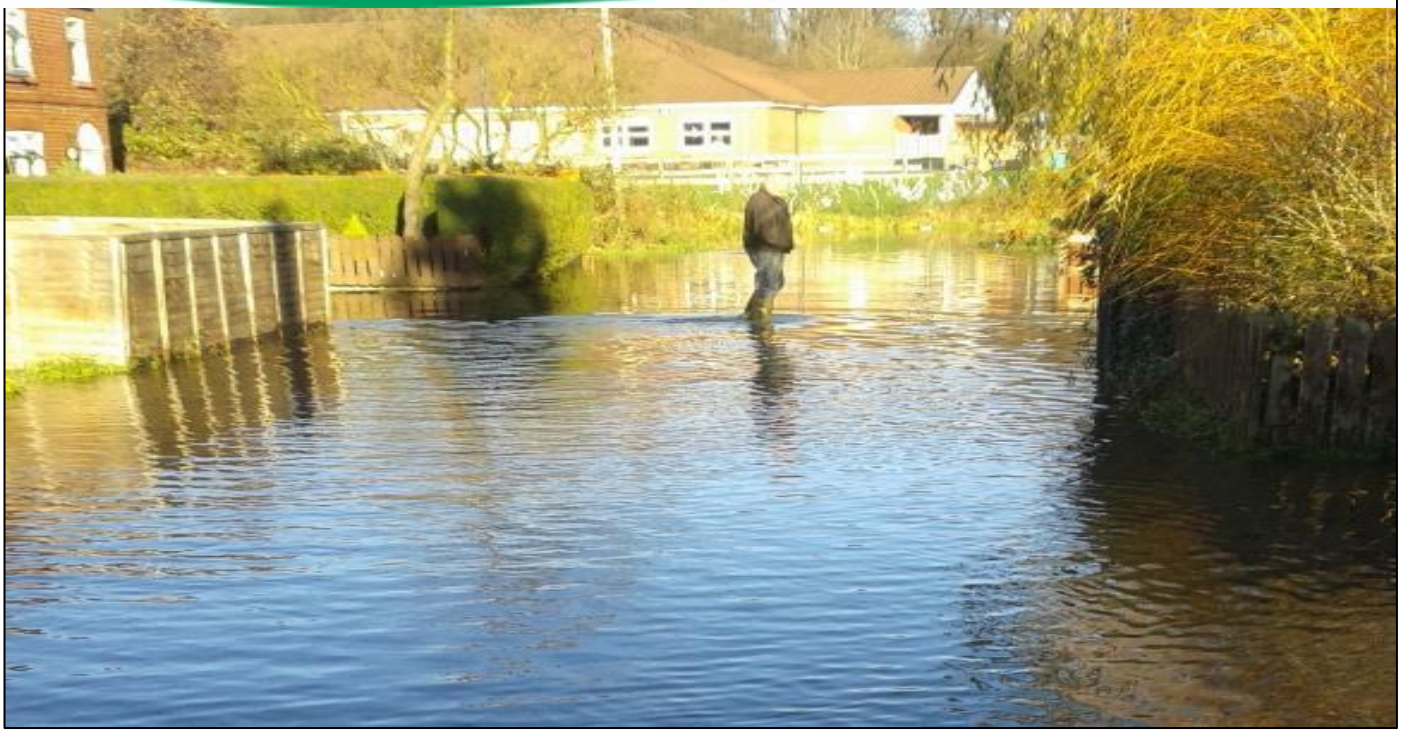
North Yorkshire County Council

Flood Investigation Report

Brotherton



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

Purpose

This document has been prepared specifically for the purpose of meeting the requirements of Section 19 of the Flood and Water Management Act 2010.

The purpose of this report is to investigate which Risk Management Authorities (RMAs) had relevant flood risk management functions during the flooding incident, and whether the relevant RMAs have exercised, or propose to exercise, their risk management functions (as per section 19(1) of the Flood and Water Management Act 2010). It does not address wider issues beyond that remit, nor include recommendations for future actions.

The supporting data has been put together based on records of internal property flooding and road closure information from a variety of sources. While every effort has been made to verify the locations of the Section 19s identified, the nature of the data and the methods used to collate this information mean that it does not include every occurrence of flooding. This data only identifies where flooding has been reported and is indicative only.

Acknowledgements

Mouchel would like to thank the following for their cooperation and assistance in this investigation:

North Yorkshire County Council Flood Risk Management Team

North Yorkshire County Council Highways Department

North Yorkshire County Council Emergency Planning Unit

The Environment Agency

Yorkshire Water Services Ltd

Selby District Council

Dates of Inspections

Wednesday 7th September & 21st September 2016

Contents

1 Executive Summary

On the 26th of December 2015 14 properties in Brotherton were flooded from surface water after the significant rainfall event on the 25th and 26th December.

Widespread and substantial rainfall had fallen over West and North Yorkshire in late December 2015. In this event, rainfall in the middle reaches of the catchment was proportionately more significant than that over the Pennines, and this pattern of rainfall had particular consequences for communities in Selby District both in terms of the scale of flooding and the lead times available for issuing warnings.

