

Flood Investigation Report

Cottingham Flooding July 8 2014

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October 2014



EAST RIDING
OF YORKSHIRE COUNCIL

Revision Schedule

East Riding of Yorkshire Council

Flood Investigation Report Tidal Surge Flooding Events on 5 December 2013

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Records of the public sewer system included are a facsimile of the statutory record provided by Yorkshire Water Services. For the purposes of this report minor sewers and other non- relevant data have been omitted from the plans for clarity. The statutory public sewer record is held by Yorkshire Water Services Ltd.

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Yorkshire Water Services

Cottingham Flood Action Group members

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Lead Local Flood Authority and Responsibilities

East Riding of Yorkshire Council, as the Lead Local Flood Authority (LLFA), has a responsibility under Section 19 of the Flood and Water Management Act 2010 to investigate significant flood incidents in its area. Section 19 states:

- (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.*
- (3) The LLFA has lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary water courses.*

This report has been prepared by East Riding of Yorkshire Council in its role as LLFA in response to extensive flooding which affected over 100 properties in several areas of Cottingham.

This report provides an overview of flooding that has occurred, describes the conditions which led to the flooding, considers the response to the flooding thus far and makes technical recommendations for the flood risk authorities concerned.

Relevant Flood Risk Management Authorities

The risk management authorities that have relevant flood risk management functions are:

East Riding of Yorkshire Council

East Riding of Yorkshire Council is the Lead Local Flood Authority responsible for managing flood risk from surface runoff, groundwater and ordinary watercourses, development of a Local Flood Risk Strategy, Asset Plans and Investigations under the Flood and Water Management Act 2010. East Riding of Yorkshire Council also has responsibility for some Coastal erosion risk management, and is the Highway Authority with responsibility for highway drainage under the Highways Act 1980.

Yorkshire Water Services

Yorkshire Water Services is the statutory sewerage undertaker for the Yorkshire region with a duty to effectually drain sewers pursuant to the Water Industries Act 1991.

Environment Agency

Responsible for managing the flood risk from main rivers, the sea and reservoirs including coastal erosion risk management, permissive powers to maintain main rivers, strategic overview over all forms of flooding and development of a national Flood Risk Strategy.

In addition:

Riparian Landowners

Riparian landowners are those who own land adjoining a watercourse and have certain responsibilities, including the following:

- They must maintain the bed and banks of an open watercourse, and also the trees and shrubs growing on the banks.
- They must clear any debris, even if it did not originate from their land, this debris may be natural or man-made.
- They must keep any structures that they own clear of debris. These structures include culverts, trash screens, weirs and mill gates.

If they do not carry out their responsibilities, they could face legal action under the Land Drainage Act 1991. Details of a riparian landowners responsibilities can be found in 'Living on the Edge' published by the Environment Agency.

Abbreviations and Acronyms

Abbreviations	Description
AOD	Above Ordnance Datum
Dia	Diameter
EA	Environment Agency
ERYC	East Riding of Yorkshire Council
FCRM	Flood and Coastal Risk Management (Environment and Neighbourhood Services)
GWL	Ground Water Level
HFRS	Humberside Fire and Rescue Service
HVP	High Volume Pump
LLFA	Lead Local Flood Authority
IDB	Internal Drainage Board
ABP	Associated British Ports
Km	Kilometre
Km ²	Square Kilometres
Km/h	Kilometres per hour
Ha	Hectare
FWA	Flood Warning Area
m/s	Metres per second
mm/hr	Millimetres per Hour (Rainfall)
YWS	Yorkshire Water Services

Glossary

Foul sewer

This is a pipe laid to convey waste water (foul) only away from properties and to a waste water treatment plant, and maintained by Yorkshire Water Services.

Surface Water sewer

This is a pipe laid to convey surface water only away from properties to a proper outfall, and maintained by Yorkshire Water Services.

Combined Sewer

This is a pipe laid to convey both waste water and surface water away from properties to a waste water treatment plant, and maintained by Yorkshire Water Services.

Private Drains

These are pipes laid to convey both waste water and surface water away from properties which are the responsibility of the property owners, and are not maintained by Yorkshire Water Services.

Watercourse

This can be an open channel or piped/culverted to convey surface water away from an area, this will include land drainage as well as surface water from properties and highways. Watercourses, known as ordinary watercourses or main river, are generally maintained by riparian land owners with the Environment Agency using permissive powers to maintain main river.

Design Standards and Return Periods

Any drainage system or flood defence should be designed to a nationally accepted standard. This standard is often expressed as a return period (in years), or as an annual exceedance probability (a percentage).

A **return period**, also known as a **recurrence interval** is an estimate of the likelihood of an event, such as a flood, occurring. It is a statistical measurement typically based on historic data denoting the average recurrence interval over an extended period of time, and is usually used for risk analysis (e.g. to design structures to withstand an event with a certain return period).

The theoretical return period is the period during which an event may be expected to occur, but as it is based on long term averages in the short term it can be misleading. A return period should be considered the chance of an event occurring each year.

For example, a 10 year flood has a 0.10 or 10% chance of being exceeded in any one year and a 50 year flood has a 0.02 or 2% chance of being exceeded in any one year, a 100 year flood has a 0.01 or 1% chance of being exceeded in any one year.

It does not mean that a 100 year flood will happen regularly every 100 years, or only once in 100 years. Despite the connotations of the name "return period" in any *given* 100 year period, a 100 year event may occur once, twice, more, or not at all. It is only an estimate of the probability of the event occurring in any given year, which is used to apply consistent design standards and levels of protection.

The significance of calculating the return period of rainstorm events is not for determining their exact occurrence interval. Instead, it is for the comparison of occurrence likelihood of different rainstorm events for the purpose of optimal drainage designs and flood risk analysis. It is an internationally accepted methodology.

Section 94 of the Water Industry Act 1991 (the Act) places a duty on sewerage companies, amongst other things, to maintain their sewers to ensure that their area is effectually drained. There is no set standard, in terms of the level of protection that water companies should provide against flooding from public sewers. The design standards for drainage applied in England and Wales have converged over many years towards providing protection from flooding with up to a 1 in 30 chance of occurring each year. This generally means that no sewage should escape from a sewer in a 1 in 30 year storm at the time the sewer is constructed¹.

The current design standard for highway drainage is the Department for Transport; Design Manual for Roads and Bridges. This gives guidance on the spacing of gullies and the area of highway which can be drained into them. The accepted design standard for new highways is that flooding should not encroach into the main carriageway as a result of 1 in 5 year (20% chance return period rainfall).

In contrast River and Coastal Flood defences are currently designed for a 1 in 100 year event return period with an allowance for climate change, as determined by Defra.

Funding for Drainage schemes

One of the main criteria for successful applications for funding for drainage works is that the proposed scheme must be designed to provide a standard level of protection, normally defined by a set return period. This standard is nationally agreed and is set by the government or a regulatory authority.

Internal sewer flooding of properties is a key performance indicator for Ofwat, whilst area flooding outside properties is not. Any property which is confirmed to have flooded internally should be entered onto the official Flooding Register (DG5), as being at risk of flooding and the statutory undertaker will develop a solution to be funded on a priority basis.

¹ . Research conducted for Ofwat indicates that other developed countries have adopted similar design standards for conventional drainage to that used in England and Wales. Although, of the six countries considered in the research, around half had developed additional approaches to manage extreme events. Surface flood pathways are identified, mapped and managed and sacrificial storage areas created. This allows flood water to be controlled on the surface in order to protect properties. These flood areas are used for other municipal functions during dry weather.

Yorkshire Water's investment programme is funded on a 5 year plan with the new plan due to commence in 2015. As part of this, the company will be looking to work more closely with other flood risk management authorities to reduce flood risk in partnership.

Funding is generally allocated on the basis of the severity and frequency of the flooding, and by the costs of protection; "does the scheme give good value for money?"

Flood Protection Measures

Measures taken to prevent a property from flooding, also known as flood resistance measures i.e. Demountable door guards, air-brick covers, flood doors, barriers etc.

Flood Resilience Measures

Measures taken to reduce the impact of flooding on a property and to speed up the recovery after a flood i.e. raise floor above most likely flood level, Replace chipboard flooring with solid floor (dense screed), replace gypsum plaster with Lime plaster, move electrical outlets above flood level etc.

1 Executive Summary

On 8 July 2014 a high intensity rainstorm was experienced in parts of the East Riding and in particular over Cottingham, resulting in significant localised flooding. The public sewer network in the village is predominantly a combined system which takes both waste water and surface water. The entire village drainage system including the sewer network, private drains and highway drains were rapidly overwhelmed.

Areas affected included Cottingham High School, Badgers Wood, Lawns Garth, Sancton Close, Stuart Garth, St Margarets Avenue and Canada Drive. Flooding also occurred at King Street and George Street, the subject of a previous ERYC S19 Report (February 2012).

