

# Wallsend Flooding

## an individual property level construction scheme to reduce the risk of flooding and to provide wider benefits to the downstream sewerage system

by Kevin Fleming & Adrian Lee

The Hadrian Park estate in Wallsend was constructed in the 1970s and is located approximately 10km north east of Newcastle upon Tyne. The drainage system on Hadrian Park consists of both foul and surface water sewerage, with individual laterals serving each property. Northumbrian Water implemented an individual property level construction scheme for over 60 properties to reduce the risk of flooding and to provide wider benefits to the downstream sewerage system. The scheme was constructed over a period of five months between November 2014 and March 2015, and with a collaborative team effort and attention to detail, ultimately successfully delivered the project before the end of AMP5 and resulted in a high degree of customer satisfaction.



Attention to Detail for Reinstatement - Courtesy of Grontmij

### Background

The area of Hadrian Park under investigation has a population of approximately 150 people, with foul flows discharging by gravity to Willington Quay Sewage Pumping Station, with flows ultimately discharging to Howden STW located 5km south east. Surface water flows are also discharged via gravity to a culverted watercourse (Wallsend Dene), located 800m south west, before discharging to the River Tyne, located 3km south.

### Flood history

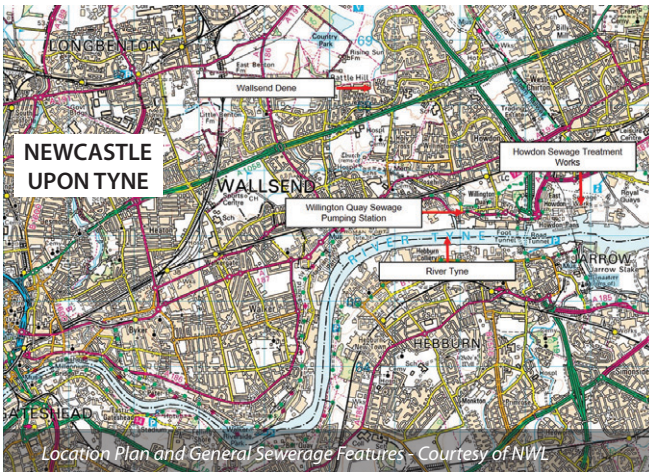
Flooding was reported to Northumbrian Water on several occasions, and most notably in June 2012 following a severe rainfall event, which recorded a rainfall return period of 1 in 500 years. Flooding described to Northumbrian Water by customers included surcharging of manholes located on private property and in the highway, as well as overland surface water, flowing from the

north of the estate. Flooding affected a number of properties, with many customers reporting sewage debris being present, with flood waters affecting gardens and also entering properties via garages, through air bricks and over door thresholds. Several customers' homes were uninhabitable for up to six months as a result of the flooding that occurred.

### Hydraulic investigation

Northumbrian Water appointed Grontmij in November 2013 to investigate and confirm the cause of reported flooding. As part of these investigations, the following sources of information were used:

- NW's GIS system.
- Connectivity surveys.
- CCTV surveys.



- A short term flow survey.
- Manhole and CCTV surveys.
- Hydraulic model.
- Topographical surveys.
- Customer interviews.
- Hydraulic model.

#### Hydraulic model

An existing hydraulic model was available from Northumbrian Water's hydraulic model library for the drainage areas and was used for the purpose of the hydraulic investigations. As well as targeted manholes surveys and historic CCTV surveys which were used to locally enhance the hydraulic model, a short term flow survey was also undertaken with the purposes of validating the results predicted by the hydraulic model.

The results of the observed flow survey, when compared to the hydraulic model, identified a significant rainfall response within the foul network which would not typically be expected within a separately drained sewerage network, and which was not replicated by the hydraulic model.

#### Connectivity surveys

To support the hydraulic investigation, individual drainage surveys were completed for over 100 properties located on Hadrian Park. Surveys completed by contractors, under the direction of Grontmij, involved testing of all locations where impermeable areas (roof, paved areas - including driveways and patios) discharged to ground and tracing the location where flows discharged to the public sewer network or otherwise, using dye and or CCTV. The drainage surveys also included testing internal plumbing connections to identify where the internal foul connections also discharged to.

