Ouseburn and North Gosforth Integrated Urban Drainage Study

Executive Summary

The Ouseburn is a urban tributary of the River Tyne. It drains the northern suburbs of Newcastle and discharges to the Tyne just east of Newcastle City Centre.

This study was focused on the North Gosforth area, in particular the Red House Farm Estate. In June 2005 a large thunder storm tracked across the Gosforth Area and around 80 properties were effected by flooding from the sewer network. This flooding occurred only a few years into the development of Newcastle Great Park, a large green field development which is ongoing in the area. Residents were concerned that the new development was going to increase flood risk in the area.

Northumbrian Water Ltd (NWL) instigated a study and identified that the sewer in the Red House Farm Estate was under capacity and estimated the standard of protection was around 1 in 5 year. To address this they implemented a £3.4 million capital scheme which included surface water separation and installation of new overflows to increase capacity within the sewer to the 1 in 40 year standard.

As part of the study carried out by NWL they suggested that one of the contributory factors to the flooding was the interaction between the river and the combined sewer overflow at Red House Farm.

This project focussed on studying the Ouseburn to understand if this interaction was happening and if so what might be done to address the problem.

To do this a network of monitoring equipment was installed and a new ISIS routing river model constructed to allow a better understanding of the Ouseburn in this location to be established.

Through public engagement we asked the residents in the areas what they thought was the cause of the problems and what their concerns and wishes were for the area. This led to some new avenues of investigation which were carried out as part of the project.

Through the study we have been able to provide evidence that the Ouseburn could reach a level where interaction with the sewer system was possible. Having reached this conclusion we looked in detail as to the major contributory factors to the flooding in the area. From this process we were able to highlight that the existing development areas of Red House Farm and Kingston Park (An neighbouring established mixed use development) were

the major areas which impacted river flows. In one event in July 2007 the Kingston Park estate contributed almost 80% of the total river flow.

The study has then looked at how we could manage the catchment better to reduce the flood risk in the area. The project has looked at what opportunities there are within the study area to reduce flood peaks, these include the multiple use of Sustainable Drainage Ponds currently being constructed within the Great Park and improvements to the maintenance in the area.

However, the project has also been encouraging individuals to be more aware of their actions. Permitted development within existing residential areas has the potential to significantly increase flood risk. The project plans to produce an information leaflet that will inform the public of the impact of their choices, such as type of driveways to the way building works such as conservatories are drained. By encouraging individuals to accept small changes bigger benefits can be achieved downstream. Accepting that your garden may be damp for a day or two can reduce runoff downstream which stops flooding.

The project has presented a united front to the public which results in more trust being achieved and better engagement. The project has successfully shared data to a degree not usually achieved in individual studies.

Ouseburn and North Gosforth IUD Project

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Project Objectives

In commencing this project it was necessary to develop some broad objectives to steer the programme and to enable the project to investigate the flooding problems being experience in the area. During the original submission to Defra the following objectives were set out;

1. Develop a better understanding of the true flood risks in the area by installing new rainfall and river monitoring equipment along with level recorders within the existing Suds systems.

2. Construction of updated and integrated modelling of the study area to understand the relationship between the sewer and fluvial catchment. This model will be specifically designed to include the direct inputs from existing housing and retail developments and highway infrastructure. Investigation into whether simple models, which will be easily used elsewhere at a much reduced costs, can replicate the modelled outputs. These models will be available to test the impact of the options developed later in the study.

3. The project will undertake a study of the catchment to determine the actual development creep. From this we will be able to estimate likely development creep we can expect in new and existing development both in this catchment and further afield.

4. We will investigate the effectiveness of the current SUDS systems which are currently being installed in the catchment. We will investigate the potential opportunities for SUDS and assess the impact of the constraints imposed by the Civil Aviation Authority in relation to open bodies of water in the vicinity of the Newcastle Airport Flight path, and the issue of bird strike within the area. Working with all partners we will investigate the retro fitting of sustainable drainage options and or storage within the existing development areas and quantify the potential benefits of doing so.

5. Having developed a sound understanding of floodrisk we will hold workshops including steering group members and other parties to develop a number of solutions to the ongoing flood risk issues. It is known that a number of these will be regulatory controls where we will influence others to address floodrisk but will also include physical works which will be

assessed and prioritised and assigned to the relevant member of the steering group to take forward

6. Working with Newcastle City Council Planning Department the project will develop a number of planning recommendations to help to control development in the catchment to reduce the development creep. A Supplementary Planning Document will be developed to help planners to control development in the area. This guidance will be fed into the ongoing masterplan for the Newcastle Great Park and will be considered for inclusion within the wider Newcastle City Masterplan. Options for the alternative disposal of surface water will be discussed with the building regulations teams to produce good practice guides which will be made available to residents and building firms.

7. Working with the existing Planning for the Urban and Rural Environment (PURE) catchment steering group we will develop a guide for residents in the catchment on how their actions impact on flooding in the catchment. It is intended that this document will give advice and tips on garden management and on options for alternative drainage options for extensions and conservatories. A good practice guide will developed following discussions with the Building Regulation teams on alternative drainage options for small extensions and conservatories and will be distributed to local builders and home improvement companies to encourage them to avoid directing surface water drainage straight to the sewer.

8. Working with the planners we will investigate the impact and the potential for the removal of permitted development rights with the Ouseburn Catchment in order to control development creep for both the existing development but also any new development within the catchment

9. Produce a final report on the project, detailing findings and the proposal for the future management. The report will include recommendations and lessons learnt by the programme.

During the project a number of these objectives have been modified as the work developed and based on consultation with local residents.