With overland flows and an overwhelmed public sewer some 107 residential and 12 commercial properties flooded with 49 properties suffering internal flooding.

Whilst the Council has made every effort to secure funding, flash flooding and the capacity of the public sewerage system for which water companies / Ofwat have responsibility still remains an issue that can only be addressed through regulated investment.

The peak estimated rainfall intensity for the storm was 89mm/hr with a total estimated rainfall volume of 40mm over two hours, this compares to the normal average July rainfall for Cottingham of 47mm per month. This report concludes that on 8 July 2014 the rainfall was of exceptional intensity and exceeded current or historic design standards for the drainage infrastructure, and that the relevant risk management authorities exercised their functions in response to the flooding incident.

2 Location of Flooding

Flooding affected the following areas in Cottingham:

- Wood Hill Way
- West End Road
- The Ridings
- Monkton Close
- King Street
- Oakdene
- St Margarets Avenue
- Canada Drive
- Mill House Woods Lane
- Park Lane
- Sancton Close
- Castle Road
- George Street
- Exeter Street
- Outlands Road
- Endyke Lane
- Stuart Garth
- Badgers Wood
- Eppleworth Road
- Dene Road
- Northgate
- Hornbeam Walk
- New Village Road
- Lawnsгарth
- Harland Way

See: Appendix 2 - for a list of properties affected, and
Appendix 3 - for a plan indicating the affected areas

3 Drainage Systems in Cottingham

3.1 Yorkshire Water Services – Public Sewer System

Yorkshire Water Services are the statutory undertaker who provide and maintain the sewerage system in the Yorkshire region, including Cottingham.

The sewer network within Cottingham is predominantly a combined system, designed to carry wastewater and surface water from properties and some highways. This system discharges into the trunk sewers in Hull. Many of the highway gullies also discharge into the combined sewers within the village, and so were unable to discharge while the the sewers were completely full.

It is the industry accepted design standard for new public sewer systems that no property flooding should occur as a result of 1 in 30 year (3% chance) return period rainfall. However older sewer systems will probably have a lower level of protection than the current standard.

3.2 Environment Agency – Main Watercourses

The Environment Agency use permissive powers to maintain some watercourses designated as main rivers in Cottingham, namely the Broadlane Beck, Wanlass Beck and Creyke Beck all of which also discharge into the trunk sewer network at Beck Bank.

3.3 East Riding of Yorkshire Council – LLFA and Highway Drainage

LLFA's are responsible for developing, maintaining and applying a strategy for local flood risk management in their areas and for maintaining a register of flood risk assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses.

As Highway Authority the Council is responsible for maintaining the public highway network and for effectively draining the public highway. The accepted design standard for new highways is that flooding should not encroach into the main carriageway as a result of 1 in 5 year (20% chance) return period rainfall. However as with sewer systems, older highways will have a lower level of protection.

Following the flooding in 2007 the Raywell Valley flood attenuation scheme was designed and constructed to reduce the flows along the Raywell Valley into the Cottingham drainage system along Eppleworth Road. The scheme works by restricting the flow along the valley and storing the excess flows in open lagoons. This will reduce the flood risk when the ground upstream is saturated following prolonged rain, when further heavy rainfall can lead to surface run-off leading to overloading of the drainage system.

However during flash flooding events such as occurred in July when intense rain fell on the urban area downstream, the lagoons were upstream of the flooded areas.

The Council has also delivered some other capital funded schemes in order to reduce flood risk in Cottingham. Minor schemes including an EA funded screen replacement programme which is ongoing, together with culvert improvement works already completed on Castle Hill Road, which resulted in a substantial amount of tree roots being removed from the pipes. An overflow has also been installed between the ditch on the north side of Eppleworth Road into the Broad Lane Beck, in an effort to reduce flooding along Eppleworth Road. Following the construction of the lagoons there is spare capacity in the Broad Lane Beck, which was utilised to take the excess flows from farmland to the north.

In addition larger capital funded schemes such as the Cottingham and Orchard Park Flood Alleviation Scheme (COPFAS) are in the Council's capital programme.

The COPFAS scheme aims to further reduce the risk of flooding to residents and businesses in the Cottingham and the Orchard Park area, by storing flows during prolonged and persistent rainfall events such as the event experienced in 2007. The scheme is being designed to reduce the impact on the public sewerage system, which in turn will reduce the impact of environmental and health risks from sewage escape.

The proposed scheme consists of a number of storm water storage lagoons situated along the route that storm water takes from the Raywell Valley, through the village of Cottingham and into Hull. The lagoons will hold large volumes of water during a storm and release it at a controlled rate into the urban drainage system after the storm.

The scheme is currently at feasibility stage and has indicative funding from both the National Flood Defense Grant (Defra) and the Local Growth Fund (Humber Local Enterprise Partnership).

This scheme is anticipated to start in 2015/16, subject to a number of approvals.

One suggestion from the Cottingham Flood Action Group is to divert water in Mill Dam Drain and Creyke Beck across Dunswell Road into Counter Dyke, and so draining into the Beverley and Barmston Drain, taking water out of the sewer system. While this suggestion appears to have merit it is felt that in more extreme conditions the flows in the Barmston Drain could be such that any additional discharge from Cottingham could lead to backing up in the drain increasing the flood risk upstream, which would in the view of the EA be unacceptable.

3.4 Flooding History

There is a history of flooding in parts of Cottingham. During the extreme events of 2007 much of the village was affected, along with much of Hull and many areas of the East Riding.

There has been repeated flooding in George Street, Crescent Street and King Street, which was the subject of a Section 19 Flood Investigation report in 2012. This report identified the need for increased routine maintenance of the sewers, which we have been told by YWS has been carried out. The 2012 report also concluded that the hydraulic capacity of the sewer system was potentially a contributory factor to the repeated flooding at this location. A recommendation of that 2012 report was that further detailed hydraulic analysis of the network should be carried out to identify any areas requiring improvement, and that the analysis should be used to build a business case for investment in improvements to the sewer network; this analysis has been carried out.

Most recently some minor root ingress into the sewer was identified and root cutting work has been undertaken. The hydraulic analysis carried out by YWS has identified that the sewer which serves George Street, Crescent Street and King Street is overloaded at a 1 in 30 year weather event, which results in external flooding to highways and properties.

Reportedly in New Village Road there have been problems with sewage escaping from a manhole during moderate or heavy rainfall, with recent incidents on 29 June, 8 July, 13 July and 20 July. (See photos 13 & 14).

Reportedly in Sancton Close sewage has escaped from the sewer system on 8 and 13 July and on the 10 August, with the road, and some gardens flooded. On 8 July several properties were affected internally, and flood water flowed out into Stuart Garth where 5 properties were also affected, before flowing onto St Margaret's Avenue where 12 properties were also affected. YWS and the Council continue to work closely to identify the issues and possible remedial measures in these areas.

Note:

There were further flooding incidents, with various roads during heavy rainfall on 8 August 2014 as ex-Hurricane Bertha caused problems in many parts of the country including East Riding. No property flooding was reported in Cottingham as a result and this rainfall event is the subject of a separate Section 19 investigation.

3.5 Future Developments and Sustainable Drainage

Any new residential or commercial development planned within the village would be required, under planning conditions, to manage surface water within the development, to restrict the discharge of surface water into the existing drainage system to no more than the existing rate, and if possible to reduce the discharge. This must be achieved within the development itself usually by attenuating flows during storm conditions or times of high flows and discharging at a controlled rate to prevent any increased flood risk to any other area.

4 The Flooding Event

The weather forecast for Tuesday 8 July was for heavy showers, with a possibility of localised flooding issues. The Flood Warning Centre issued a warning for a low overall risk of flooding over the whole of the east of England.

The weather conditions prior to the event were warm and sunny with a light wind from the north, which increased at 12:00 when the storm arrived. The storm travelled across the village from the North West and tracked across and on into Hull. The rain started just after 12:00 and had stopped or was very light by 14:30.