The results of the connectivity surveys identified that approximately 80% of the properties surveyed were incorrectly connected to the public sewerage system and confirmed that surface water drainage connected directly into the foul sewerage within the property boundary.

The results of the connectivity surveys were recorded on site plans and were used to update the hydraulic model, as well as to update NW's corporate GIS.

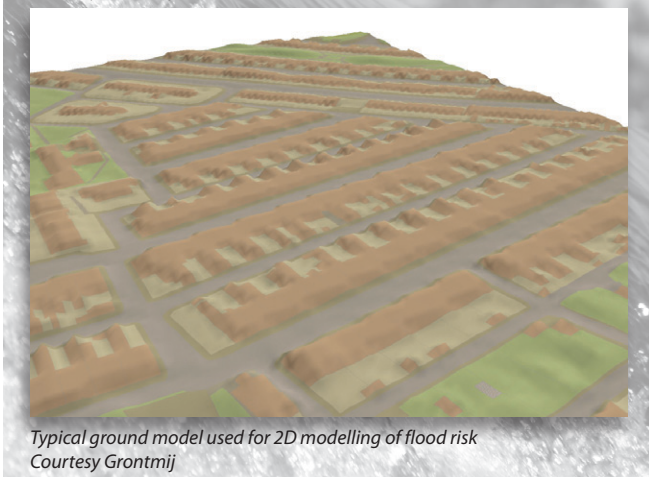
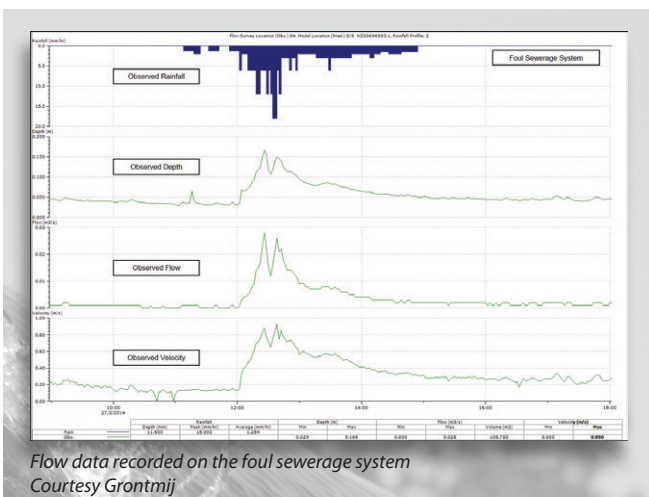
The hydraulic model was further enhanced with the details of the connectivity survey and additional local manhole surveys to represent private drains and sewers. As a result of these updates, the model predictions matched those of the observed flow results.

#### Flooding mechanism

A range of design rainfall events were simulated within the hydraulic model, up to and including a 1 in 500 year return period event, in order to historically validate the hydraulic model predictions against the flooding records.

As part of this assessment, a 2D model was also created in an attempt to replicate the anecdotal evidence from customers of overland flows from flowing from the north of the estate and flooding properties. The 2D model was created using 2m LiDAR, and supplemented with a topographical survey to increase confidence in the ground level data and to add in features such as walls, kerbs and fences.

The results of the hydraulic model assessment confirmed that the flooding reported by the customers was a result of hydraulic incapacity of the public foul sewerage system (as a result of cross connections from the surface water system) at lower return periods. The investigations also identified that additional flooding occurred as a result of surface water flooding from a nearby watercourse and further incapacity of the foul and surface water sewerage systems as a result of the severe rainfall event that occurred in June 2012.



As a result of this assessment, ten properties were added to the DG5 register of properties at risk of internal flooding, with a number of other properties also added to external flooding register. The results of the study were also shared with the Local Lead Flood Authority, where the wider flood risk identified was to be incorporated into a scheme they had developed previously.

#### Flooding technical panel

As part of the flooding programme, Northumbrian Water held weekly *flooding technical panel* meetings. The purpose of these meetings was to review the results of hydraulic investigations (presented by attending consultants and Northumbrian Water project managers) and to agree solutions to be developed.