The river model was constructed early in the process but the data which was entered into the model was limited to the data which was available from the Agency at the time. So while the physical parameters were added the to model it was only when more detailed information from the monitoring was entered that we were able to start gaining a good understanding of the way the river acted. Therefore, it wasn't until February of this year that we were able to be confident in the outputs from the model and as a result the objectives relating to objective 5 have not been fully developed a the time of report writing and as such this outputs of this objective have been included as part of the action plan from the study.

Similarly the work on Objectives 6 and 7 are still ongoing and will be completed as part of the action plan.

We also have been unable to fully investigate the issue of the civil aviation authorities bird strike issues which was added to objective 4 at a late stage, a number of papers have been written on this issue and at this time the issue of open water on flight paths remains a significant constraint to the development of Suds in the vicinity of airport flight paths.

Approach taken by Project to address the objectives

The project utilised the local skills and expertise which were available in the Newcastle area. In developing the project Newcastle University and Jeremy Benn Associates were approached and the problems and issues within the area were discussed and advice taken from these bodies on how best to investigate and address the problems faced.

Following these discussions the basic technical framework for the study was developed.

The main requirements from a technical point of view were;

1. Development of a new river model.
2. Installation of a hydrology network and data collection
3. Calibration of the river flow sites

Development of river model

In discussion with Jeremy Benn Associates (JBA) they suggested that an ISIS routing model would be a sound way to model the area. The model would be flexible allowing different flow inputs to be added to the model.
The advantages of a routing model over a dynamic model are;

Cost
The routing model was easier to construct, was able to use the geometry files from previous studies. A full dynamic model would have required much more detailed surveying of the catchment and more development by the modelling team which would have increased costs greatly.

Speed
Due to the easier development process the model was able to be constructed much quicker than the more complicated dynamic model. It is also much quicker to run flows and scenarios through the model. In the initial calibration process the modellers were running 59 separate events through the model, each run took less than a minute to run compared to many minutes which is normal for a dynamic model. This aspect itself saved many days worth of modellers' time.

Ease of modification

Routing models are much easier to modify as you can easily modify inputs to the model and quickly run design storms through the model. Unlike dynamic models which often fail to run and need very careful maintenance the routing model is very robust.

Accuracy

Routing models are accurate for river flows, the failing of routing models is that they do not generate levels unless you input specific rating curves. Without rating curves it is not possible to translate the flow into a level at any given location. Obviously when you are looking at flooding the level is critical.

In general the development of the routing model was able to provide most of the required accuracy at a significant reduction in cost and a significant improvement in speed of delivery. Unlike other models developed for the Environment Agency the model is much more of an interactive tool. Having been developed it is easy to check a new scenario, for instance the provision of a new Suds pond on an existing development, simply by modifying the input flow and rerun the model giving a quick picture of the impact of new works. A full copy of the final modelling report is included in the appendices.

Installation of a hydrology network and data collection

While the Ouseburn has a permanent network of 3 rain gauges and 2 flow sites within the catchment it was still apparent that in order to look in detail at the specific study area further data accuracy would be required. Following our meeting Newcastle University identified a number of sites within the area which allowed good coverage of the river hydrometry. (Fig 1)

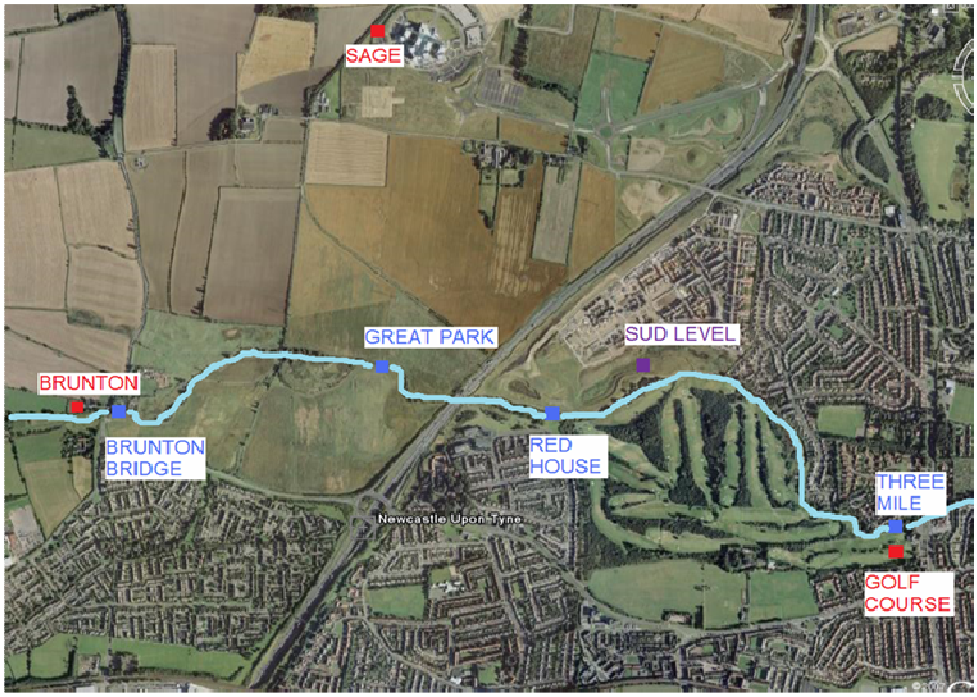

Fig 1. Location of Rain gauges and Flow Sites in the study area
(Red dots are rain gauges and blue dots are flow sites)

The location of the flow gauges was key, the site at Brunton Bridge represents the upstream end of the study reach. The catchment upstream of this location is largely rural.

The site named Great Park was just downstream of a large surface water outfall from a large urban area and allows us to monitor the impact of flows from this estate.

The site at Red House Farm was adjacent to the main flood risk area and this site was located just downstream of a major combined sewer overflow site. From this site we were also able to assess the impact of flow from the A1 trunk road.