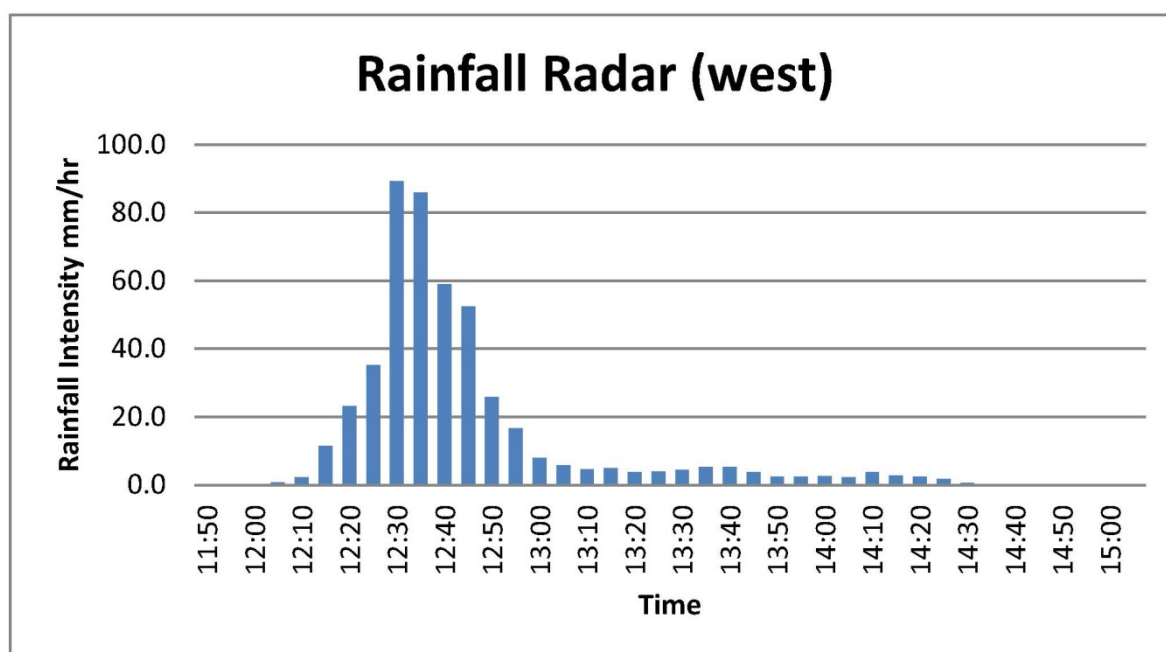
The storm which hit Cottingham was particularly intense leading to widespread flooding with roads and both commercial and residential properties affected.

4.1 Weather Data Obtained

The rainfall pattern in Cottingham on the 8 July followed a typical “summer storm” profile: short duration, very localised, with a significant variation in the peak rainfall rate together with the overall amount of rain which fell in different areas of the village. The intensity and volume of rainfall led to the drainage system being overwhelmed, leading to overland flows and significant flooding in several areas of the village.

See Appendix 1 for rainfall data collected from an EA rain gauge at Mill House Woods Lane, and from an ERYC rain gauge at Albion Mills, and Met Office Rainfall Radar Data requested for two locations in Cottingham (east and west).

Rain gauges measure the rainfall which falls directly onto the gauge, while the Radar has to be interpreted and so the rainfall is an estimate, provided by the Met Office.



Graph of the estimated rainfall intensity at the west end of the village based on radar data supplied and interpreted by the Met Office.

The data shows that the peak intensity is different at each data point, which would be consistent with the storm cell being small and tracking across the area quickly, most likely missing some if not all the data collection points. The recorded rainfall pattern is also very peaked, showing very high intensity for short periods during spells of moderate to heavy rainfall.

The highest intensity rainfall was recorded at the western end of Cottingham, which is elevated above the rest of the village. The intensity was such that the water was unable to enter the drainage system which quickly became overloaded and water flowed across the surface, causing flooding immediately downstream. Once the drainage in the west became overloaded, overland flows ran down into the rest of the village. These flows added to the water collecting due to continuing rainfall causing water to flood out of some drains and sewers.

An estimated return period with 34 mm of rainfall recorded in an hour indicates a return period for the storm of at least 1 in 60 years.

4.2 Flood Warning System - Details

The National Severe Weather Warning Service issues various warnings when forecast weather conditions are expected to cause disruption.

A warning of a low risk of flooding had been issued for much of eastern England for Tuesday 8 July, see Appendix 3

4.2.1 Severe Weather Warnings

The joint Met Office and Environment Agency Flood Forecasting Centre provides a flood warning service based on weather forecasts and forecast river and tide levels.

On Tuesday 8 July a Flood Guidance Statement was issued warning of the potential for heavy showers and localised disruption, for most of eastern England, including all of Yorkshire.

The following bulletin was issued by the Met Office Civil Contingencies office:

"The bright and sunny start for most places this morning is now seeing clouds develop across the region. Indeed, these clouds have already brought some very heavy rainfall totals locally and associated surface water impacts. During today, some other locations could see rainfall totals reach 15 to 20mm in an hour – and in excess of 30mm of rainfall in less than 2 hours. An updated Met Office Yellow Warning for rain, now covers all of North East England, Humber and Yorkshire region and is valid until 1900 today – and continues to bring a Very Low Likelihood of Medium Impacts. However, as is often the case with showers, some places will escape the highest rainfall totals, with large variations in rainfall amounts over a relatively short distance."

These warnings were not specific about locations and were not indicating the severity of the event which affected Cottingham.

4.3 Rainfall

An intense and localised storm travelled southeast across the Cottingham area, with very heavy rainfall at times up to 89 mm/hr. The long term average rainfall total for July is 47mm for the whole month. The peak estimated rainfall on 8 July is 39.5mm in less than 3 hours. The peak estimated intensity of 33.8mm in 1 hour would equate to a return period of 1 in 61 years.

4.4 Reports of the Event

Because the western end of Cottingham is higher than much of the rest of the village, overland flows were sent through it as the drainage system filled up with the amount of rainfall.

Many areas of the village were affected by water being unable to enter the drainage systems. Water flowed across the surface, flooded out of sewer manholes and highway gullies, where the system was overwhelmed. This led to flooding where the water accumulated in any low spots, which eventually drained away, but in some places flood water was left in low areas, with sewage litter and other debris left in many areas, with roads, gardens and properties all affected.

Problems were again experienced in George Street with water flooding out of the sewer manholes and highway gullies as the drainage systems were overwhelmed. Water was unable to drain away into the Broad Lane Beck culvert which was also at a high level. (See Appendix 8 for Telemetry Data).

In King Street and Market Green the drains were unable to cope with the intensity of the rainfall (see photos 1 & 2) which led to commercial premises being flooded by surface water unable to enter the drains mixed with water escaping from the sewers. The Cottingham Clinic car park was also extensively flooded, (see photo 3).

Eppleworth Road (see photo 4) opposite the Dene was affected when the riparian culvert on the north side of the road was overwhelmed, it is believed by run-off from the land to the north.

Properties on Lawnsgrath were affected by surface water running off the university site at Cottingham Lawns.

In Oakdene off Southgate (see photos 5 & 6) residents reported blocked highway gullies and blocked drains. It seems likely that the combined sewer was overwhelmed and so the affected highway gullies and branch sewers were simply unable to discharge until the flows subsided. The water reportedly drained away once the rain stopped and the flows eased. This pattern of apparent blockage and subsequent draining away is reported in many other areas supporting the conclusion that the system was overwhelmed confirming the gullies and drains were not blocked.

Farm buildings at Field House Farm, Harland Oaks and Cottingham High School were badly affected with flood water entering the school buildings. Overland flows from surrounding land ran onto the school site and inundated the drainage system. This in turn led to flooding to the Badgers Wood, and Park Lane area, where a riparian ditch was in poor condition, with excess water running down Harland Way, (see photos 7,8,9,10) with the public sewer manholes overflowing due to surface water inundation. The drainage system was then overwhelmed through the village, leading to further escapes and water unable to enter the system.

Reportedly the car parking areas at Castle Hill hospital were ankle deep in rainwater and water was running off the site onto Castle Road. This led to problems in Southwood Road, and Canada Drive area.

Monkton Close reportedly had water flooding out of sewer manholes.

Elmfield Drive off South Street had water flooding out of sewer manholes which led to flooding on Bacon Garth School field.

In some areas such as Mill Beck Bridge between Hallgate and Broad Lane Close (see photos 11 & 12) the watercourse overtopped its banks briefly causing some flooding to footpaths. The high level of flow in the watercourses will also have restricted the discharge from other surface drains which should outfall into them. In general the watercourses remained within their banks and did not overflow. However large overland flows of surface water were unable to enter the drainage system in some areas. Lower areas such as the bottom of Harland Way were flooded along the route of a watercourse, which was also overwhelmed.

In New Village Road (see photos 13 & 14) there is a known problem with water flooding out of a sewer manhole on New Village Road and on this occasion also affecting properties in Endyke Lane.

Some areas such as the Thwaite Hall snicket (see photo 15) were left with flood water standing after the event, which soaked away in time.

In Sancton Close the sewer network was overwhelmed and water reportedly flooded out of sewer manholes flooding the road and several gardens, which then flowed down into Stuart Garth, and St Margaret's Avenue and the Ridings, also causing property flooding.

