Nottingham City Council

Flood Investigation Report:

Prepared under Section 19 of the Water Management Act 2010

Woolsington Close, Strelley, Nottingham, on 23rd July 2013

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FLOOD INVESTIGATION REPORT SUMMARY

Nottingham City Council is a Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (2010).

Section 19 of the Act states that on becoming aware of a flood the LLFA must, where appropriate, investigate which Risk Management Authorities have relevant flood risk management functions and whether they have exercised, or are proposing to exercise, those functions in response to the flood.

A number of thunderstorms passed over the City on 22nd and 23rd July 2013. On the evening of 23rd July 2013 an intense storm passed over the north of Nottingham causing over 100 residential properties to flood across the City. A total of 10 properties suffered internal flooding and 2 suffered external flooding on Woolsington Close, Strelley.

This Flood Investigation Report has been completed by the City Council in consultation with relevant Risk Management Authorities. The report summarises the formal investigation that has been undertaken, including any factors that contributed to the causes and impacts of the flood event and describes all roles and responsibilities and future actions.

1 INTRODUCTION

1.1 What is a Formal Flood Investigation?

Flooding has a devastating impact that affects people, property, business, the environment and transport. There are many different sources of flooding including rivers, sewers, surface water and groundwater and there are a number of Authorities and organisations involved in managing the risk of flooding from these different sources. Flooding can be caused by a complex interaction of different sources that can be difficult to resolve, particularly in urban areas.

Nottingham City Council is a Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (2010). In recognition of the complex nature of flooding and the number of different Authorities that can be involved, Section 19 of the Act places a duty on the City Council to investigate the causes of flood events in their area, as appropriate. The legislative requirements of Section 19 are included below.

Flood and Water Management Act (2010) – Section 19

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—

(a) which risk management authorities have relevant flood risk management functions, and

(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must—

(a) publish the results of its investigation, and

(b) notify any relevant risk management authorities.

This report has been prepared in response to this legislative requirement.

1.2 Which Authorities are involved?

The Flood and Water Management Act (2010) identifies organisations that have flood risk management responsibilities as 'Risk Management Authorities'. Table 1 shows the key responsibilities of Risk Management Authorities that operate in the Nottingham City area.

Due to the number of different organisations involved, the City Council is responsible for leading on flood investigations and works in partnership with relevant Risk Management Authorities. Through leading the investigation, the City Council will identify which Risk

Management Authorities have flood risk management functions in relation to the flood event and what actions they propose to take, if any, to reduce flood risk in the future.

Table 1: Risk Management Authorities in Nottingham City Council's administrative area.

Risk Management Authority	Flood Risk Management Functions
Lead Local Flood Authority & Highway Authority: Nottingham City Council	• River (fluvial) flooding from minor watercourses ('Ordinary Watercourses') • Surface water (pluvial) flooding • Groundwater flooding • Provision and maintenance of highway drains and road gullies
Water and Sewerage Company: Severn Trent Water	• Providing effectual drainage • Maintaining adopted public sewerage network
Environment Agency	• River (fluvial) flooding from large watercourses ('Main Rivers') • Flooding from the Sea and estuaries • Reservoir flooding

1.3 When are Formal Flood Investigations undertaken?

The City Council has developed thresholds and triggers for when a formal investigation will be undertaken following a flood event. The thresholds relevant to this Flood Investigation Report are summarised below:

Nottingham City Council Thresholds for Initiating Flood Investigations

For a residential dwelling such as houses or flats including Nottingham City Homes properties a Section 19 flood investigation shall be carried out where:

- internal (over the doorstep) flooding affects five or more properties and the properties are either in close proximity or the flooding is hydraulically linked.

The flood event on 23rd July 2013 caused the internal flooding of 10 properties and the external flooding of 2 properties on Woolsington Close. This Flood Investigation Report has been compiled because the number of properties that experienced internal flooding exceeds the thresholds that have been set by the City Council.

2 DESCRIPTION OF THE LOCAL AREA

2.1 Location of the flooding incident and the local area

Woolsington Close is located approximately 6.5km north west of Nottingham City centre in the area of Strelley. This is predominately a residential area; the north side of Woolsington Close is bounded by Broxtowe Country Park (Figure 1).

Levels on Woolsington Close fall by approximately 4.8 metres from the junction with Cranwell Road to the lowest point. The surrounding residential area is interconnected by a series of footpaths and alleyways that slope downhill from 136 to 120 Cranwell Road towards Woolsington Close and ultimately Broxtowe Country Park. An area of hard standing approximately 345m^2 is present to the south of Woolsington Close which creates an impermeable surface along with surrounding alleyways and footpaths.

Where the residential properties back on to Broxtowe Country Park the land rises along a small embankment before falling again to the north and east. This is believed to be an old railway embankment.