The final location for a flow site was Three Mile Bridge which was able to pick up the flows from the SUD pond and from the estate to the north of the site.

These sites married to the rain gauges enabled the study to develop a much more detailed picture of the study area.

Calibration of the river flow sites

In order to allow the modellers to use the collected data it was imperative that a rating curve was developed for the sites. Newcastle University were able to gauge a number of floods during the year which allowed calibration of the model developed by JBA. A full report on the hydrology study is included in the appendices.

Public Consultation and Planning

From the outset of the study it was identified that we needed to have the public on board and needed their input to ensure the study actually produced beneficial outputs. This study commenced shortly after the completion of a Planning for the Urban and Rural Environment (PURE) study. As part of the PURE project, a catchment steering group had been established which was linked to local stakeholders and resident groups. As this group was already established and had good links into both the study area and the wider catchment it was considered the best option to tap into this resource rather than start public engagement from scratch.

We appointed the Ouseburn Catchment Steering Group as the project conduit to the public. This involved general awareness raising through there regular meetings but also the assistance in 2 public meetings which were held during the project. The first of these events was jointly organised with the Environment Agency and was a mechanism to involve the public in informing the project what they felt were some of the issues in the area and the source of the flooding problems. It was decided that we would use this conduit to continue public engagement. During the year we ran 2 evening workshops which were very successful.

The final aspect of the project was covered by Newcastle City Council, as the planning authority for the study area they were the authority responsible for the issuing of the planning permission for the Newcastle Great Park. The city council had imposed conditions on the developers of the Great Park to incorporate Sustainable Drainage Features into the development. However a great deal of public concern was centred on the great park development as they were already suffering from flooding problems in the area and the development of a large green field development in the immediate vicinity was only going to exacerbate the existing problems in their view.

Newcastle city council has carried out an investigation into a number of planning issues in the area which are of interest to the study. While Newcastle Great Park is a large development it is highly regulated and controlled, one area of concern for the study was the impact of unregulated or permitted development which had been carried out in the existing developments of Red House Farm and Kingston Park. Permitted development is the additional work that a householder is allowed to carry out to there home without further permissions from the local planning authority. Works such as the building of conservatories and the installation of additional parking / driveway surfaces are, in many instances, able to be installed by homeowners without additional planning permission. The Council study a number of sample areas where they were able to check the original planning permission plans with recent aerial photographs to determine development spread or creep.

The Council are also working on the development of a supplementary planning document which will help to regulate development in both the study catchment but also the wider Newcastle area. The findings from this study

are to be used in the development of that document for the benefit of the urban drainage network in the wider Newcastle area.

Report and Findings of project

The project started in February 2007 following a successful bid for funding from Defra.

The project team established included the main partners of the Environment Agency, Jeremy Benn Associates, Newcastle University, Newcastle City Council and the Ouseburn Catchment Steering Group. Additionally, Northumbrian Water (and their consultants Entec) and latterly Aone (the organisation responsible for the management of the A1 in the study area) were involved in sharing data and expertise in their fields and attended the project meetings.

The project stemmed from a flooding problem which had occurred on a regular basis in the Red House Farm Estate in Gosforth to the north of Newcastle. The most recent event had occurred in June 2005 (Fig 2) when a high intensity thunder storm tracked over the area and resulted in flooding effecting 84 properties with 24 families having to move out for a period up to 2 months

Fig 2 Flooding in the Red House Farm area in 2005

In response to the flooding and the subsequent pressure placed on them by the public and members of parliament, Northumbrian Water instigated a study into the sewer system. The study identified that the capacity of the sewer at Acomb Cresent was around the 1 in 5 year standard. To address this

Northumbrian Water commenced a standard scheme to upgrade the sewers in the area. In summary the works included installing;

- >1km 1050mm diameter overflow pipework;
- 3 new outfall structures to the Ouseburn;
- New combined sewer overflow (CSO) to the Ouseburn;
- 500m of new surface sewer in Red House Farm;
- >500m of new 675mm dia. surface interceptor sewer on Kingston Park Road;
- 380m of new 450mm diameter foul sewer;

The project cost in excess of £3.4 million and raised the standard of protection to the Red House Farm area to the industry standard of 1 in 40.

During the reporting stage for this project it was suggested that one of the contributing factors to the flooding in the area was that the sewered system was unable to discharge freely to the Ouseburn due to the elevated levels in the Ouseburn during the storm events. The effectiveness of the sewer could be improved if the sewer was able to discharge during flooding events. It was this statement that led to the development of this Integrated Urban Drainage study. Was the river effecting sewer discharges, could anything be done to improve the situation and had the traditional approach of sewer upgrading been the most efficient way to address the problem.

The Ouseburn had been studied a number of times and a Hec Ras steady state computer model had been produced as part of the Section 105 study in 2000. From the information provided by Northumbrian Water via Entec we were able to produce a schematic drawing of the Red House Farm area (Fig 3) which enabled the project to identify critical river levels.