The screens on various watercourses were monitored by the Council's telemetry and cleaned during the event by Council contractors, (see photo's 16, 17, 18)

Due to the location of the most intense rainfall which was to the east of the Raywell Valley Attenuation scheme, the lagoons were not seen to fill, (see photo 19)

4.5 The Response

There was some criticism from residents of the response from the emergency services and the Council. However in a flash flooding event such as this with no explicit warning, services can only respond once they are notified of the event. Once the problems are reported and an assessment made, an appropriate response can be mobilised.

The weather forecast for that day was for the possibility of summer storms which are very difficult to predict precisely where and when they may occur. Teams and equipment can only be mobilised once the event has started and an alarm has been raised.

The Humberside Fire and Rescue Service: reported receiving 21 calls for assistance from the Cottingham area, and crews attended various sites and provided assistance and advice. In some places pumps were deployed to drain water away from properties, but as all the drainage system was full it was difficult to know where to pump water away to.

Humberside Police: attended the incident and were involved in closing some roads during the event.

East Riding Council: as soon as the Operational Flood Risk team was alerted to the event the screen cleaning contractor was contacted and instructed to attend Cottingham, with a view to checking and removing any debris from all the screens on watercourses at Victorias Way, George Street, Willerby Low Road and Mill Beck lane.

There is also a screen at Snuff Mill Lane which is the responsibility of YWS, and on Creyke Beck at Dunswell Road which is the responsibility of Railtrack. The Council has recently received funding to replace and improve both of these screens as they are deemed to constitute a flood risk.

Operational Flood Risk Engineers were also sent to the area to co-ordinate the situation and direct the screen cleaning contractor, and offer whatever assistance and advice they could.

The Council (Streetscene Services) delivered some 300 sandbags to the area and supported the police in temporary road closures. Some post-event road sweeping was undertaken in affected areas to remove debris where this was deemed necessary.

Ward members were active in visiting affected areas, witnessing the impact of the flooding first-hand and speaking to residents.

Yorkshire Water Services reported that some drainage systems were overwhelmed by the floodwater, with some 32 properties reporting problems. YWS flood risk strategy team were on site to liaise with Councillors and Council Engineers. Customer Case Managers provided support to customers. Operational staff attended YWS assets in the area to ensure all pumping stations operated at full capacity.

Following the event YWS service partners were sent to sites to undertake clean-up operations. Investigation work followed involving inspection, cleaning and surveying of the sewer network in the affected areas. (See Appendix 6 for more details of the work undertaken).

5 The Recovery

As is the nature of flash floods the water drained away quickly once the rain stopped. This left many areas together with a number of properties in need of a clean-up. The Council arranged to collect large items of flood-damaged household goods from domestic properties for free but from commercial premises at cost, as commercial operators are assumed to be covered by insurance. This service is offered to residents in an attempt to help them return to normal life as quickly as possible following flooding.

Council staff also contacted vulnerable residents to ensure that they had access to all available services to meet their needs.

The Council Operational Flood Risk Engineers inspected screens and open watercourses, and identified some of which required maintenance work. Some of this was undertaken on riparian owned watercourses by the Council on a without prejudice basis, where it was deemed appropriate to carry out the work quickly rather than embarking on possibly protracted enforcement action.

Some culverted sections of watercourses were inspected by CCTV to check their condition, which subsequently identified no significant defects.

YWS sent crews to clean up and technicians to start investigations into the condition of the network, routine sewer cleaning and root cutting as well as CCTV surveys of various sewers has been undertaken. (See Appendix 6 YWS response)

6 Causes and Investigation Findings

Appendix 1 shows the rainfall data obtained both from radar (interpreted) and rain gauges (measured).

From the analysis of the rainfall data obtained the flooding was caused by the intensity and quantity of the rainfall which overwhelmed the drainage system. This led to overland flows and surcharging of the sewer system, which caused flooding to many parts and to properties particularly in lower areas.

The peak estimated rainfall intensity in any part of the village was 89mm/hr, and it is estimated that the total volume of rainfall was 40mm in two hours. The average rainfall for Cottingham during July is 47mm for the whole month. This volume of rain completely overwhelmed the drainage system which is not designed to deal with this amount of flow.

The sewer system was overwhelmed by the flow of surface water resulting in sewage escapes in many areas of the village, leading to contamination of the flood waters with sewage.

Some estimates for the return period for the rainfall on 8 July put the probability on occurring as high as 1 in 100 (1% chance each year). The return period calculated from the Met Office data gives a probability of this rainfall event of at least 1 in 60 (or 1.6% of occurring each year).

7 Conclusions

This Section 19 investigation concludes that on this occasion the rainfall was of exceptional intensity and exceeded current or historic design standards for drainage infrastructure. With overland flows and an overwhelmed public sewer system, some 107 residential and 12 commercial properties flooded with 49 properties suffering internal flooding.

The peak estimated rainfall intensity for the storm was 89mm/hr with a total estimated rainfall volume of 40mm over two hours, this compares to the normal average July rainfall for Cottingham of 47mm per month.

It is also concluded that Yorkshire Water Services Assets are the governing factor in much of the area, with the drainage of both waste water (foul) and surface water from the village subsequently discharging into the main trunk sewer system through Hull. As the sewer takes surface water as well as waste water during very heavy rainfall the design capacity is exceeded and the system becomes overwhelmed.

The LLFA is required to conclude whether each of the flood risk management authorities identified has exercised, or is proposing to exercise, their functions in response to the flood incident. Following the investigation it has been concluded that the relevant flood risk management authorities have or are proposing to exercise their relevant functions appropriately.

8 Recommendations

The investigation has identified a number of measures that potentially should improve flood resilience and these are set out in the following recommendations:

8.1 Recommendation 1

That the Council as LLFA write to Defra, requesting they direct Ofwat to review the currently accepted industry standard for protection of properties from sewer flooding of 1 in 30 and increase this to 1 in 100 to better align with other flood risk management authorities standards, accounting for climate change. Such a review should include close scrutiny of the appraisal methodology for regulated investment, moving the balance away from customer-based surveys to an investment methodology based on informed engineering judgement.

8.2 Recommendation 2

That YWS publish a timetable for developing a scheme to address the capacity and remediation issues identified at George Street and King Street, Cottingham.

8.3 Recommendation 3

That in accordance with requirements set out at Section 94 of the Water Industry Act 1991, that Yorkshire Water publish an action plan to demonstrate how it intends to address capacity and serviceability issues with the public sewer networks in Cottingham.

8.4 Recommendation 4

That, without prejudice, the Council as LLFA undertakes a study to understand the potential demand for property level flood protection solutions, including establishing the potential level of customer/public contributions to such a scheme where a community level flood protection scheme is not planned. This would allow the Council to understand if a business case can be made for capital funding to support such a scheme.

Useful Links and Contact Details:

Lead Local Flood Authority East Riding of Yorkshire Council County Hall Beverley East Riding of Yorkshire HU17 9BA	(01482) 887700	www.eastriding.gov.uk fcerm@eastriding.gov.uk
Statutory Sewerage Undertaker Yorkshire Water Services Ltd Western House Halifax Road Bradford BD6 2SZ	(08451) 242424	www.yorkshirewater.co.uk
Environment Agency Dales Area Office Coverdale House Amy Johnson Way Clifton Moor York YO30 4UZ	General Enquiries: 0870 850 6506 (Mon-Fri, 8am -6pm) Incident Hotline: 0800 807060 (24hrs)	www.environment-agency.gov.uk

