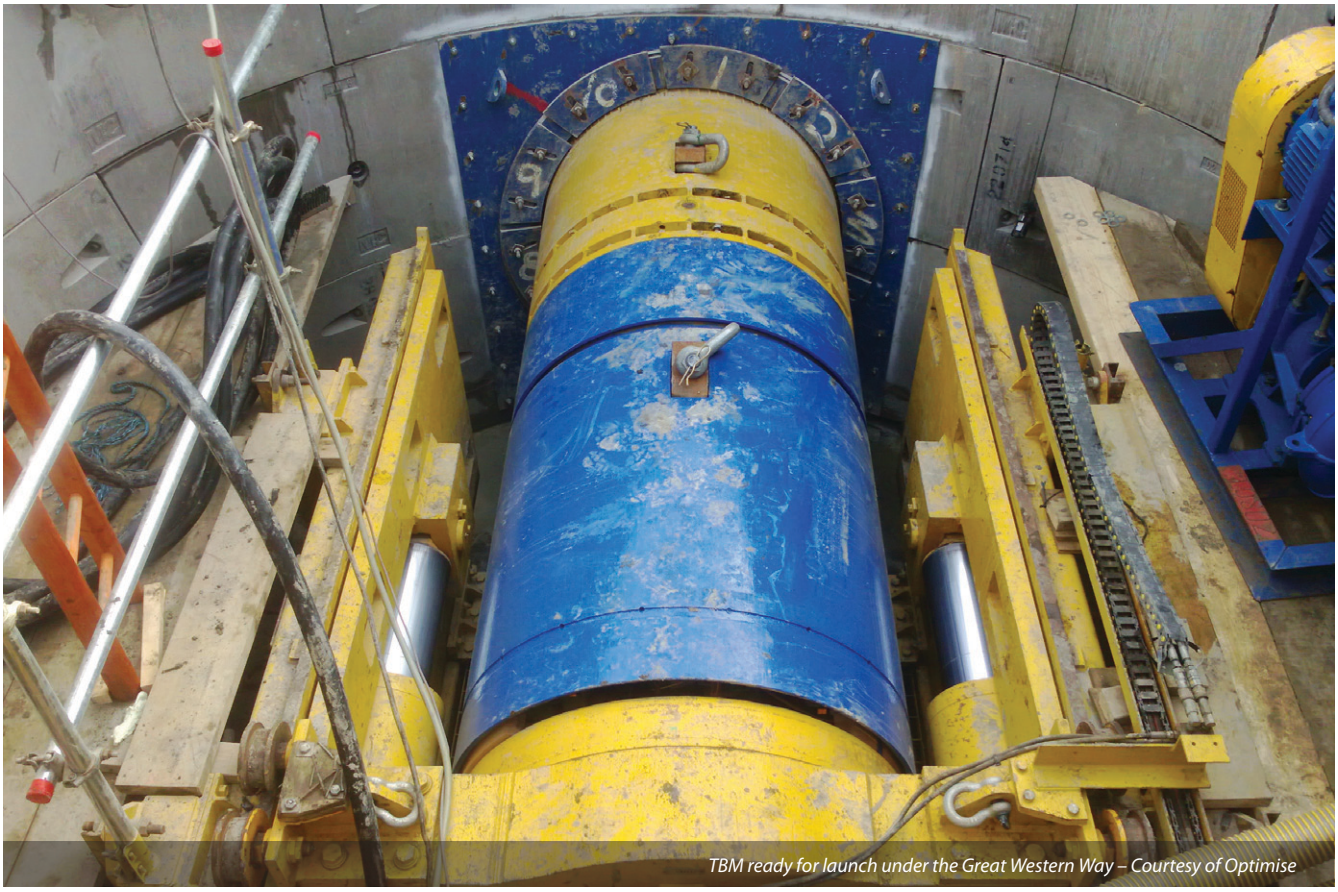
Swindon Southern Trunk Sewer Phase 2

new Thames Water 1,200mm diameter trunk sewer enables growth in South Swindon

by Alun Roberts & Neil Marples

As part of the Thames Water (TW) AMP5 programme of works, it was necessary to increase the capacity in south Swindon's foul water sewer network to enable growth in the town, mainly from the Wichelstowe development area. This scheme was Phase 2 of a new Southern Trunk Sewer and comprised of a 1.1km long 1,200mm diameter storm relief sewer and enabling works for a 400mm diameter rising main diversion. The new Southern Trunk Sewer will allow the Wichelstowe development to connect into Barnfield Road Sewage Pumping Station (SPS) which is a terminal SPS at Swindon STW. The rising main diversion enabling works will allow TW to divert flows from an existing catchment into the new Southern Trunk Sewer. This will free up capacity in an existing catchment in west Swindon to allow further growth in that area. The project's working areas included the Mannington Recreation Ground which is a large public open space owned by Swindon Borough Council, Rivermead Nature Reserve and land within the Wichelstowe development itself.