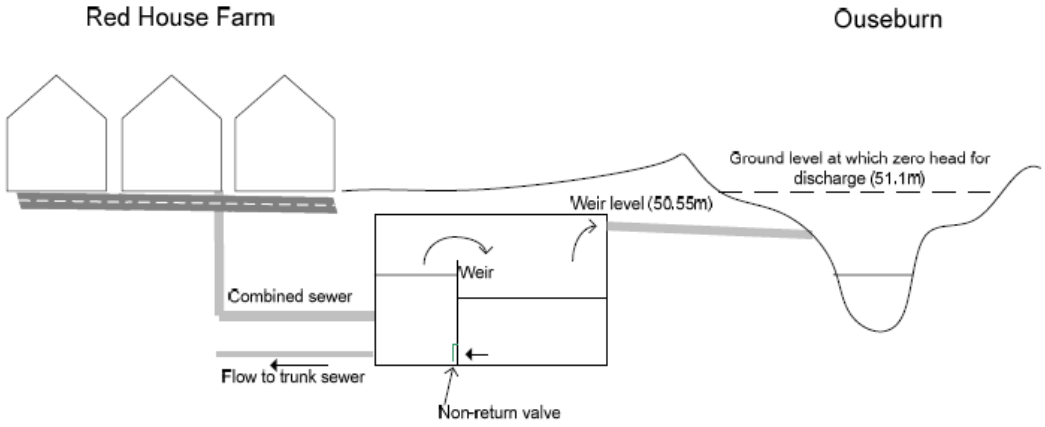

Fig 3. Schematic Drawing of Red House Farm area.

It was clear that the Red House Farm area was not at risk of flooding directly from the river, the previous modelling estimated the protection due to the high ground between the river and houses as around the 1 in 1000 year level. However, as can be seen in Fig 3 the river can still be well within its banks

and still be above the level of the houses in the estate. A critical level of 50.55m AOD was identified from the study as the point at which the river Ouseburn had the potential to start interacting with the sewer and as such impacting on the performance of the sewer.

Based on the modelling carried out in 2000, the level of 50.55m AOD was estimated as being the 1 in 5 year return period at Red House Farm. However, the modelling was developed using Flood Estimation Handbook (FEH) flow estimating supported by the gauged data available from the in situ monitoring stations.

For the storm of June 2005, the data available from the existing rain gauges and flow stations did not indicate a significant flow at Red House Farm such that there was little evidence to support the theory that the river was interacting with the sewer during the event. However, it was thought that due to the proximity to Red House Farm, of the large urban areas of Kingston Park and the A1 that during large convection storms the river in the area was reacting to the urban runoff almost as an open sewer channel and then attenuation occurred within the channel as the flow moved down the river.

To investigate this more accurately an ISIS routing model was built by Jeremy Benn Associates. (A full modelling report is attached as a separate volume). Routing models are quicker to build and run and focus on flood generating processes such as river flow and rainfall rather than the mechanisms of flooding. The model can thus be modified easily for instance to add or subtract the A1 road to assess the impact of the runoff from that area. The model was constructed quickly and following a process of calibration the phase 1 model was completed in July 2007. The calibration was carried out using data from the Environment Agency network of river and rain gauges only as the data from the ongoing monitoring carried out by the project was still being collected and was not at this point able to be used for calibration purposes. At this stage of the project the model gave no evidence of the river system reaching a level at Red House Farm which would have restricted the sewer from discharging. At this stage we were confident that the model was performing well and was supporting the information which the Environment Agency had in the form of the 2000 model.

We presented these conclusions to a number of parties and at one of the public meetings we had a significant comment from the floor when we were informed that some photographs of the June 2005 event were available which demonstrated clearly that the river was indeed interacting with the sewer during that event. The picture (Fig 3333) clearly showed that the river was high during the event.

Key to improving the understanding of the river in the area was the fine tuning of the model through the comparison of calibration events which were recorded using the data collected by Newcastle University. During April 2007 rain gauges and flow recorders were installed in the study area and data collected from May 2007 to date. The network installed was similar to that used by water companies during their network studies, and at a much greater

density than is normal for river studies. The full monitoring report is available in appendix A. During this time regular visits have been made to the site to collect the recorded data and during storm events physical measurements or gaugings have been carried out to establish the required rating curves in the area. During the period of monitoring 2 key events have occurred which have been of great use in establishing the flow regime in the area.

The 1st event occurred on the 1st July 2007. Following a relatively dry period a widespread rainfall event tracked over the area and was picked up by the monitoring equipment

The rainfall fell over the evening of 30th June to 1st July. Fig 4 shows the rainfall hyetograph and the flow recorded that the Three Mile Bridge flow recorder at the downstream end of the study area. As can clearly be seen the

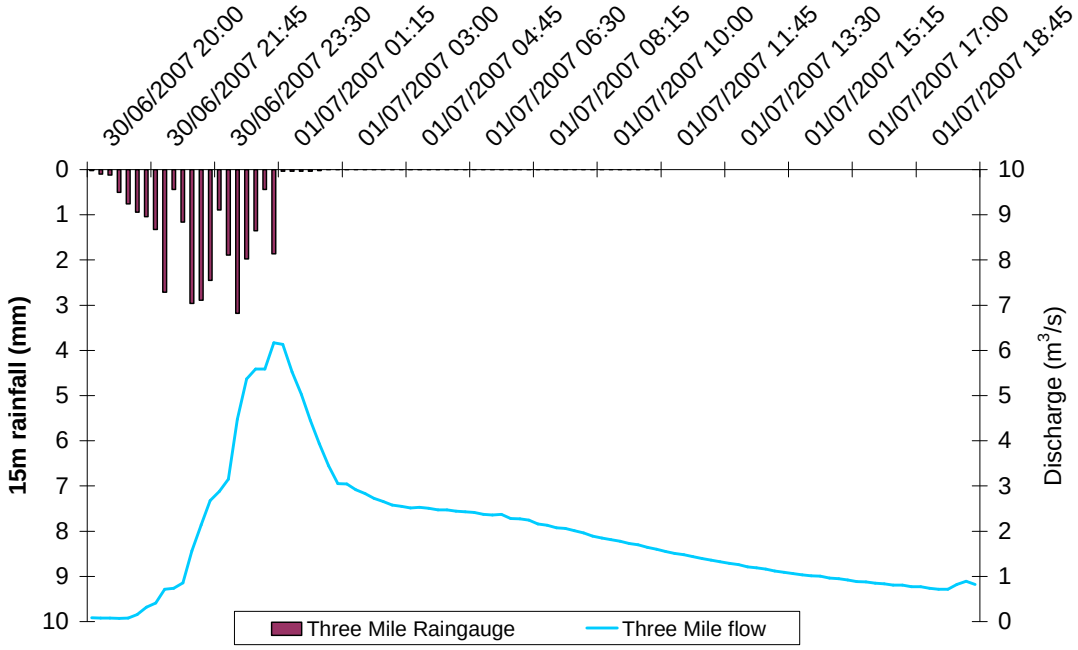

Fig 4. Rainfall hyetograph and river flow.