It had already been very wet for an extended period of time - data shows that in the Aire catchment, November 2015 was the second wettest since 1909 - catchments across Yorkshire had also received almost twice the long term average rainfall for December before the rain started to fall again on Christmas Day and Boxing Day.

The rainfall event that occurred between the 23rd to the 26th December 2015 was characterised by two distinct rainfall systems. The rainfall which caused the flooding at Low Street and Marsh Croft was brought on by the second rainfall system on the 25th and 26th December.

There is a history of flooding in this location over recent years (November 2000; February 2008 and 26th December 2015). The rainfall event that occurred brought medium intensity, long duration rainfall that fell on the Brotherton area, overwhelming the local surface water systems. On Low Street and Marsh Croft this report has identified that the main source of flooding was from excess surface water. Low Street and Marsh Croft were not directly affected by flooding from the River Aire.

The surface water flooding mechanisms during the flood event were:

- Overwhelmed highway drainage on Marsh Croft.
- The inability of the surface water system to discharge.
- Highway runoff on Low Street flooding properties.

This report has identified the actions and responses of the Risk Management Authorities who have responsibilities during a flood event in the Brotherton area. It is understood that all Risk Management Authorities have undertaken appropriate activities in response to the flood event, in line with their duties and responsibilities under the Flood & Water Management (2010) Act.

2 Introduction

2.1 Flood and Water Management Act (2010)

In his review of the summer 2007 floods, Sir Michael Pitt recommended that local authorities should be given a duty to investigate flooding.

The Flood and Water Management Act 2010 (FWMA), defines the roles and responsibilities of 'Risk Management Authorities' and designates the unitary or upper tier authority for an area as Lead Local Flood Authority (LLFA).

The LLFA has responsibility for leading and co-ordinating local flood risk management. Local flood risk is defined as the risk of flooding from surface water runoff, groundwater and small ditches and watercourses (collectively known as ordinary watercourses). The responsibility to lead and co-ordinate the management of tidal and fluvial flood risk remains that of the Environment Agency (EA).

The Act also implements the recommendations made by Sir Michael Pitt that local authorities should have a duty to investigate flooding from all sources.

2.2 Section 19 Investigation Requirement

North Yorkshire County Council (NYCC), as LLFA, has a responsibility under Section 19 of the FWMA 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.

Section 14 of the FWMA grants the LLFA power to request information associated with its functions. These powers have been exercised in the preparation of this report.

2.3 Trigger for Section 19 Report

The incident has been assessed in line with the criteria set out in Section 3 of the North Yorkshire County Council Local Flood Risk Strategy (2015) and has been judged to warrant a formal Section19 investigation on the basis of:

- Number of properties internally flooded.
- The depth, area or velocity of flooding reported.
- The frequency of flooding.
- The nature and extent of critical infrastructure impacted by the flood.

2.4 Location

Brotherton is situated in the Selby District of North Yorkshire and is home to approximately 750 residents[1]. Brotherton contains residential and commercial properties as well as the Brotherton and Byram Community Primary Academy (the

[1] 2011 Census

Academy). Brotherton (grid reference: SE 48196 25887) is located to the west of the A162 and the east of the A1, as shown in Figure 2.1. Brotherton is situated on the eastern bank of the River Aire in its lower catchment area.

The report will investigate the internal flooding that occurred in Brotherton, on Boxing Day 2015, where internal flooding was reported to 14 properties. These were all residential properties, managed by Selby District Council and were predominantly on the east side of Marsh Croft which is a cul-de-sac connected to Low Street. Four of the 14 flooded properties have frontages on to Low Street.