The area was developed in the late 1960's /early 1970's including a new drainage system at the time. Prior to this development the area was open fields and woodland with a railway servicing Broxtowe Colliery and Cinderhill following the line of houses on the north side of Woolsington Close.

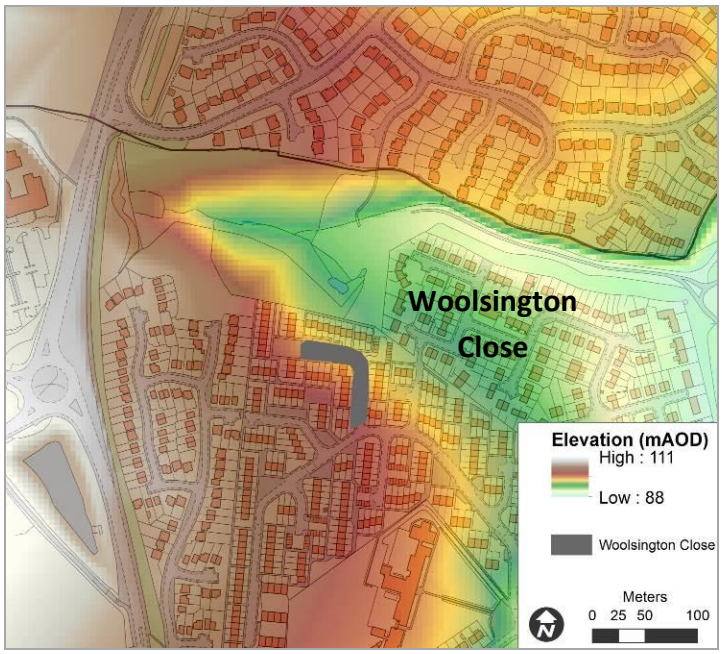

Figure 1: Site Location and Topography.

2.2 Local river and drainage systems

Broxtowe Park Brook drains the valley approximately 100m the north of Woolsington Close and is the only watercourse that may have impacted upon flooding in the area. Chilwell Dam Plantation, approximately 50m from Woolsington Close, forms a series of wetland and pond areas that drain into Broxtowe Park Brook.

Woolsington Close is served by a separate surface water and foul water public sewer network. Severn Trent Water's public sewer records show the surface water and foul water sewer pipes flow south at a shallow gradient (against the gradient of the land surface) where they combine with the public surface water and foul water sewer in Cranwell Road. The sewers in Woolsington Close are at the head of the sewer.

Severn Trent Water's public sewer records show the surface water and foul water sewers are 300mm and 225mm in diameter respectively on Woolsington Close. At Cranwell Road the surface water sewer increases to 450mm in diameter whilst the foul sewer remains at 225mm.

2.3 Historical flood events

Nottingham City Council and Severn Trent Water hold no records of internal or external flooding as a result of rainfall on Woolsington Close prior to the flood event on 23rd July 2013. Flooding has been recorded in the surrounding area in the past five years but not at Woolsington Close.

Following the flooding of 23rd July residents have reported that properties on Woolsington Close have flooded with varying frequency in the past. Events in 2006 and 2008 are reported to have been a similar magnitude as flooding in the 23rd July 2013 with both internal and external flooding experienced. One resident reports that their property floods approximately twice a year during heavy rainstorms.

2.4 Areas predicted to flood

The Environment Agency's Flood Map for Surface Water is a national dataset which shows areas that are predicted to be at risk of flooding from surface water. The Map was made publically available on the Environment Agency's website[1] in December 2013.

The Flood Map for Surface Water shows that some properties on Woolsington Close are at a high risk of surface water flooding. High risk means that each year, there is a chance of flooding

[1] Environment Agency Flood Map for Surface Water, available online at maps.environment-agency.gov.uk, select 'Risk of Flooding from Surface Water'

of greater than 1 in 30 (3.3%). Areas at Medium risk (chance of flooding between the 1 in 30 and 1 in 100), Low risk (chance of flooding between the 1 in 100 and 1 in 1000) and Very Low risk (chance of flooding of less than 1 in 1000) are also indicted on the Map. The Map shows that surface water flooding is consistent with a hollow in the topography as identified in Section 2.1. Anecdotal evidence of flooding from 23 July suggests that the flooding experienced is more widespread than is predicted by the Flood Map for Surface Water.

An extract from the Flood Map for Surface Water is included in Appendix A.

3 CAUSES AND IMPACTS OF FLOODING

3.1 Weather conditions before and during the event

General conditions in the weeks leading up to the 23rd July 2013 were dry. Rainfall data from the City Council's rain gauge network shows that between 21:00 on 22nd July and 12:30 on 23rd July 2013 three rainfall events occurred. The Bulwell Riverside rain gauge, which is located 3km north east of Strelley, recorded a total of 24mm of rain during this time (Figure 2, Events 1, 2 & 3).