River responds rapidly to the rainfall and starts the fall as soon as the rainfall stops. There is very little lag in the system at this point. However of great interest was the way the river responded within the whole of the study reach. Figure 5 shows the flows recorded at all the river stations in the study area during this event. There are 5 flow recorders on this graph, the 4 in the study area and the Environment Agency flow recorder at Wolsington , upstream of the study area. Figure 1 shows the position of the river gauges through the study area with Brunton Bridge being the most upstream and representing the flow of a mainly rural catchment and Three Mile Bridge being the downstream station. Woolsington and Brunton Bridge show an expected relationship with the peak flow increasing due to increased catchment area and the peak occurring first at the upstream site followed by a gradual reduction in level over a number of hours.

However, what was very revealing to the project team was the way that the 3 other gauges responded. The rainfall event started at around 20:30 with light rain before intensifying from around 9pm and it wasn't till well after 22:30 that the rural gauges started to respond, however the gauges representing the

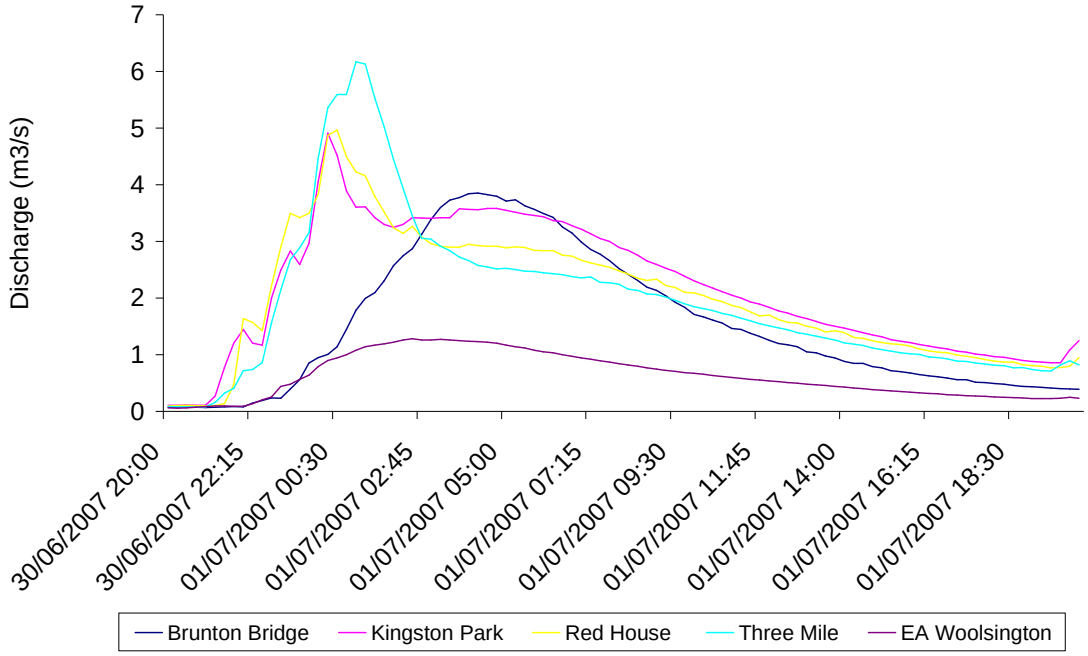

Fig 5. River flows during the 1st July 2007 event

Urban areas started to respond almost immediately around 9pm. The flow graphs are almost mirror copies of the rainfall showing very rapid response and rapid runoff. At its peak, runoff from the Kingston Park area represented almost 80% of the total river flow and was contributing around 4m3/s. It is clear from this graph that the river was responding extremely quickly and that large flood peaks were being generated although only for a very short period of time. As these peaks subsided the rural flow increases and the stations responded again and peaked much later around about the same time as Brunton Bridge. This potential to double peak was a key finding from the study, as was the shear scale of the flood peaks which were generated by the urban runoff during a summer storm scenario.

The second key event captured by the monitoring team was the 21st January 2008 event. This was a more typical winter storm, it followed a prolonged wet period which had largely saturated the rural catchment. Fig 6 shows the rainfall compared to flow at the downstream station. It can be seen that this event was much longer in duration lasting approximately 18 hours in total. Again the reaction of the river is better seen when you look at all the stations at as shown in fig 7. Here the urban areas still respond quicker the traces are similar in profile. These types of event are well represented by the traditional river modelling techniques while the summer events are more difficult to replicate.

Armed with the calibration data for the 1st July event the modelling team revisited the model and carried out more calibration. Using the data the team progressively worked along the river to achieve the best results possible.