Appendix 1: Rainfall Data

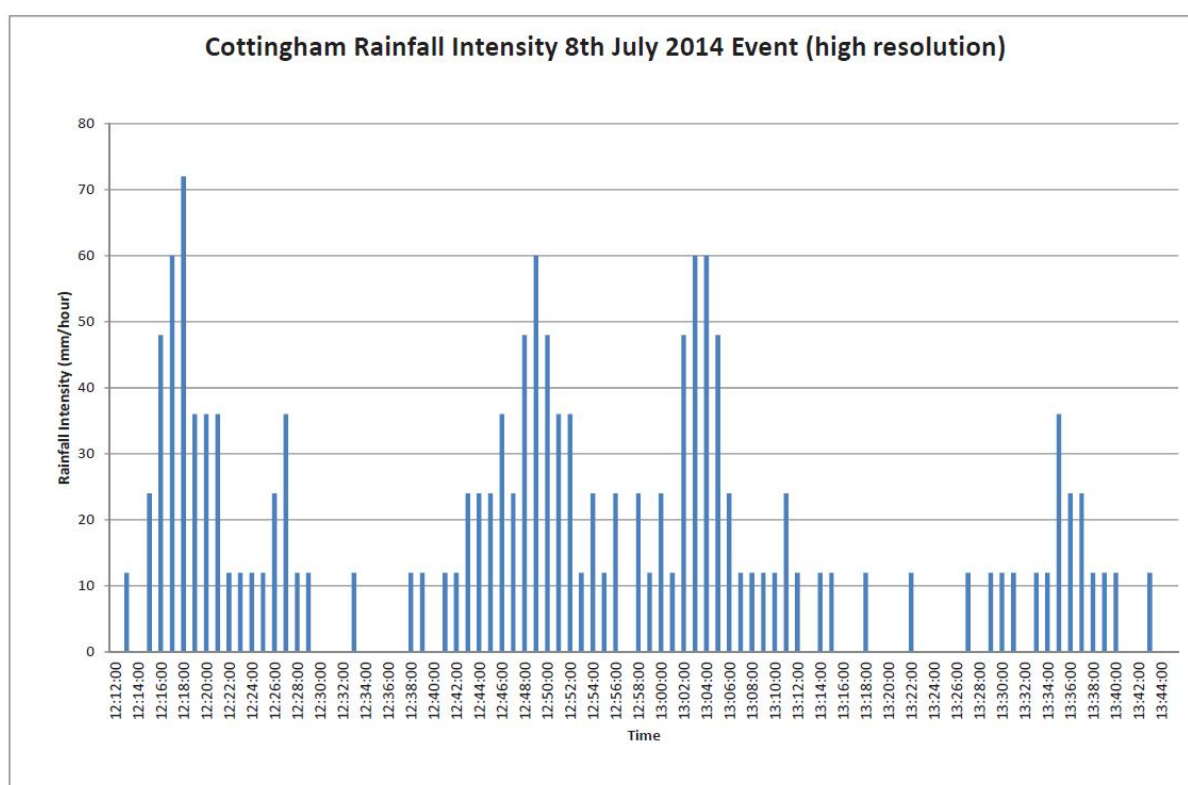
Due to the very localised nature of the rainfall, data has been collected from four locations around Cottingham, which each give different values. The following charts show the estimated rainfall rates from the met office rainfall radar and actual recorded rainfall from rain gauges.

Summary of Rainfall data

Data Source	Peak Intensity (mm/hr)	Duration (hrs)	Total depth (mm)
EA gauge at Mill House Woods Lane	72	1.5	26.6
ERYC gauge at Albion Mills	48	2	18.5
Met Office Radar data (east)	36	2	18.5
Met Office Radar data (west)	89	3.25	39.5

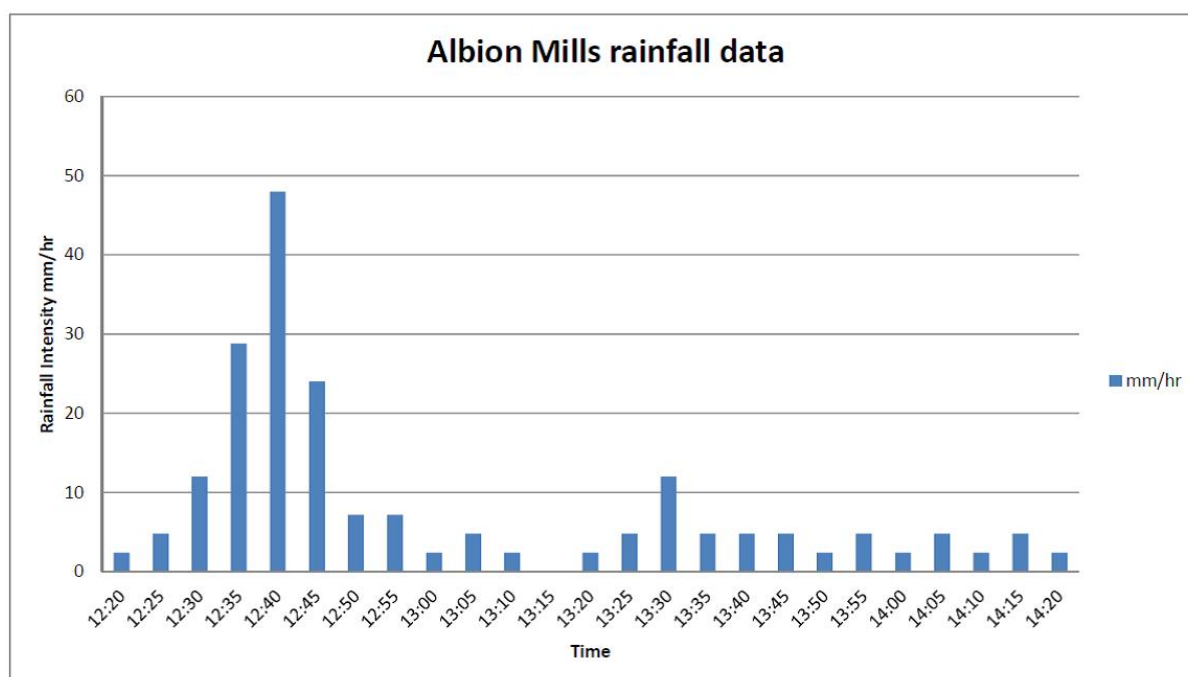
Data from the EA rain gauge at Mill House Woods Lane.

Readings recorded at 2 minute intervals.



The EA rainfall data shows an initial peak intensity of over 70mm/hr declining quickly but then returning to 60mm/hr twice more during the following hour. The rainfall started just after 12:00 and lasted for 1 hour 45 minutes, a total depth of 26.6mm.

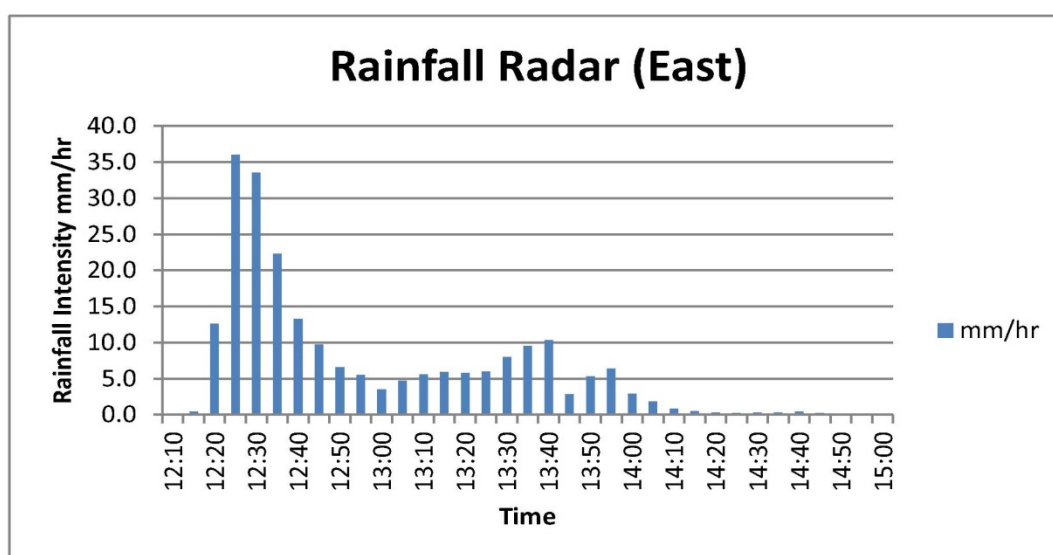
Data from ERYC rain gauge at Albion Mills



This is an ERYC rain gauge which shows a peak intensity of 48mm/hr at the beginning of the storm quickly declining to an average of 5mm/hr. The rain started at 12:20 and lasted for 2 hours, a total depth of 18.5mm.

Met Office Rainfall Radar from the East end of the village.

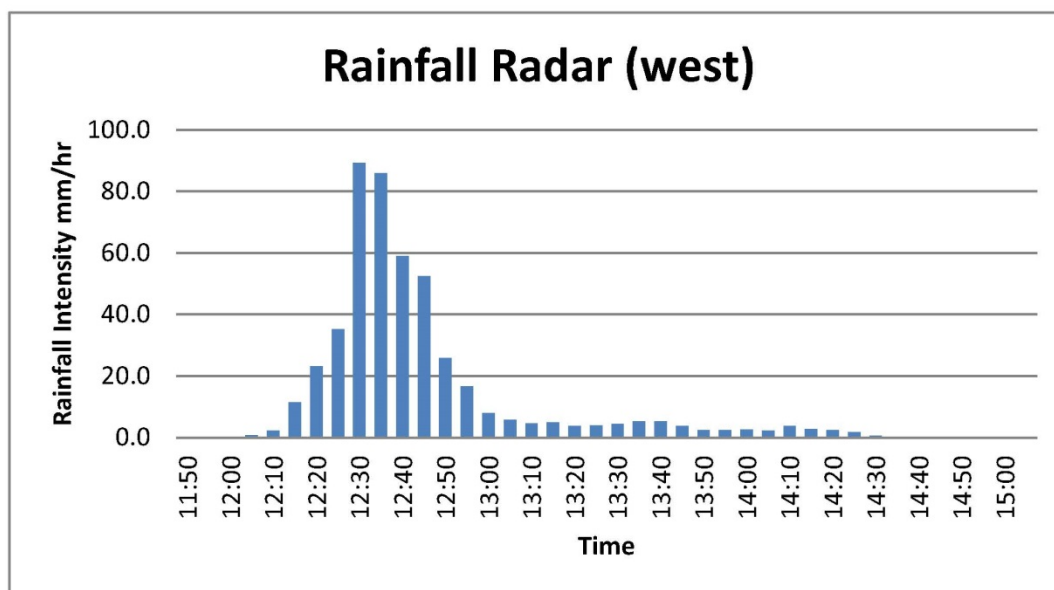
Data source: Met Office



This shows a peak intensity of 36mm/hr at the start of the storm which quickly declined to less than 10mm/hr. The rainfall started at 12:15 and lasted for 2 hours and 30 minutes, a total depth of 18.5mm.