At 17:00 on 23rd July an intense storm moved south west to north east across the north of Nottingham City, including the Strelley area (Figure 2, Event 4). Rainfall data from the Bulwell Riverside rain gauge recorded 25.8mm of rain in 29 minutes, though affected residents on Woolsington Close recall the rain lasting for up to two to three hours. At the peak of the storm 17mm of rain was recorded in 10 minutes. It is important to note that rainfall can vary greatly over short distances and that the rainfall data reported here was recorded at Bulwell. The flood event started during the intense rainfall event at 17:00 on 23rd July 2013.

The City Council commissioned a report to undertake detailed analysis of the rainfall data from the Bulwell rain gauge. This concluded that the main storm at 1700 was a 1 in 36 annual probability event.

The intensity of the rainfall event is important because the current industry standard for design of sewers is to accommodate flows for up to the 1 in 30 year annual probability rainfall event. More severe storm events are therefore more likely to exceed this design capacity and possibly overwhelm the public sewer network. Sewerage systems are designed to the modern water industry standard and are ordinarily expected to accommodate the 1 in 30 year event. The rainfall event exceeded the design standard and Severn Trent Water therefore class the event as 'extreme'.

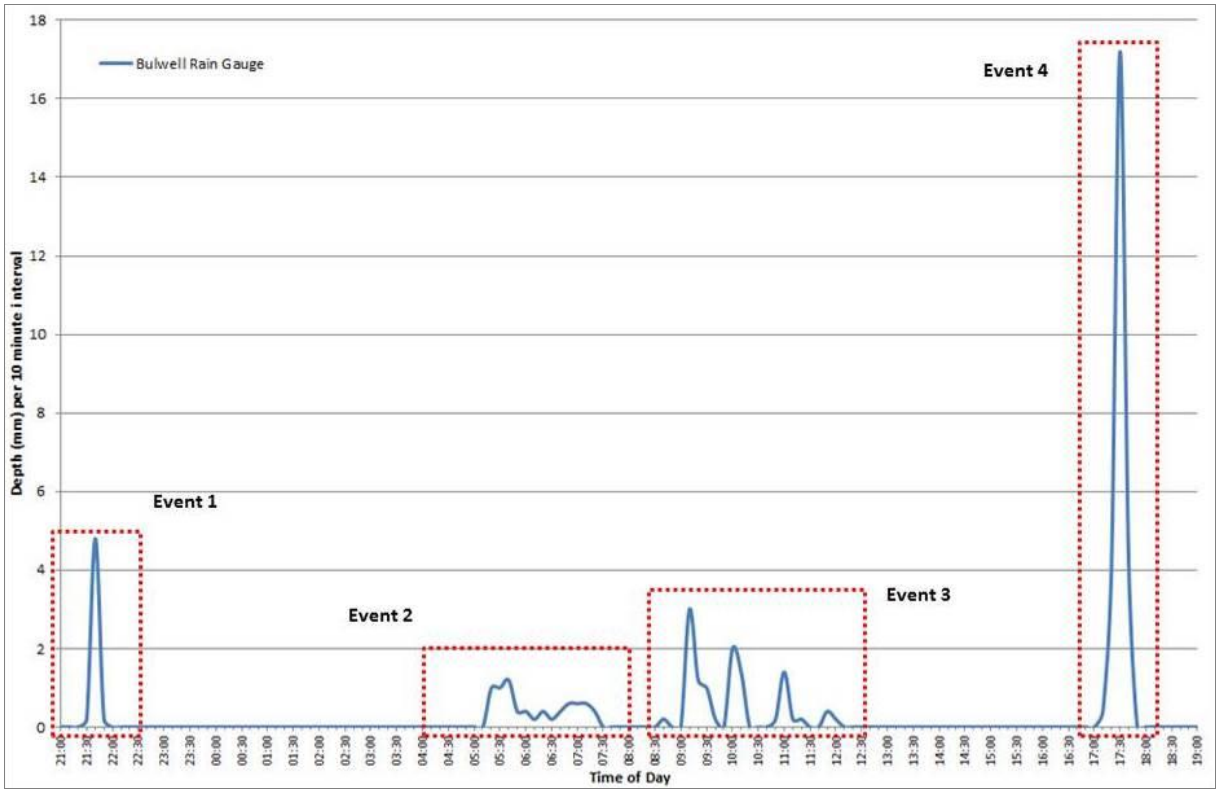

Figure 2: Rain gauge data from Bulwell for the evening of 22nd July 2013 and throughout 23rd July 2013

3.2 Flooding mechanisms and impacts

3.2.1 Observed flooding mechanism

The flooding of properties on Woolsington Close occurred during and after the intense rainfall event at 1700 on 23rd July 2013. It is likely that rainfall in the 24 hours before the main rainfall event (Figure 2, Events 1-3) had saturated areas of green open space both locally and within the wider Strelley area. This, combined with the intensity of the main rainfall event, resulted in rapid overland flow and ponding of surface water in low lying areas.