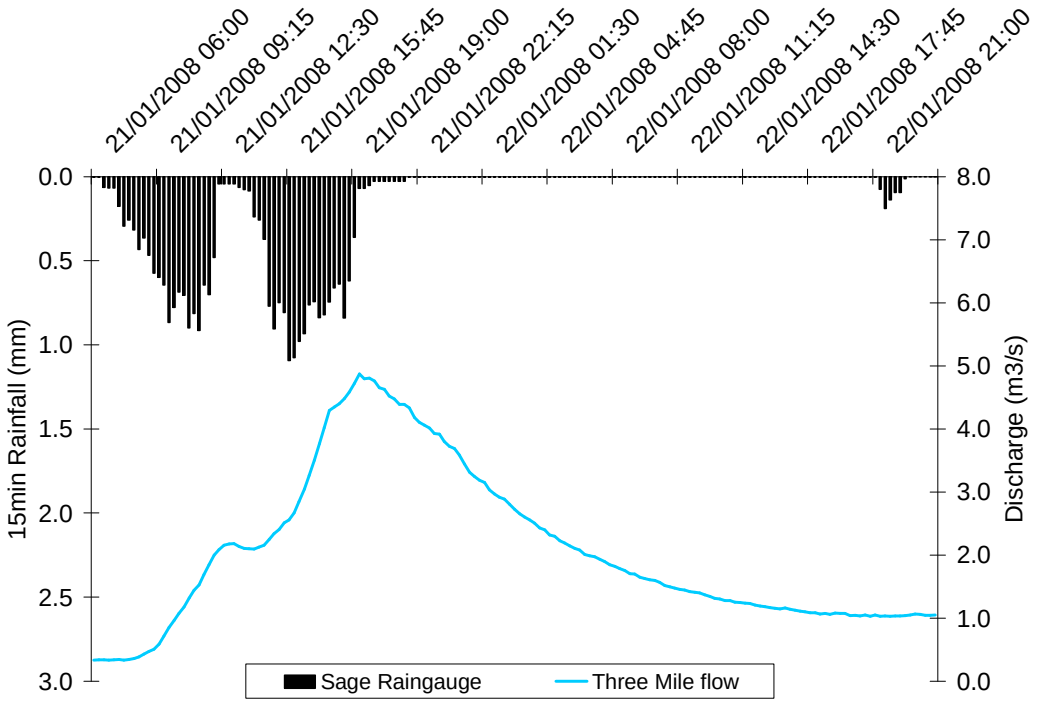

Figure 6. Rainfall and River Flow for January 2008 event

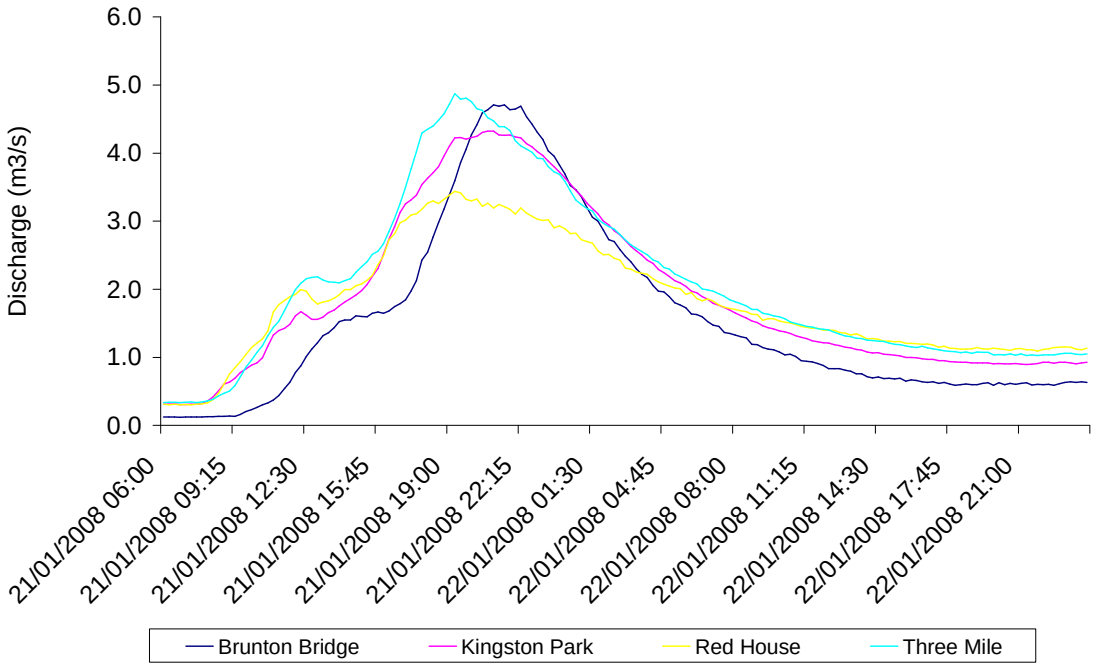

Figure 7 River Flows during January 2008 event

Over a period of time the modellers were able to achieve a satisfactory calibration based on the data provided. However, to do this a couple of

issues arose. When calibrating to the summer events captured by the University the river model was under predicting the observed river levels. Having assessed all available options the modellers opted to increase the roughness of the channel within the model up to 0.1. This is at the upper end of allowable figures for watercourses and would normally only apply to very rough catchments. However, was the reasonable. During the summer backside vegetation is in full leaf, any river bourn debris may catch on the vegetation. Further work is required to look at this issue and will be carried out as part of the action plan for further works.

If the river vegetation is affecting the mannings coefficient so significantly then there may need to be changes to the timing of maintenance works in the area to maximise the channel efficiency during the summer periods.
This new channel roughness was added to the model and then all the original calibration events were run through the model. This then produced a number of events which did appear to exceed the 50.55mAOD critical river level. It was therefore concluded that there was evidence that during moderate storm events the river was able to reach a level high enough to interact with the efficient discharge of the combined sewer over flow at Red House Farm.