TBM ready for launch under the Great Western Way – Courtesy of Optimise

Growth in Swindon

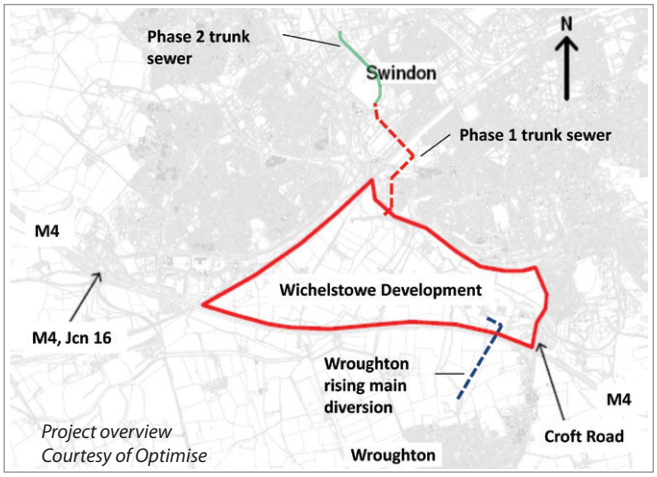
Growth in south Swindon is centred around the Wichelstowe development area, which is currently under construction. This large 4,500 property development is located in a triangular area of land between the M4 motorway and the town. The development also consists of employment space, public open space, shopping areas, community facilities and schools. The first homes were occupied in 2009 with development expected to continue until around 2025, depending on market conditions.

At the time of writing (June 2015), around 800 properties had been completed. Foul water flows from the majority of the 4,500 properties are to be drained by gravity all the way to Swindon STW, with around 800 served by a new intermediate SPS within the development. As there are also further ongoing and planned development areas towards the south east of the town, TW's long term strategy is to divert flows from the existing Wroughton catchment away from the south east by diverting them into the Wichelstowe development area and therefore the new Southern Trunk Sewer.

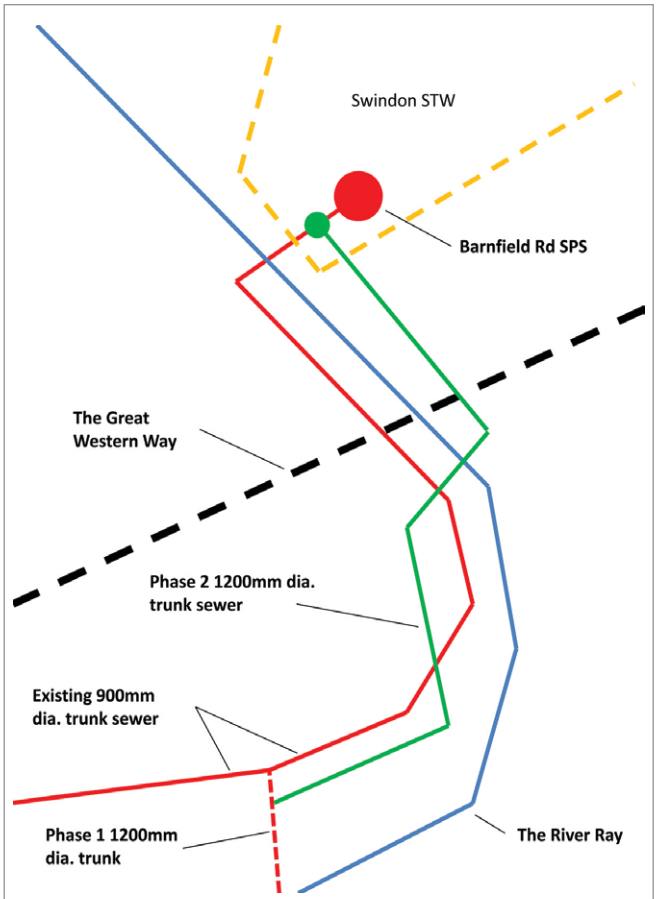
A phased approach

Optimise is a joint venture formed to deliver AMP5 projects for Thames Water and is made up of four companies: MWH, Murphy, Barhale and Clancy Docwra. The designers on this scheme were MWH, the main contractor was Murphy and the microtunnelling sub-contractor was Barhale.