Surface water flowed down towards Woolsington Close from surrounding higher ground, with footpaths and roadways acting as conduits. Site investigation suggests that that water was mainly conveyed from hard standing and impermeable surfaces surrounding Woolsington Close where it travelled to low points in the topography. It is observed that Cranwell Road has a south east sloping camber that may convey the majority of surface water towards Kildonon Close and Shanwell Drive rather than divert it in to Woolsington Close.

Residents report water flowing from the front and rear of properties of Woolsington Close and pooling in low lying areas. It was observed that the road gullies were not draining water away and one resident reported that the manhole to the east of Woolsington Close was surcharging.

There is no evidence that Broxtowe Park Brook contributed to the flooding impact on Woolsington Close due to its location on lower ground to the north of Woolsington Close.

There is no further evidence of contributory factors that may have increased the flood impact across the area.

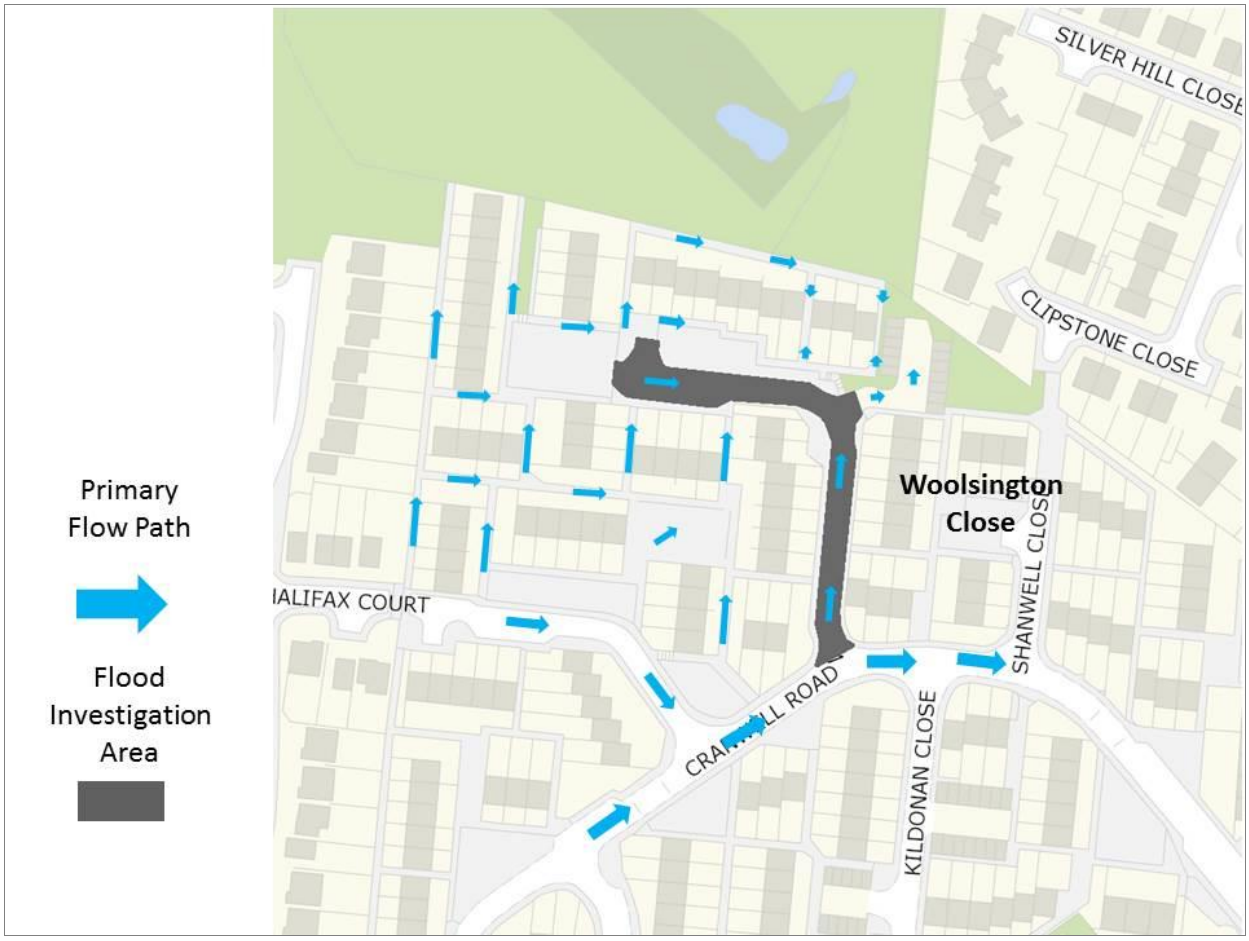

Figure 3: Primary flow routes of surface water during the flood event (based on observed topography).
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3.2.2 Woolsington Close