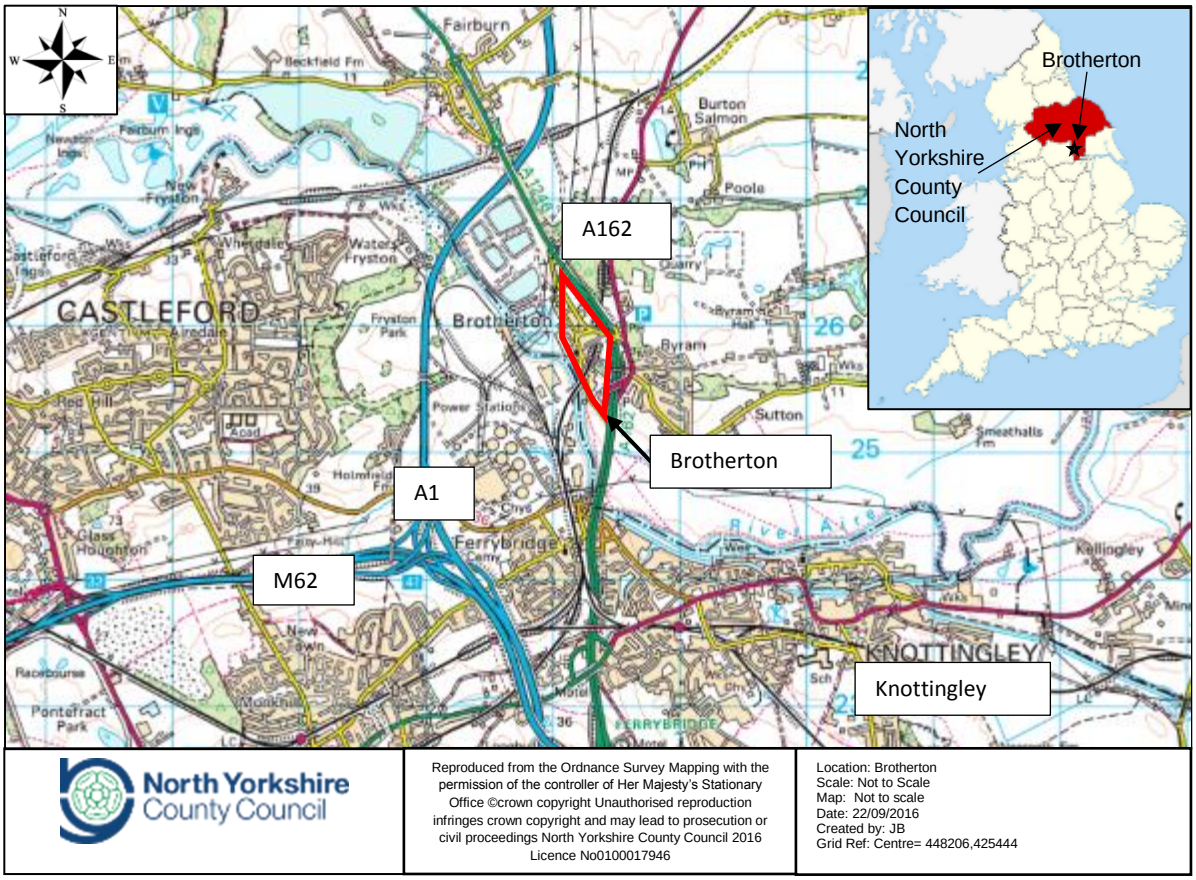


Figure 2.1 Brotherton Location Map (Source: NYCC)

2.5 Topography

Brotherton is situated on low lying flat land at a similar level to the adjacent floodplain[2]. Marsh Croft is lower than Low Street. The residential area of Brotherton is to the east of Low Street, whilst the River Aire floodplain lies to the west[3].

The Academy situated to the north of Marsh Croft is higher in elevation. The A162, situated to the east of Marsh Croft is also higher in elevation. Low Street falls in elevation from where it joins the A162, and Marsh Croft falls in elevation away from its junction with Low Street[3].

[2] OS Maps
[3] Site Inspection

The key locations of the overall site are depicted in Figure 2.2.