Key Findings from the Modelling and Monitoring

1. A routing model is a good tool to modify complex issues with multiple inflows
2. A routing model is much cheaper and more robust and accurate for flows
3. A high density monitoring network gives much greater understanding of the rainfall and flow regime.
4. There is benefit in collecting data for a relatively short period of time as it gives a quick insight into flow mechanisms
5. Channel roughness may need to be altered to allow for seasonal variations
6. The biggest single area that influenced flow in the area was the Kingston Park Estate

Public Consultation

As part of this study it was always the intention to get the public involved and informed. We wanted to make sure that we knew what the publics concerns were and what they thought were the problems were in the study area. In order to prepare for this we completed the first phase of the modelling before planning a consultation event which we held in August 2007.

We wanted as many people from the area to benefit from the consultation process as possible and thus devised an extensive publicity campaign.
We planned a drop in session at a local rugby club which was easily accessible for the study area.

We prepared a programme from around 4pm when the drop in session started. The day consisted of a constant drop in session from 4 till 7:30, we organised 2 walking tours of the study area which individuals had to book onto and then at 7:30 had a number of short presentations. By having a number of different events timetabled rather than just a drop in session many more people attended the day.

We advertised the event with a leaflet drop in the study area and a number of press releases. We got excellent coverage in the local press and local radio and even managed to get a mention on the BBC website.

The leaflet had contact details and encouraged those unable to attend the event to call, email or write to us with their comments on the Ouseburn
For the later part of the event we organised a small crèche to ensure that parents were able to come along to give their comments without the distraction of looking after the children for a short period.

Fig 8 The Drop in Session in full swing

The first event was a great success and we gathered a great deal of information from the public. The varied formed of delivery was welcomed and very successful, with the 2 walking tours being very popular despite the heavy rain on the day. These tours took the form of a guided walk by one of the project team who talked through the features in the area such as the sewer overflows and suds ponds and how they all work. Within each group we have another project team member who talked to the individuals on the tour and gathered much information in the much less formal setting of the tour. These

tours were very novel yet very useful, the cost was reasonable at around £100 for the hire of the bus but the information gathered was very useful

Fig 8 Presentations during the 1st Public Workshop

Over the event around 100 people attended which was at the higher end of expectations, during the presentations it was standing room only.

From the evening we received a lot of comments, a copy of the compiled list is included in the appendices. But broadly speaking the publics concerns fell into 4 main categories.

Newcastle Great Park
Existing Development (Roads and Estates)
Three Mile Bridge
River Maintenance

This information was taken and we included a number of specific items in the remainder of the study. We specifically added the A696 to the model, and carried out a new survey of the Three Mile Bridge which was added to the model. This survey did identify a significant amount of siltation beneath the bridge. The modellers were given the bed profile as existing but one of the actions for the future will be to investigate the removal of the silt from the bridge. This will be run through the model to assess the impact of the works to ensure that is beneficial.

Thee issue of maintenance was noted and would be looked at towards the end of the project, this aspect of the study still needs to be fully addressed although as noted above some changes to the timing of works may be required to improve the channel roughness especially during the summer months.

Newcastle Great Park and in particular the sustainable drainage ponds were specifically mentioned during the workshops. These have been designed from the outset of development and, on the whole, have been operating as expected since the development commenced. However, one pond overtopped on 2 occasions in 2005 due to incorrect construction and this did much to undermine public confidence in the success of the ponds. At the public meeting the Environment Agency spokesperson was very supportive of the ponds. However, to the public this sounded as if the Agency was defending the Great Park builders. Therefore, Newcastle University were asked to look into the ponds to assess performance and ensure that they were performing as designed.

All the comments from the 1st workshop were read and checked so that we were confident that we could address the public concerns as part of the study.

The planning work of Newcastle City Council is still ongoing as this report is being compiled. The city has looked into development creep as part of permitted development but to date the final report on this aspect of the study has not been completed. However, it has been obvious that the existing urban areas represent the greatest influence on flood risk within the study area. The council are considering a number of planning issues such as removal of permitted development rights to the requirement that all building in the area has sustainable drainage and / or rainwater harvesting installed to reduce the impact of the urban drainage.

Conclusions from the Pilot Study

For the first time a full understanding of the river system in the Red House Farm area has been developed. Without this study the evidence of interaction between the sewer and the river would have been anecdotal. As a result of this study we have some evidence that that potential does exist.

We also have clear evidence of the main sources of flow in the area, at the outset of the study the A1 had been identified as a key concern. While it doesn't have any formal attenuation the system is limited by its design and as such has a physical restraint to flow. Such a restraint does not exist on the Kingston Park estate and as such this area is identified as a major issue.

Kingston Park is a well established mixed development with a large retail and employment area surrounded by residential development. There is limited new development proposed in the area.

Due to the regulation on the Newcastle Great Park, the development itself does not increase flood risk in the area. In fact, the development does offer a

number of opportunities. As part of the planning permission works to the A1 are proposed. This presents the opportunity to reroute the flow from the A1 into the ponds constructed on the Great Park. This option has been run through the model and it does have a positive impact on flows in the Red House Farm Area.

The ponds on the Great Park do give an opportunity to act as a flood storage facility and to receive high flows from the Ouseburn. While the routing model is not the correct toll to assess the storage requirement an approximation can be achieved which suggests around 10000m^3 of storage could significantly reduce the potential interaction between the river and the sewer. Further work on this in included within the action plan.

There is a lot we can achieve through public engagement. A solution to the urban flooding is to allow the public to see the impact of small changes that they can make. While it is unlikely that you will achieve large take of things like rainwater harvesting within existing areas, the provision of water butts does help in a small way. If additional parking is required the design and material used has a huge effect on run off rate. For instance, the use of gravel instead of concrete and tarmac reduces runoff rates. When building conservatories etc, do you need to drain the roof to the sewer, can this water just be allowed to fall to the ground and soak away?