During the storm, surface water flowed rapidly along the impermeable surfaces surrounding Woolsington Close. Due to the topography of the area water was conveyed towards the north east side of the road where garages and residential properties are present (Figure 5). The old railway embankment forms an artificial bund that allows water to pool and not flow towards the Chilwell Dam Plantation and Broxtowe Park Brook (Figure 4).

Surface water flows may have been exacerbated by areas of hard standing on the north side of Woolsington Close and the garage area to the east which will have encouraged overland flow towards lower lying areas (Figure 5).

Figure 4: Old railway embankment (top of bank is marked by the red dashed line) forming artificial bund to the north of properties on Woolsington Close. Broxtowe Country Park is visible beyond the fence line.

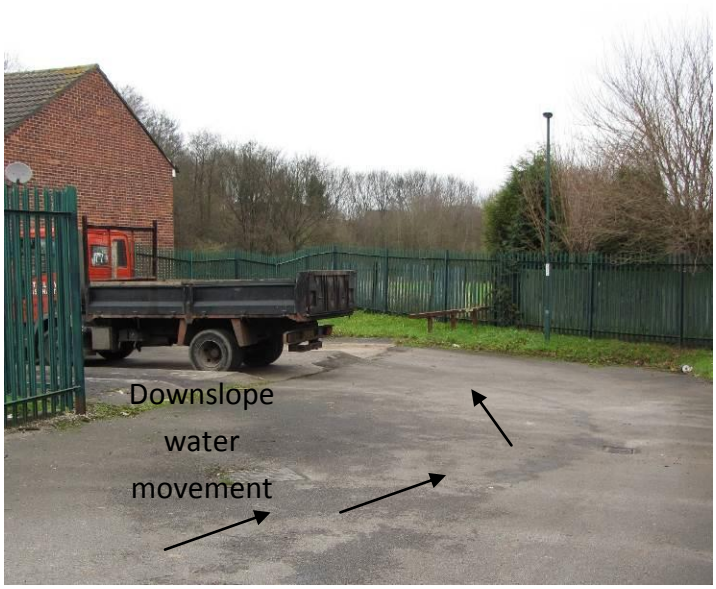

Figure 5: Garage area with hard standing at the north east end of Woolington Close. Broxtowe Country Park is visible beyond the fence line and flow routes are marked.

Severn Trent Water public sewer records show the sewer network servicing Woolsington Close has cover levels that are lower than the main sewer on Cranwell Road. Residents report that the road gullies were overwhelmed during the storm and were no longer able to function properly. This allowed surface water to breach the curb and flow towards low lying houses (Figure 6).

Figure 6: Low lying houses on Woolsington Close.

This excessive surface water flow led to the internal flooding of 10 properties on Woolsington Close with internal flood depths reported of up to 150mm and external flood depths reported up to 750mm. The houses on the north side of Woolsington Close have thresholds below the road level with evidence of a low point at the east end. Water was able to pool and cause the internal flooding from the front and rear of the properties. Two properties reported external flooding only (Table 2).

Table 2: Flooding impact on properties during the flood event.

Location	Number of Properties	Flooding Source	Impact
Woolsington Close	12 (of which 5 are Nottingham City Council owned and 7 are private)	• Surface Water	• Downstairs internal and external damage to electrics, carpets, floors, doors, walls & furniture.

4 RESPONSIBILITIES, AGREED ACTIONS & RECOMMENDATIONS

4.1 Which Risk Management Authorities have flood risk management functions in relation to the flood event

The flooding that occurred on Woolsington Close was as a result of intense rainfall that generated large volumes of surface water runoff and likely overwhelmed drainage systems causing water to pond in low lying areas. The following authorities therefore have flood risk management functions in relation to the flood event:

- **Nottingham City Council** is responsible for managing flood risk from surface water and for providing and maintaining highway drainage systems.
- **Severn Trent Water** is responsible for providing effectual drainage on the public sewer network.

4.2 Actions taken by Authorities and the Community before the event

The City Council has an annual, cyclical maintenance regime of road gullies within the City Council area. As a minimum, each road gully is cleansed annually and requests for maintenance are responded to within three working days. The road gullies in the Strelley area are subject to this annual maintenance regime. It is likely that the road gullies and highway drains in the flooded area and the wider catchment were overwhelmed by the volume, flow and depth of surface water flowing down roads and pathways. The highway drainage connects into the public sewer network and evidence observed during the event suggests surface water would have been unable to drain away because the public sewer network was at maximum capacity.