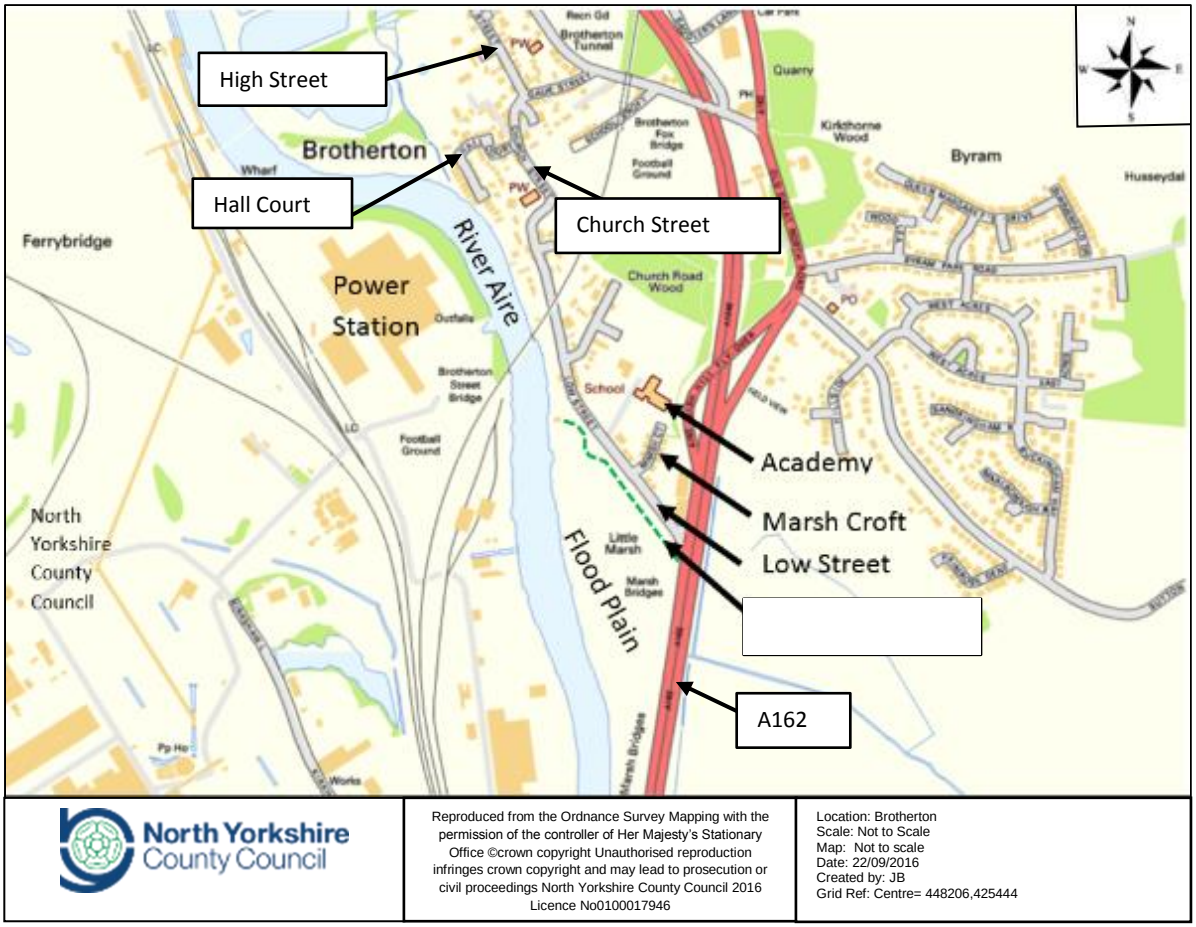


Figure 2.2: Brotherton Local map (Source: NYCC)

Brotherton is located on rich soil (alluvial deposit of silt or fine clay) over a bed of magnesium limestone which thickness ranges up to 20 metres[4]. River terrace sand and gravel are present along the River Aire valley.

2.6 The River Aire

The River Aire is classified as a main river running from its source at Malham, in the Yorkshire Dales National Park, to Airmyn where it discharges into the River Ouse[5]. It is approximately 148km in length. River Aire levels are gauged in the vicinity of Brotherton at Ferrybridge Lock, Castleford and Beal. Ferrybridge Lock is 800m downstream, Castleford is 6.5km upstream and Beal is 7.5 km downstream of Brotherton. Gauge results show[6] the normal range of water depth is between 1.02m and 2.0m at Castleford and between 0.32m and 3.55m at Beal, there is no normal range available for Ferrybridge Lock. According to the Environment Agency when the Aire rises above 2.1m at Ferrybridge Lock, 2.0m at Castleford or 3.55m at Beal, then river flooding is possible.

[4] Brotherton Formation, British Geological Survey
[5] River Aire Fact File, Environment Agency
[6] Flood Information Services, Environment Agency

The River Aire has tidal influence up until Chapel Haddlesey[5], which is approximately 10km downstream of Brotherton. Hence flood risk from the Aire in this area is purely river flooding and is not influenced by tidal action.

2.7 The River Aire Floodplains

There are two floodplain areas, separated by the A162 carriageway, that affect the Brotherton area; Floodplain X and Floodplain Y as shown in Figure 2.3. Both floodplain areas are connected by four culverts (each approximately 3.5m wide x 1.5 m high) beneath the A162[3]. Marsh Drain runs south on the east side of the A162 (Floodplain Y) under a private vehicular access[2], as shown in Figure 2.3.