TW made the decision to deliver the new Southern Trunk Sewer as a phased solution. In early 2013, Optimise completed Phase 1 of



Project overview
Courtesy of Optimise



Project schematic
Courtesy of Optimise

Sewer route south of the Great Western Way (New 1200mm diameter Phase 2 trunk sewer shown in red, existing 900mm diameter trunk sewer shown in blue) - Courtesy of Optimise

the new trunk sewer which began in the Wichelstowe development area and ended at a connection point with an existing 900mm diameter trunk sewer in the Mannington Recreation Ground, which is around half way from the development area to Barnfield Road SPS. This was feasible as a temporary arrangement, due to only a small proportion of the full Wichelstowe development being on line.

This deep sewer consisted of 1.4km of 1,200mm diameter concrete pipework, which was constructed using microtunnelling and included a crossing under the mainline railway. The scope of the Phase 2 scheme was to reinforce the existing 900mm diameter trunk sewer, which in the future would be taking flows from the Wichelstowe development, an existing large combined catchment in the south west of the town and the diverted Wroughton catchment.

Design options

As the new 1,200mm diameter Phase 2 trunk sewer would be following a similar route to the existing 900mm diameter trunk sewer with connections to it at its up and downstream ends, there were three design options: to intercept the new Wichelstowe development flows and continue Phase 1 down to the SPS in isolation, to split all flows evenly between the two sewers or to install the new 1,200mm diameter sewer as a storm relief sewer, keeping all dry weather flows in the exiting 900mm diameter sewer. MWH made a recommendation to the client and subsequently took forward the third option on the basis that it would be preferable to maintain dry weather flows in the smaller pipe keeping velocities high during times of low flow. This was of particular concern during the interim period before the Wichelstowe development comes fully online.

The selected route

Between the end of the Phase 1 sewer and Swindon STW, several engineering and environmental challenges existed for the new Phase 2 sewer. These included crossing Sunday league football pitches during the football season, the River Ray main river, the Great Western Way dual carriageway and a nature reserve which contained Great Crested Newts. The new storm relief sewer was to roughly follow the route of the existing 900mm diameter trunk sewer between the two defined connection points described above. However, it would not be possible to keep the new sewer on one side of the existing sewer along its whole length without causing significant environmental and social issues, such as pipelaying across three football pitches, the removal of around 100 trees and 500m of pipelaying through a Great Crested Newt habitat.

In order to avoid these issues, a solution was devised to allow the new 1,200mm diameter sewer to cross the existing 900mm diameter sewer at two points. This allowed it to run along both the eastern and western side of the existing trunk sewer where it was advantageous to do so for different sections along its route. As well as reducing environmental and social impacts, this solution also had cost and programme benefits.

Sewer crossing points

Sewer crossings were achieved by constructing large 4.5m x 4.5m square reinforced concrete 'crossover' manholes. Inside these manholes the new 1,200mm diameter sewer intersected the existing 900mm diameter sewer at a level which was determined by the hydraulic modelling of future storm flows. This difference in level provided a weir which will allow flows to split between the two sewers during storm conditions.

Crossing the Great Western Way

The route of the new sewer was split in half by the Great Western Way, which is a dual carriageway road that runs into Swindon from Junction 16 of the M4 motorway. This main road is raised on an embankment as it travels north and is highly traffic sensitive,

as it is one of the main routes into Swindon from the motorway. Crossing this road was one of the key engineering challenges of the project. Microtunnelling was utilised by specialist sub-contractor Barhale to pipejack 1,200mm diameter pipes under the carriageway. The crossing was completed in a 125m drive which also included crossing approximately 1m under a 300mm diameter intermediate pressure gas main. Due to the new pipeline being a gravity sewer between two predetermined connection points, there was little scope to adjust levels and make the crossing deeper. The microtunnelling was carried out using an Iseki Tunnel boring machine between two caisson shafts on either side of the road.

Crossing the River Ray

Another significant engineering challenge of this project was the crossing of the River Ray. In order to get to Swindon STW from the Mannington Recreation ground, the new sewer would have to cross this main river. Unfortunately, due to the size of the pipes and the required levels of the new sewer, a crossing had to be made with very little cover between the crown of the pipes and the river bed.