Met Office Rainfall Radar from the West end of the village

Data Source : Met Office



This data again shows an intense period of rainfall at the beginning of the storm, up to 89mm/hr again declining to less than 5 mm/hr. The rainfall started at 12:10 and lasted for 1 hour 30 minutes, resulting in a total depth of 39.5mm.

The long term average amount of rainfall in Cottingham for July is 47mm for the whole month, in this event some areas of the village received almost 40mm in 2 hours.

What this data analysis shows is that the rainfall was both intense for short periods and the intensity and overall quantity of rainfall varied across the village. However the net result was that the drainage system was overwhelmed.

The Met Office estimation of the Storm Return Period) is a 1 in 61 chance of occurring each year, (based on a maximum rate of 34mm in an hour). The current design standard for public sewers is that property flooding should not occur during less than a 1 in 30 year return period storm.

The YWS estimation from the radar data of the storm return period was 40.49mm in 45 minutes giving a 1 in 101 chance of occurring each year.

Cottingham Return Period Estimates;

Data Source	Peak Intensity (mm/hr)	Duration (hrs)	Total depth (mm)
EA gauge at Mill House Woods Lane	72	1.5	26.6
ERYC gauge at Albion Mills	48	2	18.5
Met Office Radar data (west)	36	2	18.5
Met Office Radar data (east)	89	3.25	39.5

LTR :The Long Term Average Rainfall for July is 47mm for the month

EA rain gauge

Between 12:15 and 13:15. 22.8 mm in 1 hour, Return Period. 1 in 10 years

Between 12:15 and 14:15. 26.6 mm in 2 hours, Return period 1 in 9 years

Albion Mills

Between 12:00 and 13:00. 12.2 mm in 1 hour, Return Period 1 in 2. years

Between 12:00 and 14:00. 15.8 mm in 2 hours, Return period 1 in 3 years

Radar East

Between 12:00 and 13:00. 33.8mm in 1 hour, Return Period 1 in 61 years

Between 12:00 and 14:00. 38.1mm in 2 hours, Return period 1 in 38 years

Between 12:00 and 15:00. 39.4mm in 3 hours, Return period 1 in 26 years

Radar West

Between 12:00 and 13:00. 11.8 mm in 1 hour, Return Period 1 in 2 years

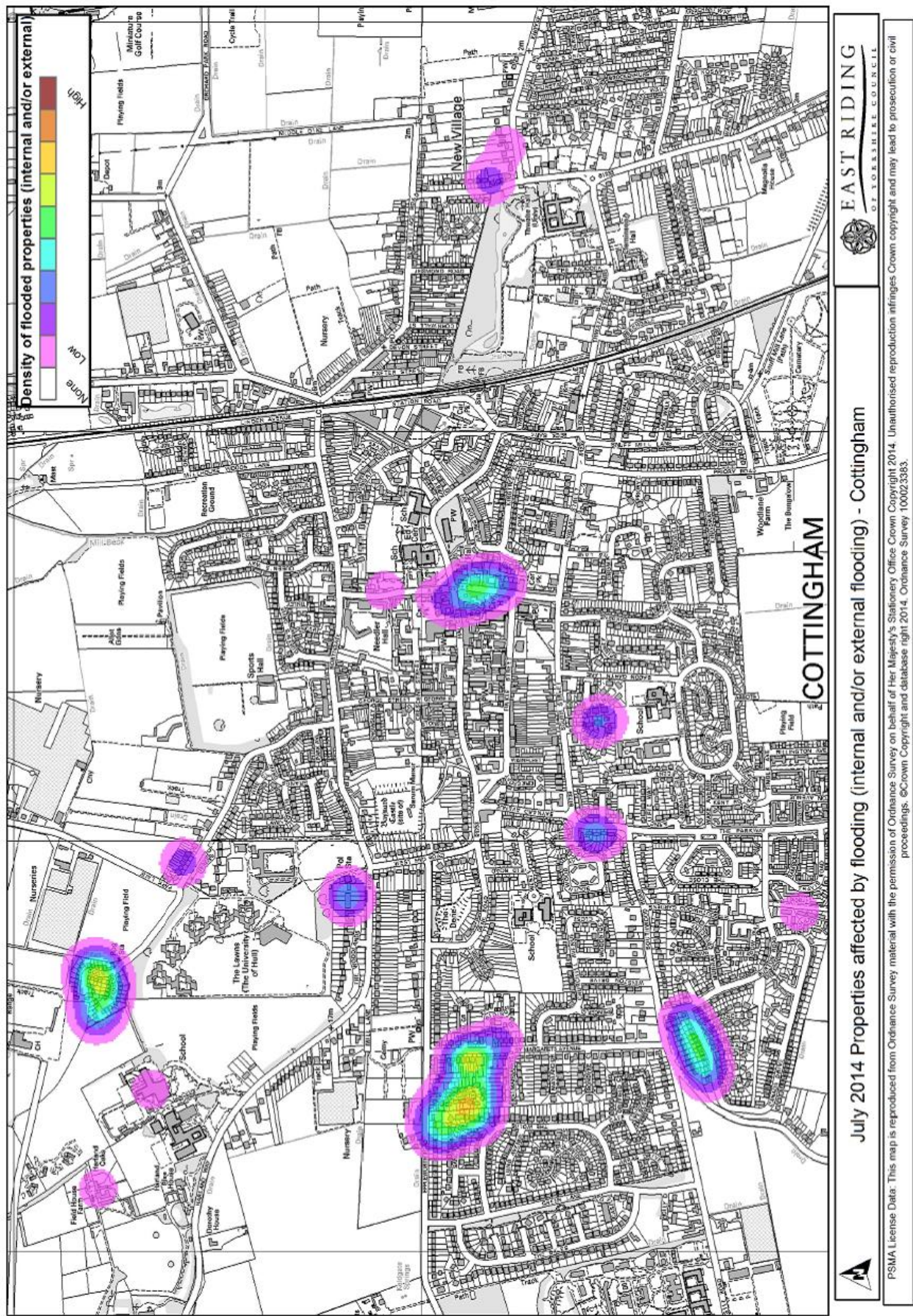
Between 12:00 and 14:00. 17.9 mm in 2 hours, Return period 1 in 3 years

A return period in years, is the chance of an event occurring during each year.

Appendix 2: Properties Affected

Street name	Internal	External	residential	commercial	Total
Badgers Wood	5	14	19		19
Burton Road		1	1		1
Canada Drive		13	13		13
Dunswell Road	1		1		1
Elmfield Drive	1	2	3		3
Endyke Lane	1	1	2		2
Eppleworth Road		6	6		6
George Street		3	3		3
Hallgate	1			1	1
Harland Way	4	2	6		6
King Street	10	1	1	10	11
Market Green	1			1	1
New Village Road		6	6		6
Park Lane		2	2		2
Sancton Close	2	9	11		11
Southwood Road	4	1	5		5
St Margarets Ave	12	3	15		15
Mill House Woods Lane		1	1		1
Stewart garth	7	5	12		12
Total	49	70	107	12	119

Appendix 3: Plan of Reported Areas Affected by Flooding



Appendix 4: Flood and Weather Warnings

The Flood Forecasting Centre had issued a Flood Guidance Statement indicating a medium risk of minor disruption due to predicted heavy showers anywhere in the east of England.

