Longbenton Flood Alleviation Scheme

protecting properties from flooding in North Tyneside

by Lynn Preston, Peter Dibben and Paul Joyce

Northumbrian Water (NWL) is investing £6.4m to alleviate sewer flooding to 93 (No.) properties in the Longbenton area of Newcastle upon Tyne. The flooding properties are located between Goathland Avenue to the east, and Ongar Way to the west, following the line of the natural drainage valley through the area. Phase 2 of the construction work started in January 2011 and is the result of extensive investigations in order to ensure the flooding mechanism was fully understood and the best solution selected. The investigation work was completed by MWH utilising the latest 2D hydraulic modelling techniques to develop the solution. The project has entailed much stakeholder and customer management, along with close liaison with the contractor to overcome numerous construction challenges.

Figure 1: Flooding in the Longbenton Area *Courtesy of MWH*

Catchment description

The combined sewer system draining the catchment, passes through a Combined Sewer Overflow (CSO) at Grassholm Place, at its downstream end, with foul flows being conveyed to Howdon STW, and excess storm flows discharging into a 2.1m diameter surface water sewer, which in turn discharges to the Ouseburn. In peak storm conditions, levels in the Ouseburn can rise sufficiently to increase depths in the surface water system raising levels at the CSO and in the upstream catchment. Two large business parks, the second still under construction, have significantly increased the paved area draining to the surface water system.

The area of Killingworth to the north is largely drained by a separate system with the surface water flows discharging to Killingworth Lake, which overflows into the combined sewer system, connecting upstream of Grassholm Place CSO.

The Longbenton Letch, a watercourse with a largely urbanised catchment, connects into the combined sewer system immediately upstream of the main flooding area.

Once it was confirmed that there was no opportunity to provide a combined solution, the project was split into two phases. Phase 1, which covered thirteen properties in the upper reaches of the catchment, was investigated with a solution being delivered in advance of phase 2.

Problem understanding

The complex interactions within the catchment led to the requirement for an integrated modelling approach. An existing InfoWorks sewer model was enhanced and verified with the aid of a 60 monitor short term flow survey. Flow from two watercourses, the Longbenton and Forest Hall Letches, were added, utilising cross section details from an existing river model provided by the Environment Agency (EA). Influence of the Ouseburn was represented utilising another existing model provided by the EA. Assessment of overland flow routes utilised the InfoWorks 2D module, making use of LiDAR topography data already available for the catchment.

Information on historical flooding events was gathered from flood assessment forms (FAFs) completed by property holders and supplemented with customer interviews where required. Following initial assessment of the problem a public meeting was held to gather further information primarily on the extent and severity of flooding.

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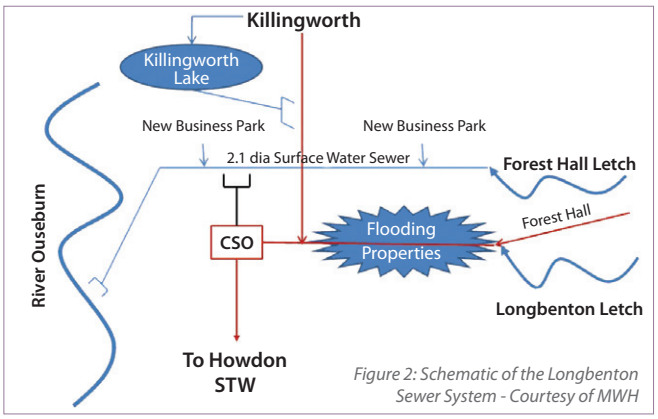

Figure 2: Schematic of the Longbenton Sewer System - Courtesy of MWH

Figure 4: Preferred solution (in red) with relief pipework and 10,500 m³ of storage Courtesy of MWH

The EA was consulted to get information on the watercourses and any change in flow regimes planned. The local authority, North Tyneside Council, was also consulted to collect additional information on the flooding, some of which had been reported directly to them, and details of highway drainage and operation of Killingworth Lake.

During verification of the model, several site visits were made in storm conditions to observe surface runoff and flow characteristics to confirm model accuracy. Following this, the 2007 and 2008 rainfall events which had caused extensive flooding were run through the model and compared with the extent and severity of reported flooding. Figure 3 (below) illustrates the extent of properties predicted to be affected by a 1 in 20 year return period storm; this matched closely with reported flooding, giving confidence in the models representation and predicted performance of the catchment.

The model demonstrated that the cause of flooding was due to a combination of factors; capacity of the trunk sewer, inflows from the watercourses and influence of the Ouseburn. Classification of flooding properties for inclusion on the flooding register was undertaken using a combination of customer feedback and the depth of flooding predicted by the 2D model results.

Optioneering

The primary objectives of options considered were to protect properties against flooding, which would allow them to be removed from the flooding register, ensure no adverse impact on existing levels of service in the surrounding area, and provide a cost effective solution.

It was recognised that it would be beneficial to remove the Longbenton Letch from the sewer system, thus reducing flows unnecessarily passed forward to treatment and reducing spills from a CSO further downstream. NWL worked closely with the EA and North Tyneside Council to identify an option to remove the Longbenton Letch but engineering constraints meant this was not possible as part of this project.