The flooding technical panel included senior representatives from each of Northumbrian Water's technical consultants, as well as senior members of Northumbrian Water's flooding team. The panel's meetings allowed catchment knowledge to be shared across the supply chain and sort to reduce timescales in the programme by sharing project risk and agreeing solutions which best met and satisfied the needs of the project, as well as those of the customer.

#### Solutions investigated

The options agreed at the technical panel were:

**Option 1: Tank sewer:** This option required the construction of approximately 150m<sup>3</sup> of storage within the public highway. The option would have resulted in a full road closure, significantly restricting access for all of the customers to their homes during construction period.

The design of the housing estate was also such that no footways were constructed for pedestrians and therefore maintaining pedestrian access to properties during construction works would have also been problematic.

**Option 2: Surface Water Separation:** This option required extending surface water sewers at over 60 properties. For each property, the work would involve disconnecting the surface water flows from the foul sewer and diverting flows along private driveways to the existing surface water sewerage located on the public highway.

The option would require working on privately owned land and subject to statutory notice periods. The work would also require a degree of disruption to each individual customer, as well as an extensive and detailed reinstatement requirement.

Both options were presented back to Northumbrian Water as viable and affordable solutions, with Option 1 being identified as the preferred option based on the following criteria:

- Lower estimated project costs.
- Less disruption to customers, including those not affected previously by flooding.
- A shorter construction programme.

However, based on the evidence submitted, Northumbrian Water decided that in this case the most sustainable option should be constructed ahead of more traditional sewerage upgrade. The wider benefits of completing such a scheme included:

- A reduction in peak flow arriving at Howdon STW of approximately 30l/s, reducing onward pumping and treatment requirements.
- The potential accommodation of new housing within the local area as a result of increased headroom at the STW.
- Reduction of spills at downstream combined sewerage overflows and therefore the potential to improve water quality issues.
- Providing customers with a corrected drainage system which was fit for purpose.



Block paving removal exposing the existing pipework - Courtesy Grontmij



Existing pipework - Courtesy of Grontmij

### Pre-construction

As part of the pre-construction process, Northumbrian Water, Grontmij and Seymour Civil Engineering Ltd visited every customer individually to discuss the proposed work. Grontmij arranged individual customer appointments with times extending into evenings and weekends to suit each customer's availability. The customer consultation process programme lasted four weeks and was concluded with minimal objections to the proposed scheme, facilitated by the management of customer expectations, guarantees given regarding the quality of reinstatement of private property and detailed responses to any of their issues. Dialogue with customers was recorded and relevant site notes and customer specific requirements were issued to the contractor as part of the works information.

### Construction and post-construction phase

The construction phase of the project began in November 2014 and concluded in March 2015. The construction phase included two teams who started work on individual properties at opposite ends of the estate to minimise local disruption. Some of the works constructed or actions taken by the project team, specifically to meet the individual requirements of customer's are listed below:

- Assurances given to customer's about private driveway reinstatement on quality and appearance post construction.
  - Where full driveway reinstatements were required, cost neutral alternative materials were offered in accordance with the customer's preferences.
  - Correction of defective private drainage connections to avoid pollution of the surface water system.
  - Improvement of existing drainage features (where appropriate and were part of the planned works), i.e. re-profiling, slot drainage, new manhole covers to maintain customer relationships.
- Detailed attention paid to reinstatement requirements, for example numbering of individual block paving to provide an excellent finished product.

After the construction of the scheme, Northumbrian Water sent out customer feedback forms to all of the residents affected by the work and received a number of extremely complimentary responses, which underpinned the overall success of the project.

### Conclusion

Northumbrian Water implemented an individual property level construction scheme for over 60 properties to reduce the risk of flooding and to provide wider benefits to the downstream sewerage system. The project team managed a challenging programme of events to successfully deliver the project within the short timescales associated with the end of AMP5. These included:

- Detailed investigations into the sewerage network and customer interviews.
- Property level internal and external connectivity surveys and mapping of these assets on GIS.
- Hydraulic modelling and validation of the model's outputs with flow monitoring.
- Confirmation of hydraulic incapacity and wider flooding issues within the catchment.
- Extensive customer consultation and engagement pre construction, during construction and post construction.
- The provision of a sustainable solution with wider catchment benefits, as opposed to a more traditional sewerage upgrade scheme.

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