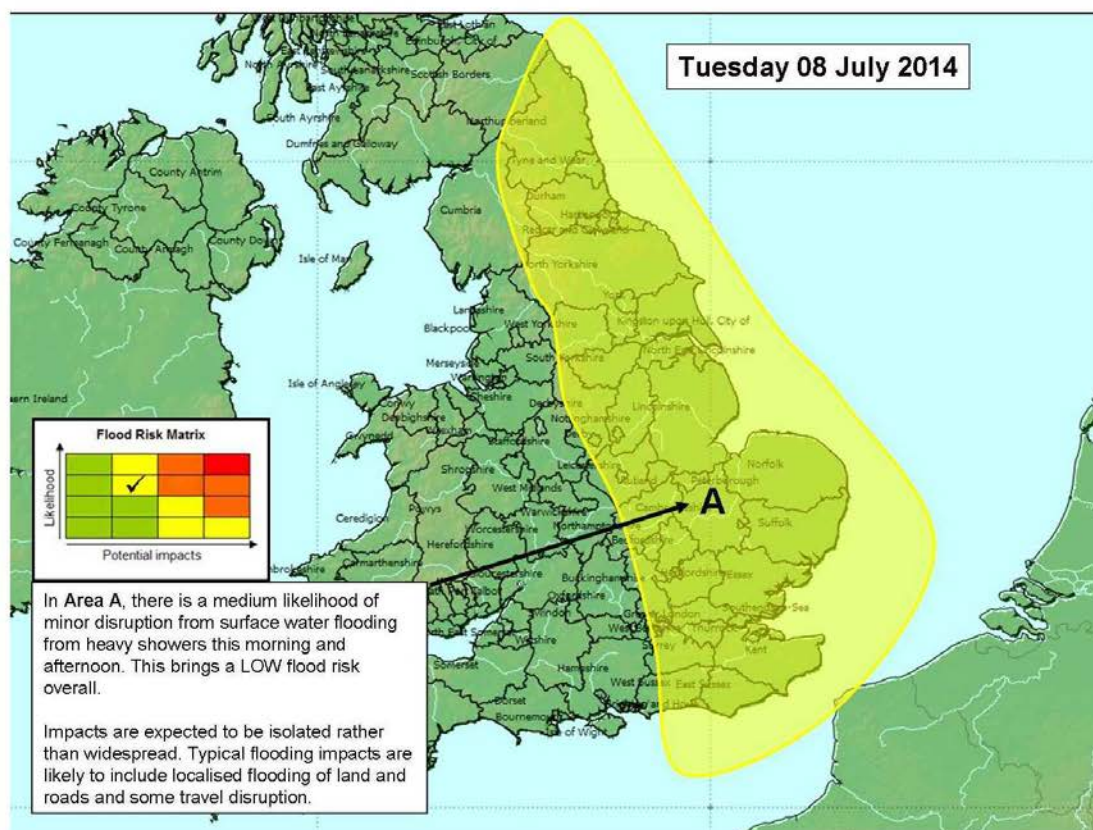
Flood Guidance Statements issued on 8 July 2014

Warnings and Alerts in force in England and Wales at 10:30hrs

Flood (click here)	
Severe Flood Warnings	0
Flood Warnings	0
Flood Alerts	0

Severe Weather (click here)	
Warnings	Yes
Alerts	No

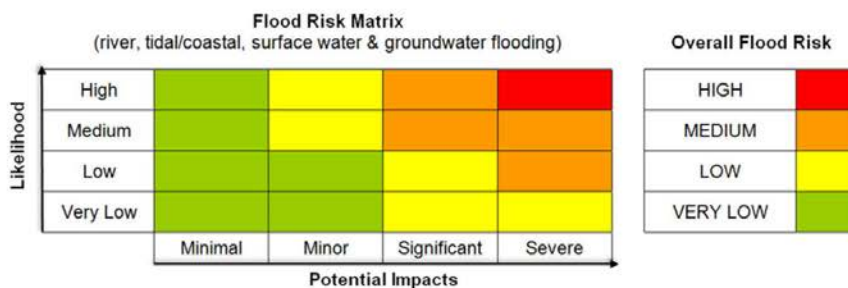
Specific areas of concern



Next statement due: 10:30hrs Wednesday 09 July 2014

Contact details: Flood Forecasting Centre Duty Hydrometeorologist: 0300 12345 01

All times are local.



[Click here](#) for the Flood Guidance Statement User Guide.

Appendix 5: Photographs



Photo 1: King Street



Photo 2: King Street during the storm



Photo 3: Cottingham Clinic on King Street car park flooded



Photo 4: Eppleworth Road



Photo 5: Oakdene showing highway flooded



Photo 6: Oakdene showing highway gully drainage away



Photo 7: Harland Way sewer manhole after the storm



Photo 8: Sewer Manhole surcharging



Photo 9: Merchants Drive Harland Way



Photo 10: Harland Way



Photo 11: Mill Beck Bridge footpath between Hallgate and Broad lane Close



Photo 12: Mill Beck Bridge, after the floods



Photo 13: Property affected on New Village Road



Photo 14: Water flooding from a sewer manhole on New Village Road



Photo 15: Thwaite Hall Snicket off New Village Road, flood water trapped



Photo 16: Creyke Beck showing the depth of flow on the bank side weeds

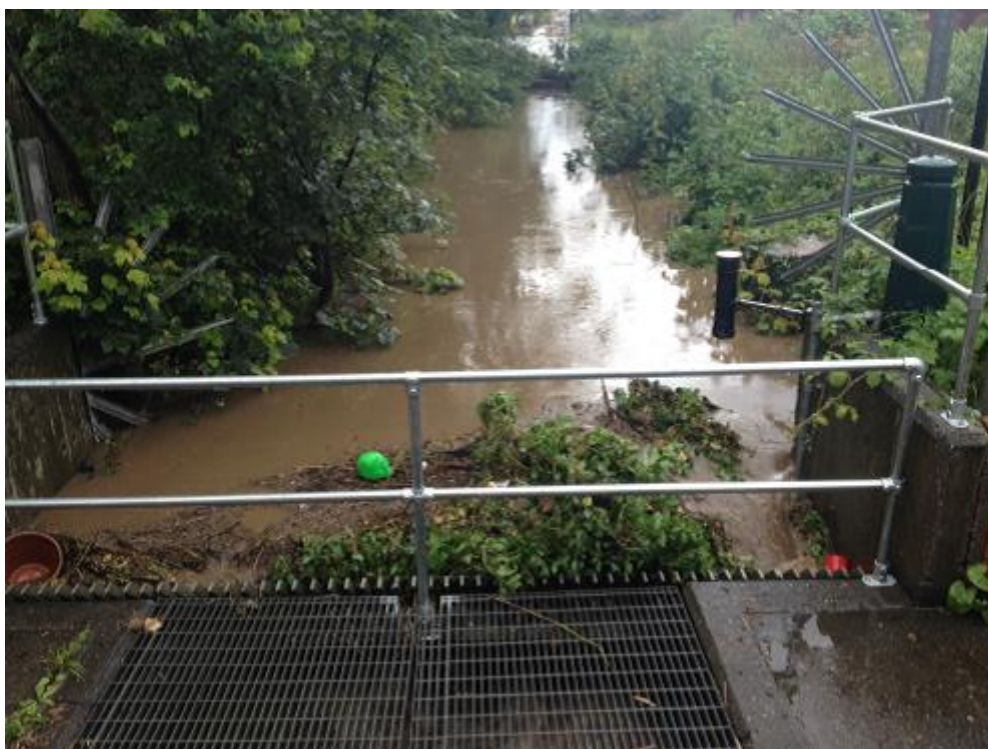


Photo 17: Victorias Way Screen, showing debris build up



Photo 18: Victorias Way screen being cleaned



Photo 19: Raywell Valley Attenuation Lagoon after the storm

Appendix 6: Yorkshire Water Services Response

Part of the S19 report process is an information request to other relevant Flood Risk Authorities, in this case YW, this is a summary of their response.

Cottingham S19 Information Request

Any estimates of Rainfall figures, and return periods for the event on 8 July

See attached excel spread sheet giving return periods for the whole of Cottingham

‘Rainfall information 08/07/2014’

This estimates the return period for the rainfall to be 101 years.

Details of the reported affected areas and properties

Summary of data supplied

Street	ext	int	total
St Margarets Avenue	6	1	
Eppleworth Road	1		
George Street	3		
New Village Road	6		
Sancton Close	2	1	
Southwood Road	1	1	
Endyke Lane	1		
Stewart Garth	5		
Dunswell Road		1	
Elmfield Drive		1	
Mill House Woods Lane	1		
King Street	1		
	27	5	32

‘Flooding Reported to YWS 08/07/2014’

Other known issues which are known but no official report are:

Badgers Wood- External Flooding Multiple
Oakdane- External Flooding Multiple
87 Harland Way- External Flooding

Details of works done post event, i.e. CCTV surveys and sewer cleaning

CCTV and Jetting

St Margaret's Avenue
Eppleworth Road
George Street
Kings Street
Sancton Close
Crescent Street
Badgers Hill
Stewart's Garth
Elmfield Drive
New Village Road
Oakdene
Harland Way

Root Cutting

Section of sewer between Eppleworth & Sancton Close
Crescent Street

Any faults or significant defects found? i.e. blockages, pump failures etc?