After surveying around 500m of the river to find a suitable crossing point, a location was found however, this still only gave 400mm of cover between the pipe crown and the river bed. This constraint completely ruled out any form of trenchless pipelaying to minimise environmental impact. It was therefore necessary to temporarily flume the river and install the new sewer pipes under the flume arrangement. To give adequate protection, the new 1,200mm diameter pipes were installed with a reinforced concrete surround spanning the width of the river incorporating flexible joints to allow movement.

New Barnfield Rd SPS inlet manhole

The new Phase 2 sewer was to be connected back into the existing 900mm diameter sewer at its downstream end at the existing Barnfield Rd SPS inlet manhole. Unfortunately, the size of this existing manhole meant that it could not be modified to incorporate a new 1,200mm diameter pipe. It therefore had to be re-built and this involved installing submersible pumps in a temporary pumping shaft to over-pump the manhole while it was demolished and rebuilt as a 5m deep, 4.5m x 4.5m cast in situ reinforced concrete structure. This new manhole incorporated two large penstocks to isolate either sewer and a platform in the benching to allow the future installation of a temporary pumping arrangement should TW wish to isolate the SPS.

Wroughton rising main diversion

As mentioned above, as well as the new Phase 2 sewer, the scheme also included enabling works to allow TW to divert foul water flows from an existing catchment into the Wichelstowe development area and therefore down the New Southern Trunk Sewer to Barnfield Rd SPS. These works included commissioning a 1.5km rising main diversion which had been installed by Swindon Borough Council. This involved laying approximately 100m of 500mm OD Polyethylene pipework and making a valved connection to the existing 400mm diameter ductile iron Wroughton rising within a new chamber.

Conclusion

This challenging project was successfully completed in June 2015 allowing growth to continue in South Swindon. The construction team's efforts were rewarded with the achievement of a silver award at the national Considerate Constructors Scheme awards.

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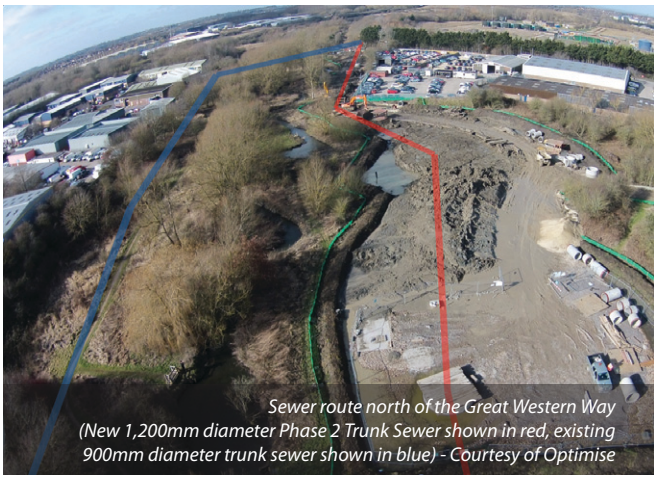
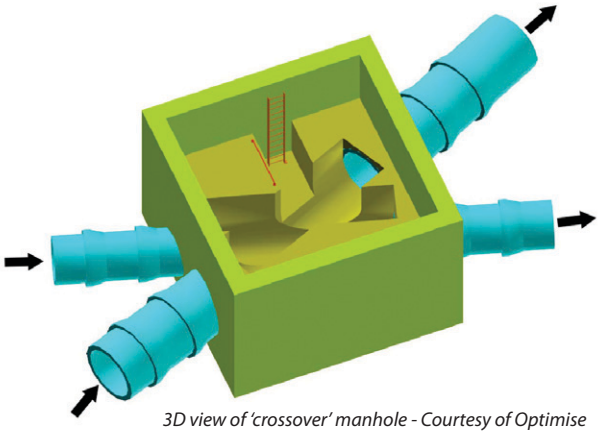


Sewer route north of the Great Western Way (New 1,200mm diameter Phase 2 Trunk Sewer shown in red, existing 900mm diameter trunk sewer shown in blue) - Courtesy of Optimise



3D view of 'crossover' manhole - Courtesy of Optimise

1,200mm diameter pipework being unloaded - Courtesy of Optimise

New Barnfield Rd SPS inlet manhole under construction with temporary over-pumping in place - Courtesy of Optimise