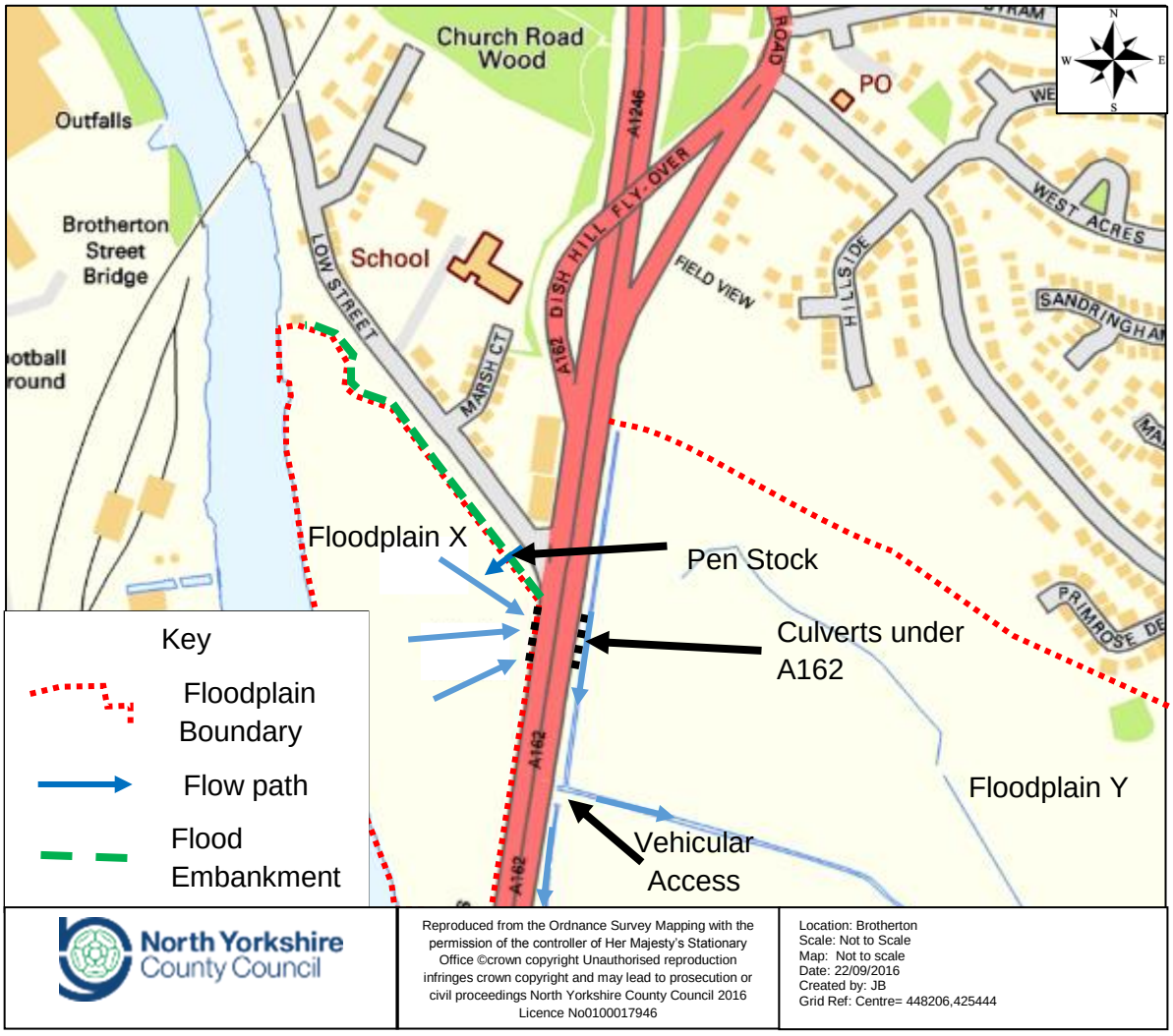


Figure 2.3 Key features on floodplains (Source: NYCC)

Alongside Low Street a flood embankment, located on Floodplain X, provides a purpose built flood barrier that prevents flood water reaching Low Street from the River Aire[3]. Data received from the EA[7,8] has put the crest level of the flood embankment between 10.67m and 11.31m AOD. A manually operated penstock in the flood embankment allows for any accumulated water on the Low Street side of the flood embankment to be discharged onto Floodplain X[3]. This can only occur

[7] Asset Information Document, Environment Agency
[8] Asset Map, Environment Agency

when floodplain water levels are lower than the accumulated water level on the Low Street side. A drainage ditch running parallel to the flood embankment and Low Street conveys surface water towards the penstock[3]. The site visits, on the 7th and 21st September 2016, identified this ditch to be heavily silted up and overgrown.

2.8 Public sewers

The surface water system in the Marsh Croft area receives surface water discharges from the eight properties on Low Street, 14 properties on Marsh Croft and the Academy, as shown in Figure 2.4[9]. The main surface water carrier runs from the Academy, via a manhole containing a non-return valve[10] (Manhole A in Figure 2.4), to the eastern side of the A162 where it discharges into Marsh Drain[9]. The secondary feeders take surface water discharges from the front of the residential properties to Manhole A. Manhole A and a second chamber to assist inspections are both located in an informal footpath that is alongside number 11 Marsh Croft. The chambers are located on land that is owned by NYCC.

The foul system receives foul discharges from the rear of the properties via secondary feeders to the south west of Marsh Croft, where they discharge into the main carrier on Low Street[9]. Most of the foul discharges are taken in foul sewers but the main carrier on Low Street is a combined system. The connection of the foul sewers from Marsh Croft to the combined main carrier on Low Street was not present in the YWSL sewer map. However it has since been confirmed by Yorkshire Water Services Ltd (YWSL) that the Marsh Croft foul sewer discharges into the combined sewer on Low Street, as shown in Figure 2.4.

The main combined sewer carrier runs along Low Street and then turns towards a pumping station near the Academy were it is pumped via a rising main to a combined sewer, north of the site, which carries the discharges to Sutton Lane waste water treatment plant (Grid reference: SE 49991 25588), 1.6km east of Marsh Croft[9].

Some of the foul and surface water discharges from Hall Court, Church Street and High Street (shown in Figure 2.2) are taken down Low Street from the north west and pumped north via the same pumping station.

There are a number of places where the foul and surface water sewers cross paths on Marsh Croft.