In order to achieve large benefits we need the public to accept small personal sacrifices. If they were happy to allow their gardens to be wetter and hold water for a few hours that could have a significant benefit in the catchment. Keeping clean surface water on the surface longer reduces the load on the sewers and thus can reduce the flood risk downstream.

Benefits of Integrated Approach

In total the project has spent to date almost £75,000 on this study, a large portion of this was the modelling and the travelling cost associated with attending the IUD workshops at around £37,000. The monitoring and data collection cost just over £20,000 with the planning projects and public consultation and making up the remainder of the costs.

On top of this the project has utilised a large amount of staff time which has been provided over and above this, the remaining Defra monies (£10k) are allocated to the writing and publication of a guidance leaflet for the public on what they can do to manage flood risk in the area.

Without the funding from Defra this project would not have been carried out, both Northumbrian Water and the Environment Agency had good models of the area and had carried out investment in the area to address their responsibilities in the area. The Environment Agency were satisfied that direct flooding from the river was not a problem and Northumbrian Water had invested £3.4 million upgrading the sewers to reduce flood risk in the area. The new development was regulated and the impact of the Newcastle Great

Park was being managed by the planning conditions placed by Newcastle City Council.
However, as a result of this study there has been a much more open approach to data sharing, the organisations have allowed data to flow in both directions to a degree not seen before. The additional funding from Defra has allowed a more focused approach to be undertaken and as a result a much better understanding of the river and sewer relationship has been achieved.
By presenting a unified approach, the public have had more confidence that the study was looking into all aspects of the flood regime and have wanted to fully engage in the work of the study.

As a result of involving the university and steering group a more free thinking approach to options has been developed. Rather than think about what we are allowed to do the steering group have looked much more at what could be done. In order to achieve Integrated Urban Drainage solutions a much more integrated approach is required. Rather than keep Suds ponds exclusively for drainage can they not be used for river flows, (Fig 9) to clean water and potentially store flood water.

Integration of The River with the SuDS

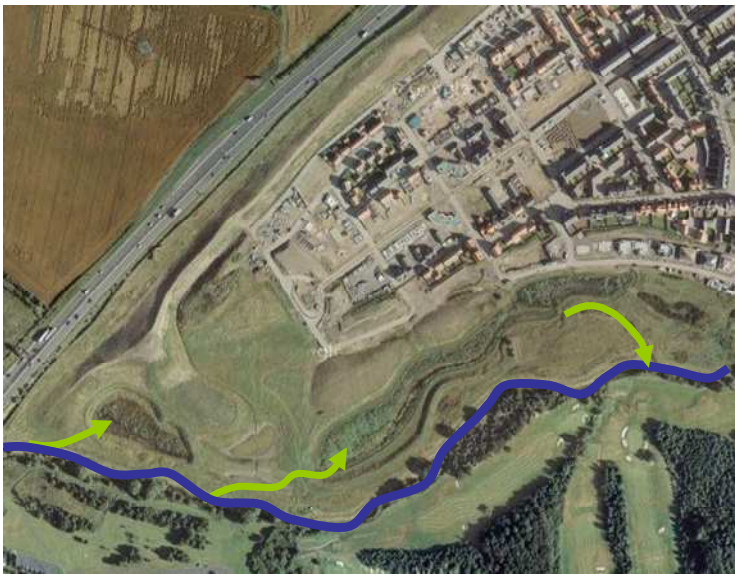

Fig 9 Why not use the ponds for more than drainage

One of the final outcomes from this study is that the public are now engaged in the issue of flood management, their fears regarding the Great Park have diminished and they are looking forward to positive changes in the future.

Action plan and future implications of study

To date the project has been unable to complete all of its objectives and as such further work is required to produce greater benefits to the local population.
There are significant benefits in maintaining the current rain gauge and river station network; this allows continued monitoring of the hydrology in the area. This will also allow us to see the impact of changes within the catchment and to assess the success of any projects in reducing flood risk. It is hoped that through discussions with the Environment Agency further funding will be sourced and this work can continue

During the project a great deal of positive work has been achieved with the public groups, those who attended the workshops, especially the 2nd one in March 2008 were very keen that things would happen in the area. Those present at the meetings were extremely complimentary about the progress which had been made but it is vital that this momentum is taken forward. Therefore the Ouseburn Catchment Steering Group will continue to operate. This group will work on the publication of the public information leaflet and the remaining £10000 funding from Defra will be used to allow this to happen.

The work that is ongoing by Newcastle City Council on development creep and supplementary planning guidance will be completed. Newcastle University have proposed that a future student project will be to develop the development creep work further. Earlier this year Northumbrian Water kindly installed some flow monitoring within the Kingston Park area as a result of our modelling findings. This data has not been able to be included in this report as it was installed too late. However, as part of the work on development creep it will allow us to better understand the runoff regime in the area.

Having identified the potential to utilise some of the ponds on the Great Park as potential flood storage options, further work will be carried out to assess their capacity and to design them for that purpose. A number of discussions will be required to secure the effective maintenance of these ponds and those discussions will commence between the builders, Newcastle City and the Environment Agency.

The Environment Agency are to look into the findings of this study and to assess whether changes to the current maintenance regime will be of benefit in the area. Some works around the Three Mile Bridge are currently being investigated as a result of the modelling report completed for this study.

In conclusion, while this study has not produced as much as it hoped at the outset it has highlighted a number of important issues which were previously not been fully understood. As a result a number of small changes can be implemented immediately, such as maintenance changes. It is also worth noting that the benefits of this project are already been reaped, the model produced by the project is currently being used for a flood warning project which will benefit the whole of the Ouseburn Catchment.