Severn Trent Water has a programme of serviceability inspections on the public sewer network to inspect the condition of sewers and remove blockages. It is expected that the sewerage system is designed to modern water industry standards and can ordinarily accommodate up to the 1 in 30 year storm event.

Interviews with affected residents have indicated that this level of flooding has occurred before, though this was not reported to the City Council at the time. Due to the time of day when many residents were out and the flashy nature of the storm, residents did not take any preventative measures before the event on 23rd July 2013.

4.3 Agreed future action plan

Surface water, highway drains and public sewers are closely linked. During this flood there is evidence of surface water being unable to drain into the highway drainage system contributing towards surface water volumes. Any future solution to reduce the risk of flooding to the

affected area would need to be undertaken in partnership between Severn Trent Water and Nottingham City Council.

Due to the number of flooded properties on Woolsington Close Nottingham City Council has targeted the area to improve the flood risk and protect existing properties. Site visits have revealed the potential for a long term solution for diverting surface water away from the properties and into Broxtowe Country Park. Subject to full funding and preliminary investigations Nottingham City Council aims to begin construction works in 2015/2016.

Nationally, the modern public sewer network is designed to accommodate the 1 in 30 annual probability rainfall event. The rainfall event exceeded the modern design standard and Severn Trent Water therefore class the event as 'extreme'. Severn Trent Water prioritise investment in capacity improvements to the sewerage system based on risk, with the priority given to the most frequent and severe internal flooding. Currently, flooding in an extreme weather event beyond the design standards of the sewerage system does not meet criteria for a capacity improvement scheme at this time.

The City Council recognises that there is an opportunity to divert surface water flows away from the properties and into Broxtowe Country Park in extreme rainfall events that overwhelm drainage systems. Bids were submitted to central Government in March 2014 and partial funding has indicatively been allocated for the construction works to be completed in 2015/16 subject to the securing of full Government and partnership funding. The City Council is currently working to fill the funding gap. Feasibility and design work will commence in advance of this date and the community will be invited to comment on the proposals as part of this process.

In addition to the proposed works, other future actions are recommended, which focus on improving community preparedness and resilience. The Action Plan below summarises the actions that have been agreed between Nottingham City Council and Severn Trent Water.

Nottingham City Council Actions	**Status**
Submit funding bid to central government for Flood Defence Grant in Aid to deliver a surface water flood risk management scheme in the Woolsington Close area.	Completed bid submitted March 2014. Partial funding has been secured from DEFRA subject to the funding gap being filled by Nottingham City

	Council.
Commission a topographic survey of Woolsington Close and surrounding land.	Completed in 2015
Commission an Optioneering study to model different surface water management options at Woolsington Close to decide the most cost-effective solution for the funding that has been allocated.	Work commissioned and underway. Outputs due in summer 2015.
Construct surface water flood risk management scheme for Woolsington Close	To be completed with the release of funding from Government and once partnership funding is secured.
Continue to maintain road gullies on a regular basis to ensure that the maximum volume of surface water is transferred to the public sewer network. Gullies on Woolsington Close are to be placed on the Targeted Gully Cleansing Regime for more regular maintenance.	Ongoing maintenance activity. Gullies have been placed on Targeted Gully Cleansing Regime.
Severn Trent Water Actions	**Status**
Ensure flooding of the 23rd July 2013 is included on Severn Trent's records.	Completed
Maintain serviceability of public sewer system by inspecting and undertaking necessary remedial action (blockage removal etc.).	Ongoing
Monitor any future reported internal or external flooding incidents and the nature of the storm that causes flooding to identify any triggers for capital investment.	Ongoing

4.4 Recommendations for affected residents and/or landlords

The table below contains recommendations for individual residents and/or landlords to improve resilience and preparedness of properties on Woolsington Close.

Recommendations for Residents and/or Landlords	Further Advice*
Residents should recognise that their property is vulnerable to future flooding in extreme rainfall events and make a **Flood Plan**, which involves ensuring that you have all of the information available that you may need in a flood event and helps you to consider what actions you will take if another flood occurs.	Environment Agency Personal Flood Plan Guidance: https://www.gov.uk/government/publications/personal-flood-plan
Residents should consider installing appropriate property level flood protection measures such as flood resistant doors and smart airbricks on their properties to prevent water entering the property and reduce the impact of future intense rainfall events.	Environment Agency 'What to do before, during & after a flood': https://www.gov.uk/government/publications/flooding-what-to-do-before-during-and-after-a-flood
Residents should maintain adequate flood insurance cover for the property. The National Flood Forum provides advice on flood insurance cover.	National Flood Forum website: nationalfloodforum.org.uk
Residents should report any blocked road gullies to Nottingham City Council so that the City Council can act quickly to resolve the issue.	See 'Contacts' on Page 19
Residents should report any future external or internal flooding to both Nottingham City Council and Severn Trent Water. If this information is reported it will support evidence for future capital investment to reduce flood risk.	See 'Contacts' on Page 19

