24" cast iron gas main, 1,000mm surface water sewer and 16 high voltage electricity cables. In total, the pipeline crossed approximately 100 different buried services.

Directional drilling

700m of pipework across the project was laid using the horizontal directional drilling (HDD) technique, making up 25% of the total pipe laid during the project. HDD was used to minimise disruption to environmentally sensitive areas, including a river and woodland. This technique was also used to cross under a traffic sensitive road, a school playing field and an area with a high concentration of buried services. Cost savings were also made by using this method rather than traditional 'open cut' pipelaying. HDD was not only used to install pressure pipework for the rising main, but also for gravity sewers where it was used with high levels of accuracy to achieve the specified gradients.

Pumps

Within the pumping station sump, three 45kW variable speed, submersible, centrifugal, storm return pumps provide an initial pumping rate of 60l/s to cater for Phase 1 of the solution. When Phase 2 becomes live, the operating regime of the existing pumps will be re-configured to deliver 120l/s. Above the pump sump sits a recirculation pump, which will mix the waste water when the storage is being utilised in order to keep solid matter in suspension therefore minimising maintenance for the client.

15m diameter shaft being sunk as a caisson using hydraulic jacks - Courtesy of Optimise

Control

As mentioned above, the new rising main connects to an existing rising main, which in turn discharges into a trunk foul sewer that leads to Rye Meads STW. This trunk sewer currently lacks capacity during storm events and can surcharge, leading to flooding at manholes along its route. In order to not exacerbate this situation, the pumps at the new pumping station are controlled by a level sensor installed in a manhole on the trunk foul sewer downstream of the rising main discharge point.

When the sewer is running at a high level of surcharge, the lever sensor will send a signal back to the pumping station via GPRS to inhibit the pumps. Whilst the pumps are inhibited, the 1,000m^3 of storage will be utilised. Thames Water has plans to upgrade this trunk sewer in the future in line with Harlow's growth and once this takes place it will be possible to adjust this control function or remove it completely.

Shaft construction

The 15m diameter pumping station and storage shaft was sunk into the ground as a caisson, using 15 hydraulic jacks fixed to a 2.5m wide, 2m deep reinforced concrete collar. The shaft was sunk to a depth of 15m below ground level before a 1.8m deep mass concrete plug was poured.

Above the plug a 1m deep reinforced concrete structural base slab was formed, on which the pump sump, structural benching and a dry weather flow channel sit. This method of construction was dictated by local ground conditions, as at 6m depth the ground turned from good firm clay to sand and then sandy silt. The nature of this ground would not have allowed the shaft to be constructed using an underpinning method.

Installing the 15m diameter roof slab presented many problems and consideration was given to the construction of a central supporting column. However as vehicular access to the site was very good it was decided to locate two 34 tonne beams spanning the shaft to support the precast concrete roof slab. The beams, which were installed using a 200 ton crane, were some of the largest ever installed by Barhale on a wastewater project. The shaft itself was constructed from bolted precast concrete segments.

Customer care

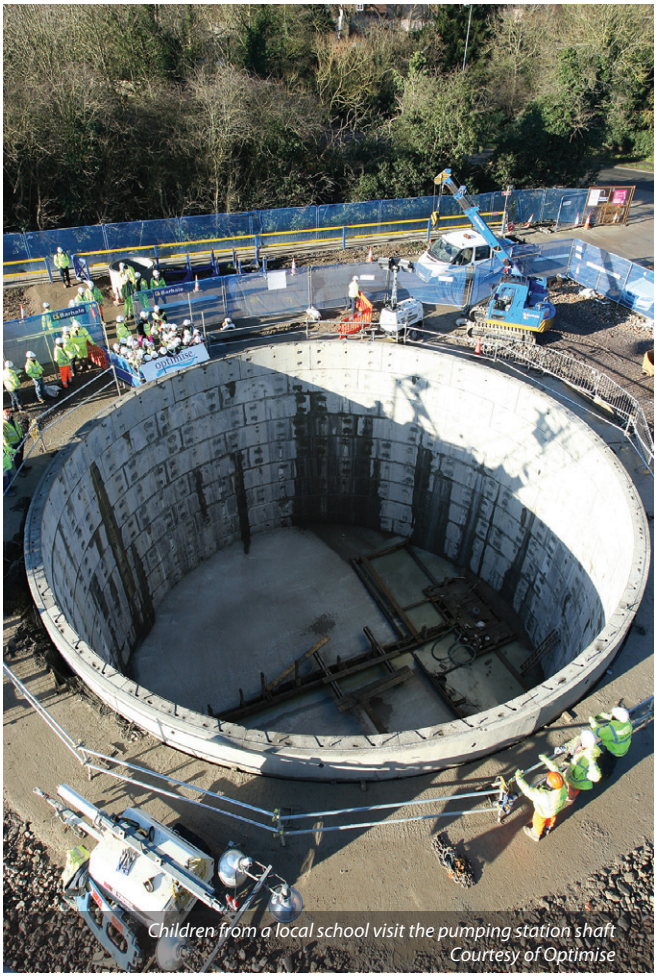
The project was subject to a lengthy planning permission process, as the area is particularly sensitive with many local residents opposed to the new development taking place around them. The pumping station was constructed on greenfield agricultural land, adjacent to a watercourse and a large manor house. The choice of location was restricted by the line of the existing TW sewers and a new connecting sewer laid by the housing developer.

During both the design and construction phases of the project, customer care was carefully managed by the project's Delivery Team. This involved customer 'drop in' sessions, large scale letter drops and weekly visits to affected residents. In order to engage with the local community during the works, presentations were given at a local primary and secondary school to give an insight into the work, with follow up site visits to the new pumping station. Other work in the community included installing bird boxes and repairing fences at a local school, as well as repairing headstones and gardening at a local church.

The editor and publishers would like to thank the following for preparing this paper for publication: Mark Cooper, Contract Manager with Thames Water, Alun Roberts, Design Engineer, and Neil Marples, Design Team Leader, both with MWH.

The authors would like to thank: Richard Ford, MWH, Shane Gorman, Enda Murphy, Micheal Harvey and Denis Fitzpatrick, all with Barhale for their input.

Mass concrete 'plug' being poured - Courtesy of Optimise


Children from a local school visit the pumping station shaft Courtesy of Optimise