[9] Sewer Records, Yorkshire Water Services
[10] Selby District Council

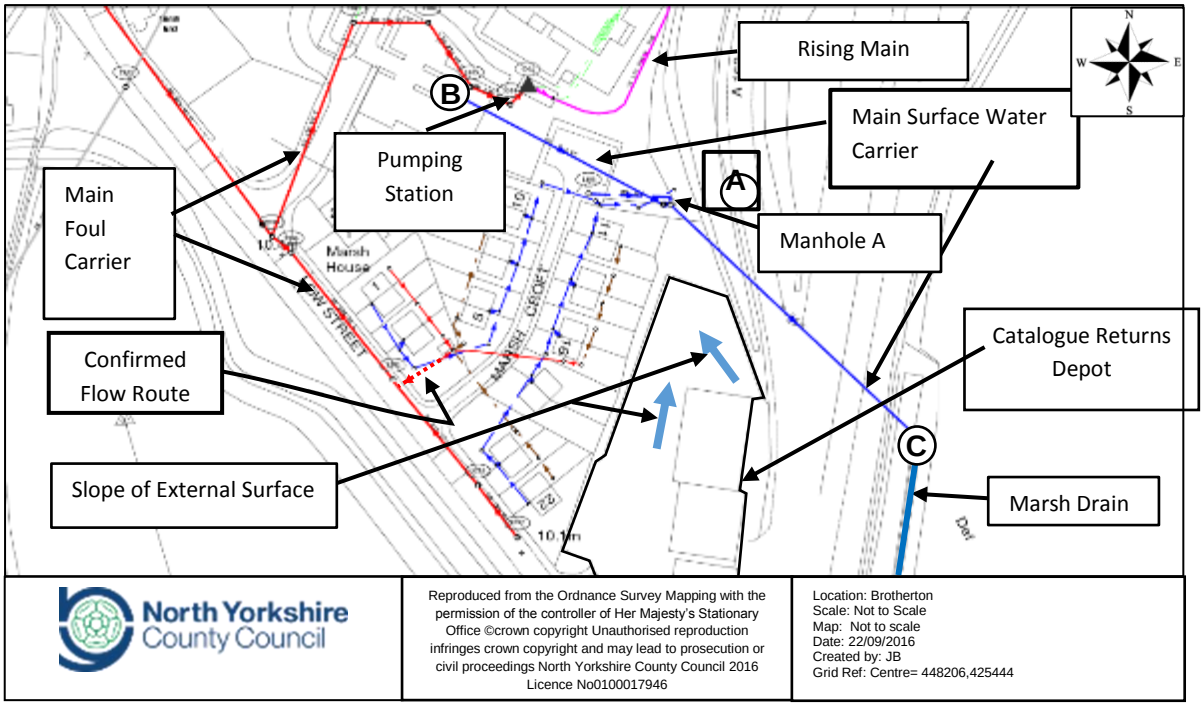


Figure 2.4 Foul and surface water sewer system (Source: YWSL)

2.9 Highway drainage

The floor levels of the dwellings along the east side of Marsh Croft are consistently below the level of the adjacent carriageway surface, as such their drives fall away from the road level[3].

Marsh Croft highway drainage is via conventional road gullies set to collect the surface water runoff[3]. The carriageway width of Marsh Croft is single lane flanked by footways on each side. On Marsh Croft the footways are separated from the carriageway by continuous shallow rise override kerbs. This feature provides for two way movements of road vehicles by allowing road vehicles to be driven over the relevant footway. The key highway drainage features are shown on Figure 2.5 and 2.6.