Consideration was also given to the downstream influence of the Ouseburn and increasing the capacity of the existing surface water sewer was investigated. Adding capacity to the surface water sewer, approximately 1.7km in length, was ruled out as prohibitively expensive. In addition, pumping of flows from the surface water sewer into the Ouseburn to provide a hydraulic break point was also discounted on cost and environmental grounds.

Acceptance of the downstream, and possibly upstream, constraints and then focusing on the local catchment to provide a solution therefore appeared to meet the primary objectives best. Given the route of the existing trunk sewer, it was not possible to upsize or dual this length. It was therefore proposed to provide high level relief to the system at key points and attenuate peak flows. This consisted of providing 2km of relief pipework, some oversized to provide additional storage, and a 10,500m³ storage tank. This size of tank was required as there was no option to remove the letch from the sewerage system.

Several locations for storage were considered and an ideal location, north of Ongar Way was identified. The preferred solution is shown in figure 4 (above).

Third Party and Customer Liaison

Customer communication has been at the heart of this project from the start. Six information sessions, hosted by NWL and North Tyneside Council, have taken place in the local area to which all customers affected by the flooding have been invited. The purpose of the sessions has been to keep customers informed of progress at each stage of the project process, and to explain the works involved with the construction of the solution. The sessions have also been useful to gain a deeper understanding of the flooding mechanism from the customers own experiences.

During the project, monthly updates were sent out to the local authority, the mayor, the local MP, and Ofwat, the Water Industry regulator. A website was set up during the construction phase of the work where people can check on progress, the latest dates for road closures and diversion routes.

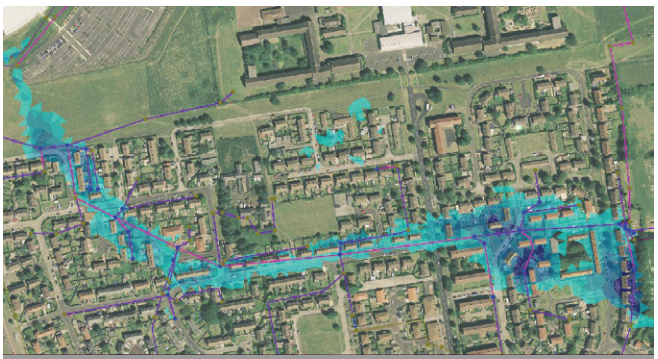

Figure 3 – InfoWorks 2D Flooding results for a 1 in 20 year return period storm, which was compared with the location of properties reporting flooding - Courtesy of MWH

Figure 5 – Construction of the Insitu and Precast Concrete Storage Tank Courtesy of MWH

Figure 6 – Constructing the benched drainage channels within the tank *Courtesy of Northumbrian Water Ltd*

As soon as feasible options were identified, discussions were held with landowners, tenants, and other interested parties to ascertain the impact of the work. Meetings were set up with the local authority and the EA to discuss the project and potential solutions. The selected option identified that a large portion of the construction works would take place in and around Longbenton Community College. A good relationship had already been established with the College Head, and a series of meetings took place to agree working times and methods. The college agreed to suspend all summer holiday events to allow the contractor a 6-week period in which to lay the 1,800mm diameter sewer along the main access road to the college. The good relationship with the college has continued with the contractor keeping in regular contact with the Head.

Design and Construction

The solution was developed through Preferred Option Development and Detailed Design Stages, with further data collection including a detailed ground investigation, utilities surveys, consisting of trial pits and radar survey and further topographical, manhole and CCTV surveys taking place to reduce the level of risk during construction.

The construction works were competitively tendered under an NEC Option A contract by NWL's Framework Contractors. The contract was awarded based on cost and quality, to Seymour (Civil Engineering Contractors) Ltd, and began on the 6th January 2011. MWH undertook the roles of administering the construction contract, site supervision and CDM Coordinator.

Some of the key challenges faced by the contractor during their planning and construction phase were:

- Careful sequencing of the works to ensure the completion of the tank prior to connecting any of the new system,

Figure 7 – Construction of the Insitu and Precast Concrete Storage Tank Courtesy of Northumbrian Water Ltd

Figure 8 – Example of the poor road construction disintegrating during construction - Courtesy of MWH

Figure 9 – Breaking into the existing sewer with a new relief pipe *Courtesy of MWH*

whilst also complying with the prescribed road closure dates.

- Management of a very large volume of spoil from the tank excavation given the limited working area and efficient disposal of excess material off site.
- Maintaining access for residents as far as possible, exacerbated in some areas by the poor road construction, which disintegrated when any construction traffic moved over it, as shown in figure 8 (previous page).
- Working closely with residents, local business, the college and school on a day to day basis to minimise disruption over and above complying with the constraints and requirements identified earlier in the project.

Conclusion

Northumbrian Water is investing £6.4m to protect 93 (No.) properties against flooding in North Tyneside. Excellent stakeholder management and communication led to support for the scheme from the Local Authority, Environment Agency, Local Councillors, MP and residents, and has resulted in a significant amount of positive feedback during the works.

A thorough understanding of the problems within the catchment and complex interactions with the surrounding drainage system and environment, led to the construction of a robust solution, which the project team delivered to a high quality ahead of programme and below budget.

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