The section of sewer which serves George Street, King Street and Crescent Avenue a 20% root blockage was found.

Section of sewer between Eppleworth & Sancton Close a very small amount of roots were found

Do you have any operational Surface water attenuation systems? i.e. tanks in Cottingham

The sewer water system which serves Apple Garth Mews has on-line storage made up of four 750mm SW pipes before it discharges into Broadlane Beck. This should be mapped on your sewer records, if not please ask for an updated version.

Progress on the Hull Model including Cottingham, does this indicate any deficiencies in the network in Cottingham

The model shows issues with the combined sewer which serves the George Street, Crescent Street and King Street. This is overloaded at a 1 in 30 year weather event.

The result of this is external flooding highway and property flooding.

George Street, King Street update following 2012 S19 recommendations and recent sewer cleaning/root cutting work?

The sewer was placed on a three monthly root cut and de-silt since 2012. A hawk eye was also installed to monitor sewer levels.

Sancton Close area sewer records, please confirm the records are correct

Yes, these sewers were recently CCTV'd and are as mapped

Any proposed works on sewer network in Cottingham

Cottingham will continue to undergo normal operational maintenance on the sewer system and investigate should any problems arise. We will also continue to look into the known issues around the George Street King Street area for any lower cost solutions.

We also have outstanding lining work on the combined sewer on Crescent Street, this will be carried out in an effort to reduce root ingress.

Appendix 7: Flood Resilience Information for Property Owners

People who have been flooded before have found the following guides helpful:

The Environment Agency's flood advice can be accessed here:

<http://www.environment-agency.gov.uk/homeandleisure/floods/default.aspx>

Two Environment Agency documents that might be particularly useful are: Protecting your home: <http://cdn.environment-agency.gov.uk/geho1009brdl-e-e.pdf>

and Temporary and Demountable Defenses:

<http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter9.aspx?pagenum=10>

Homeowners guide to flood resilience:

<http://www.knowyourfloodrisk.co.uk/pdf/protection-guide.pdf>

The National Flood Forum. Ready for flooding:

<http://nationalfloodforum.org.uk/wp-content/uploads/Ready-for-flooding.pdf>

The British Insurance Brokers Association (www.biba.org.uk). Guide on getting insurance for high risk flood areas:

<http://www.biba.org.uk/UploadedFiles/600floodguide.pdf>

The Royal Institute of Chartered Surveyors. A clear guide to flooding for property owners: http://www.rics.org/Global/Downloads/A_clear_guide_to_Flooding_for_property_owners.pdf

The Association of British Insurers. A guide to resistant and resilient repair after a flood:

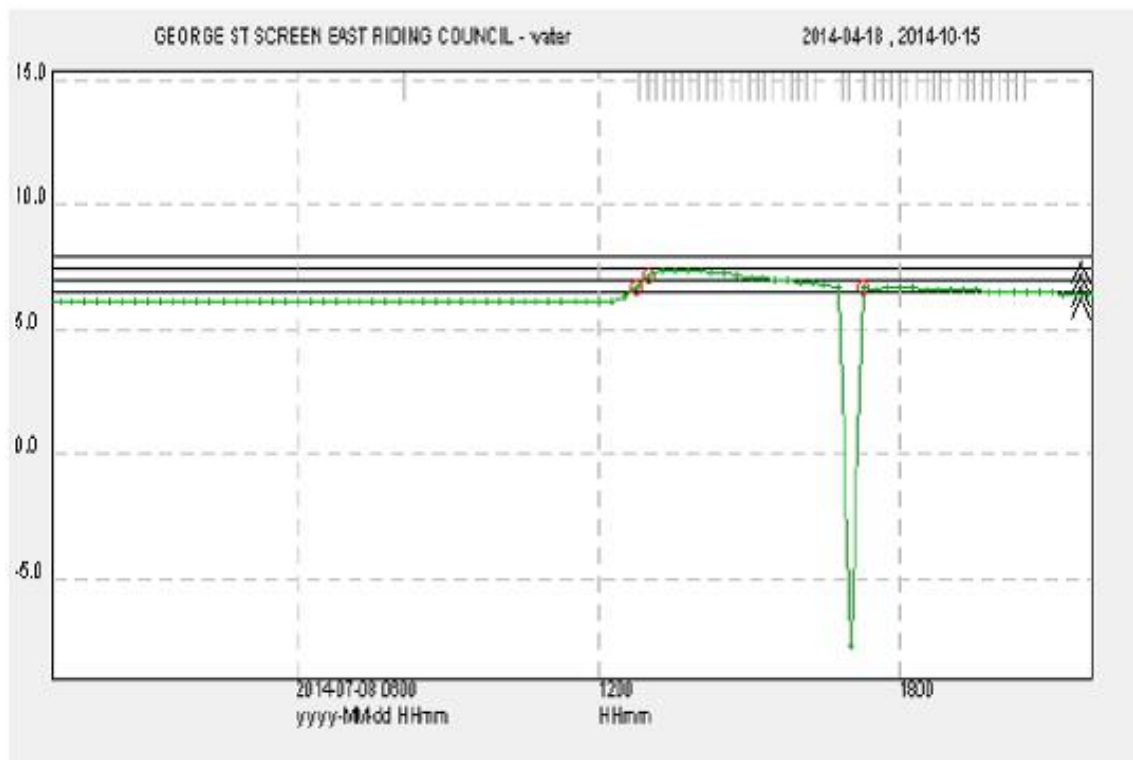
http://www.abi.org.uk/Publications/ABI_Publications_A_guide_to_resistant_and_resilient_repair_after_a_flood_670.aspx

More information is available on the ERYC Website, on the A to Z, F - 8 Flooding, Flooding and Flood Preparation.

Appendix 8 Telemetry Data From Watercourse Screens

The Council has a telemetry system monitoring water levels at various locations.

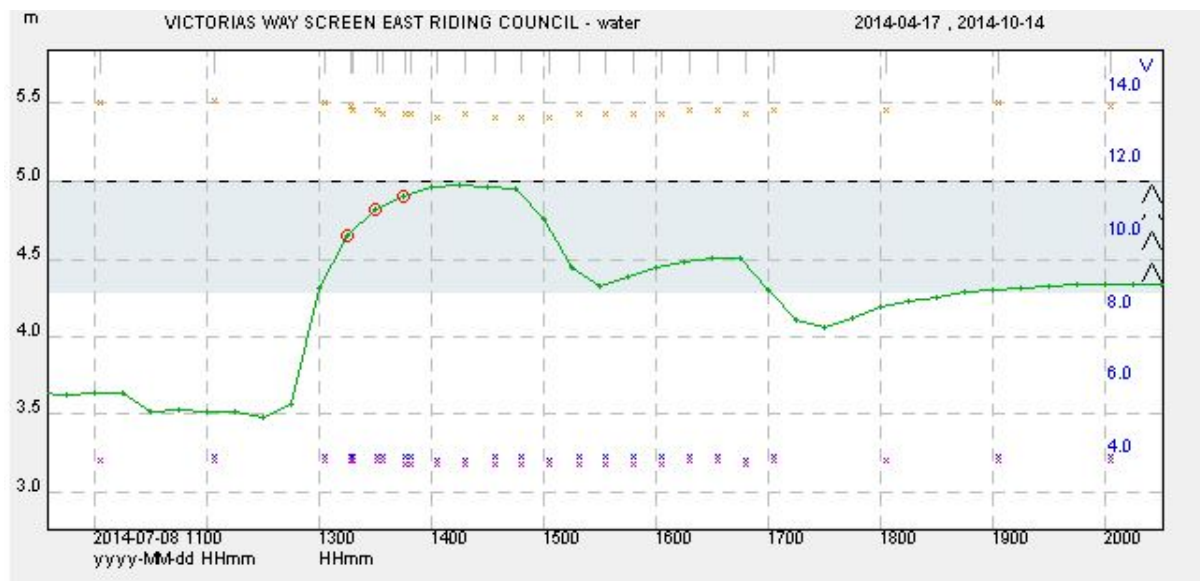
Telemetry data showing the water level in Broad Lane Beck at George Street screen on 8 July.



This shows that the level at the screen rose sharply at 12:15 and alarmed, then the level slowly returned to normal.

The spike at 17:00 shows a loss of echo, this is caused when the radar beam hits debris not water and does not return to the radar head. This is a normal occurrence and does not affect the overall effectiveness of the unit.

Telemetry data showing the water level in Mill Beck at Victoria's Way Screen on 8 July.



This shows that the level in Mill Beck rose sharply from 12:30, peaking at 14:30, before dropping slowly, but remaining at a higher level than before the storm.

Both screens were cleaned prior the event and during the event the Council's contractor attended site and removed debris washed onto the screens.