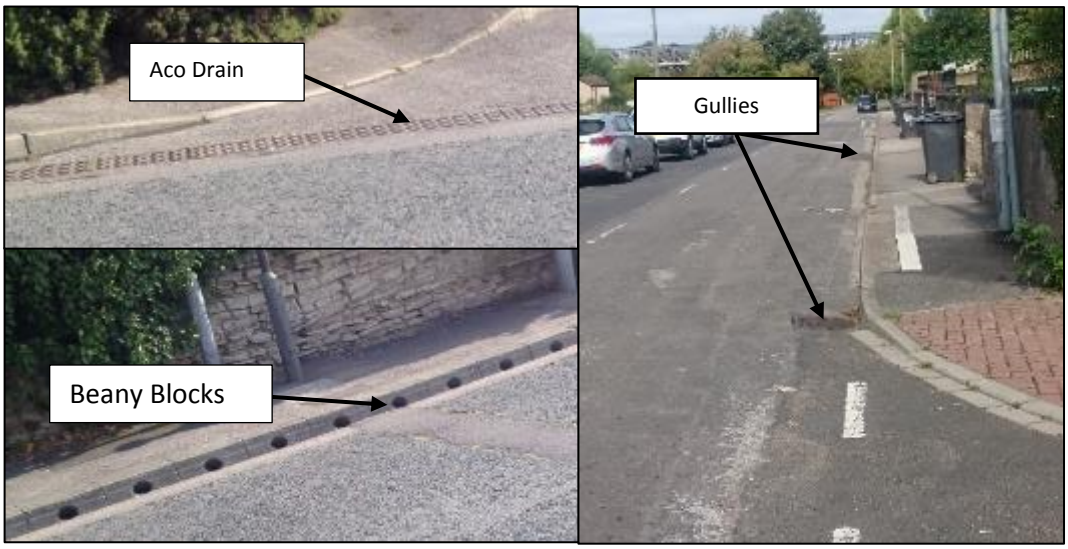


Figure 2.5 Photographs showing Marsh Croft and Low Street drainage systems

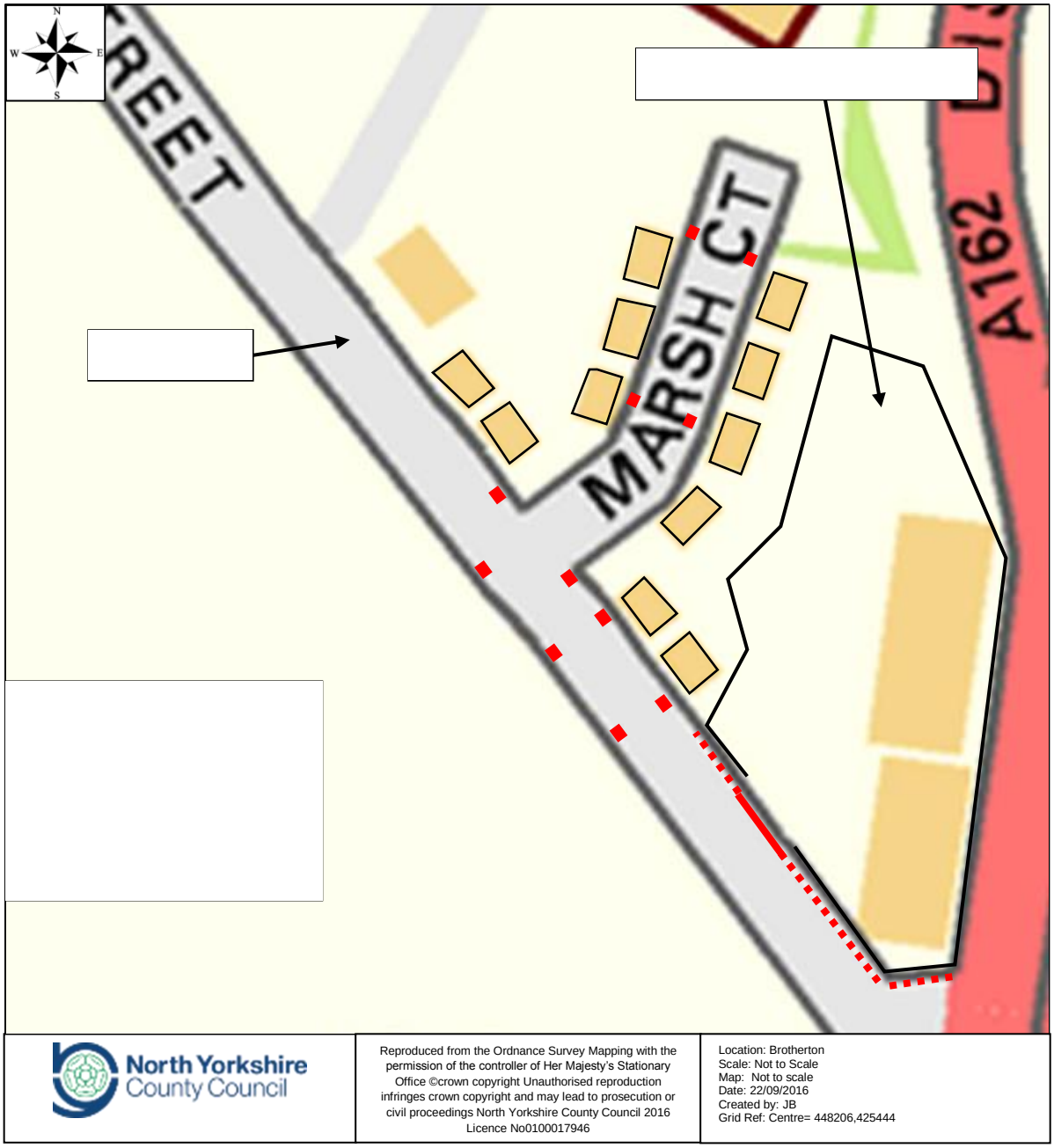


Figure 2.6 Marsh Croft and low street key drainage features (Source: NYCC)

Highway drainage for Low Street is via a combination of Beany Blocks and conventional road gulley collection pots[3], as shown in Figure 2.5. A series of speed control humps reduce vehicle speeds but some do not have edge treatment. Edge treatments are recessed sections at the edge of the speed hump to allow surface water to flow down the edge of the road.

It is unclear at this stage where the highway drainage system on Low Street discharges. The site inspection undertaken on the 7th of September 2016, identified some evidence of highway drainage works in close proximity to a series of beany blocks at the entrance of the Catalogue Returns Depot and the YWSL combined sewer, as shown in Figure 2.7.