** Most documents referred to are available on the internet. These can be provided by Nottingham City Council in hard copy format upon request. See 'Contacts' section on page 19*

5 CONCLUSIONS

A total of 12 residential properties were reported flooded on Woolsington Close in Strelley. A series of three heavy rainfall events passed over the City on 22nd and 23rd July 2013 that saturated the ground and filled available storage in underground drainage networks. A fourth rainfall event passed over Nottingham at 17:00 on 23rd July 2013 resulting in the internal flooding of 10 properties and external flooding of 2 properties on Woolsington Close, the properties that were affected are predominately in low lying areas.

Nottingham City Council and Severn Trent Water are the Risk Management Authorities that have flood risk management functions in relation to the flood event. Nottingham City Council is responsible for managing the risk of flooding from surface water and highway drainage and Severn Trent Water is responsible for providing effectual drainage and public sewers (surface water sewers and foul sewers). Due to the complex nature of the interactions between surface water and public sewers the City Council and Severn Trent Water have worked in partnership to investigate the flooding and agree an action plan.

Nottingham City Council has applied to central government and been granted indicative funding from Flood Defence Granting Aid to improve the level of flood risk to properties on Woolsington Close and the surrounding area. Nottingham City Council is working with partners to secure the remaining funds. A preliminary investigation is currently underway to develop and design the most cost effective surface water flood risk management option. Government funding is due to be released in 2015/2016 to carry out improvement works once partnership funding is secured.

Due to the extreme nature of the rainfall event the flooding incident does not meet Severn Trent Water's criteria for capacity improvements at this time. The City Council and Severn Trent Water will continue to undertake maintenance of the existing drainage systems so that they operate at maximum efficiency during rainfall events.

A number of recommendations have been made for residents and/or landlords to improve the level of preparedness and resilience of their properties. It is also important for residents to report any future flooding issues to Nottingham City Council and Severn Trent Water.

6 DISCLAIMER

This report has been prepared as part of Nottingham City Council's responsibilities under the Flood and Water Management Act 2010. It is intended to provide context and information to support the delivery of the local flood risk management strategy and should not be used for any other purpose.

The findings of the report are based on a subjective assessment of the information available by those undertaking the investigation and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event. Nottingham City Council expressly disclaim responsibility for any error in, or omission from, this report and the supporting technical assessment Report arising from or in connection with any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the time of preparation and Nottingham City Council expressly disclaim responsibility for any error in, or omission from, this report arising from or in connection with those opinions, conclusions and any recommendations.

The implications for producing Flood Investigation Reports and any consequences of blight have been considered. The process of gaining insurance for a property and/or purchasing/selling a property and any flooding issues identified are considered a separate and legally binding process placed upon property owners and this is independent of and does not relate to the City Council highlighting flooding to properties at a street level.

Nottingham City Council does not accept any liability for the use of this report or its contents by any third party.

7 CONTACTS & USEFUL LINKS

Nottingham City Council Contacts & Links		
Drainage Team	0115 8765275 or 01158765279 *Monday to Friday 9:00-17:00*	*For advice on improving the level of protection to your property*
Highway Services Team	0115 9152000 *Monday to Friday 9:00-17:00* Online reporting: www.nottinghamcity.gov.uk/article/26940/Report-a-fault	*To report problems with blocked road gullies or flooding incidents during office hours*
Emergency Contact	0115 9152222 *Out of office hours*	*To report emergency flooding incidents out of office hours*
Useful Web Pages	http://www.nottinghamcity.gov.uk/article/25423/Flooding	
Severn Trent Water Contacts		
Emergency contact	0800 783 4444 *24 hours*	*To report flooding incidents or blockages on sewers*
Environment Agency		
Floodline	0345 988 1188 *24 hours*	*For advice on current flood warnings*
Useful web pages	https://www.gov.uk/government/publications/flooding-what-to-do-before-during-and-after-a-flood	
Emergency Services		
Non Emergency Contact	101	

8 APPENDIX A: MAPS AND POLICY

Table A1: Nottingham City Council Thresholds for Initiating Flood Investigations on residential properties. (Section 19 Flood Investigation Policy)

Threshold / Trigger	Included	Excluded
• All incidents where internal flooding affects five or more properties and the properties are either in close proximity or the flooding is hydraulically linked. • Where there is uncertainty around the cause of flooding or the responsible Risk Management Authority, regardless of the number of properties affected. • Where the frequency or impacts of flooding are particularly severe, regardless of the number of properties affected.	'Internal' flooding relates to: • Flooding of any area of a property that was originally intended to be habitable at ground floor level and above e.g. kitchen, reception rooms, sleeping accommodation. • Flooding of a sub-surface structure, such as a basement or cellar, where the floodwater contains sewage or other contaminants that cause concern for public health.	The following exclusions relate to the definition of 'internal' flooding: • External areas such as gardens, driveways and paths. • Structures that were not originally designed to be part of the habitable property such as sheds, summer houses, conservatories or garages. • Flooding of a sub-surface structure, such as a basement or cellar, where the floodwater does not cause concern for public health.

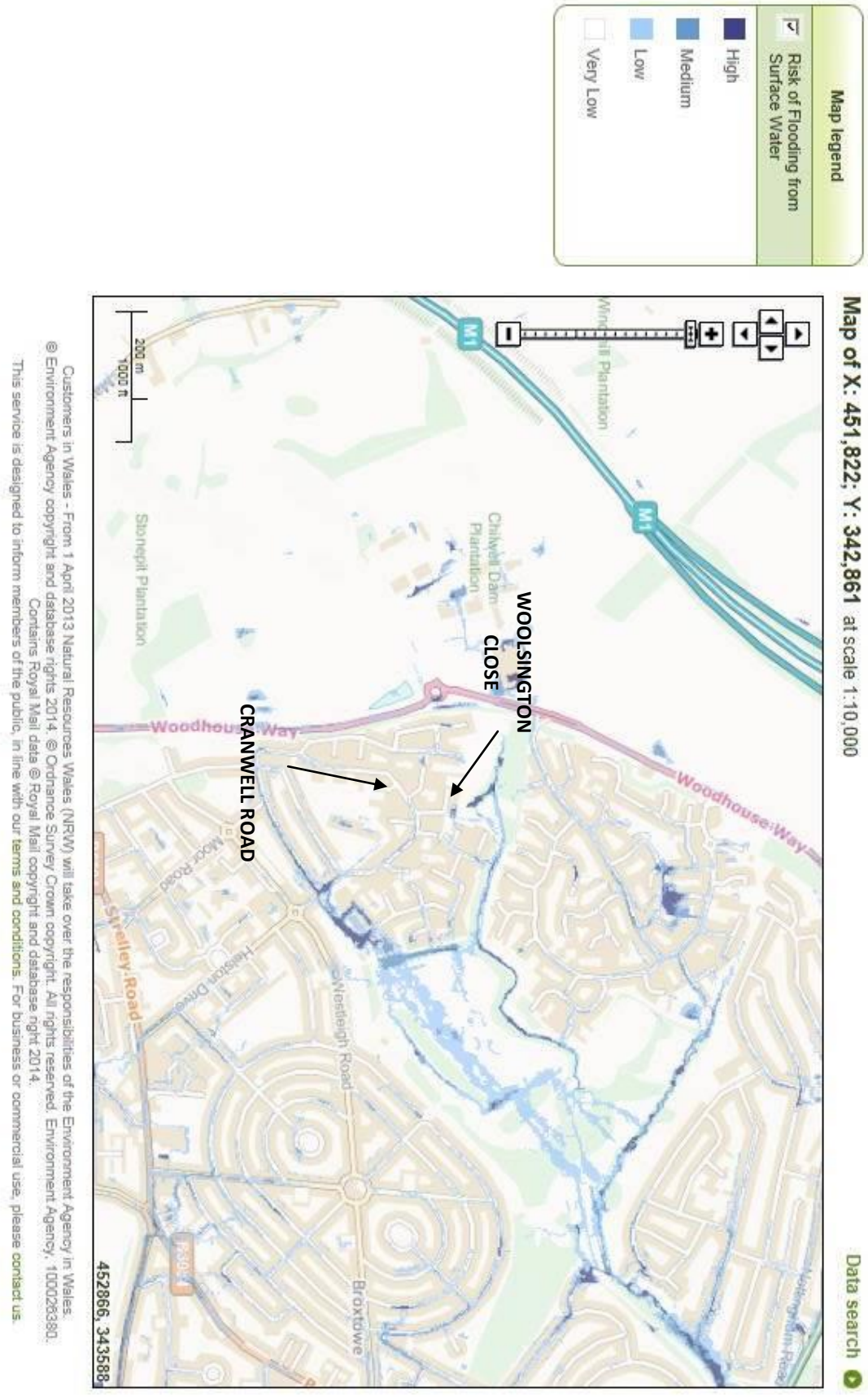

Figure A1: Environment Agency Flood Map for Surface Water