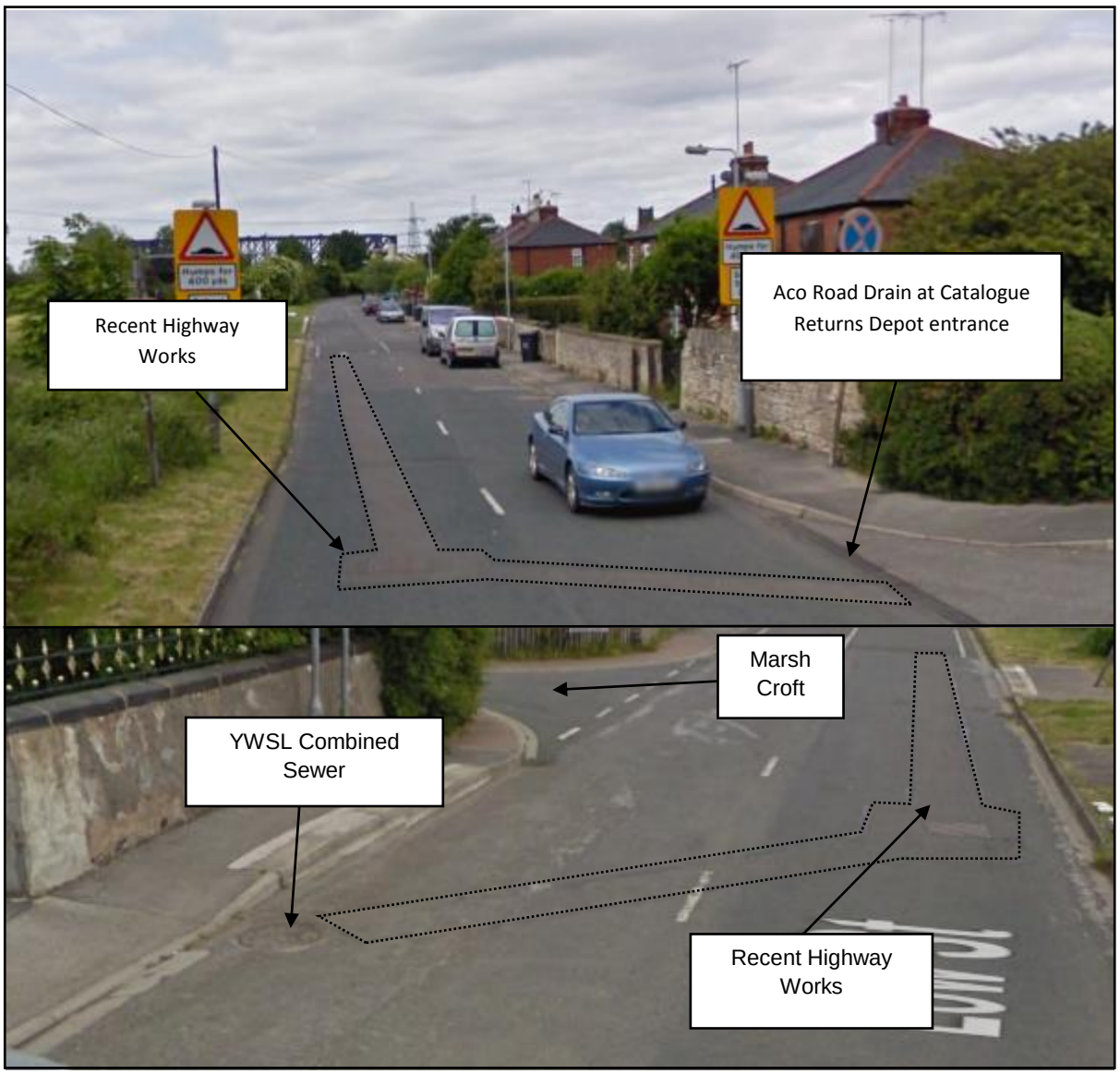


Figure 2.7 Photographs showing recent Highway works (Source: Google Maps)

The surface water culvert running under the A162 is owned by Highways England. The culvert is known to contain a significant amount of silt[11] but its overall condition is unknown at this stage.

2.10 Selby Area Internal Drainage Board

Brotherton does not lie within an Internal Drainage Board (IDB) drainage district[12], however on the east side of the A162 there are Selby Area IDB Maintained Drains[13]. There is a hydrological connection from the drainage in the Brotherton area to the IDB Maintained Drains. Marsh Drains B and C, in Figure 2.8, are managed by Selby Area IDB, however Marsh Drain A, running parallel to the A162, is not. The responsibility for the maintenance of Marsh Drain A lies with the riparian owner. Marsh Drain A receives surface water discharges from Marsh Croft, the Academy and flood water from Floodplain X via the culverts under the A162 as discussed in

[11] NYCC and Selby DC Site Inspection
[12] Internal Drainage Board Maps
[13] Discussions with Asset Coordinator, Selby Area IDB Map

Section 2.4. Marsh Drain A runs south from the out flow of the Marsh Croft surface water system, as discussed in Section 2.7. It then splits, one drain continues south and another starts (Marsh Drain B) heading east.

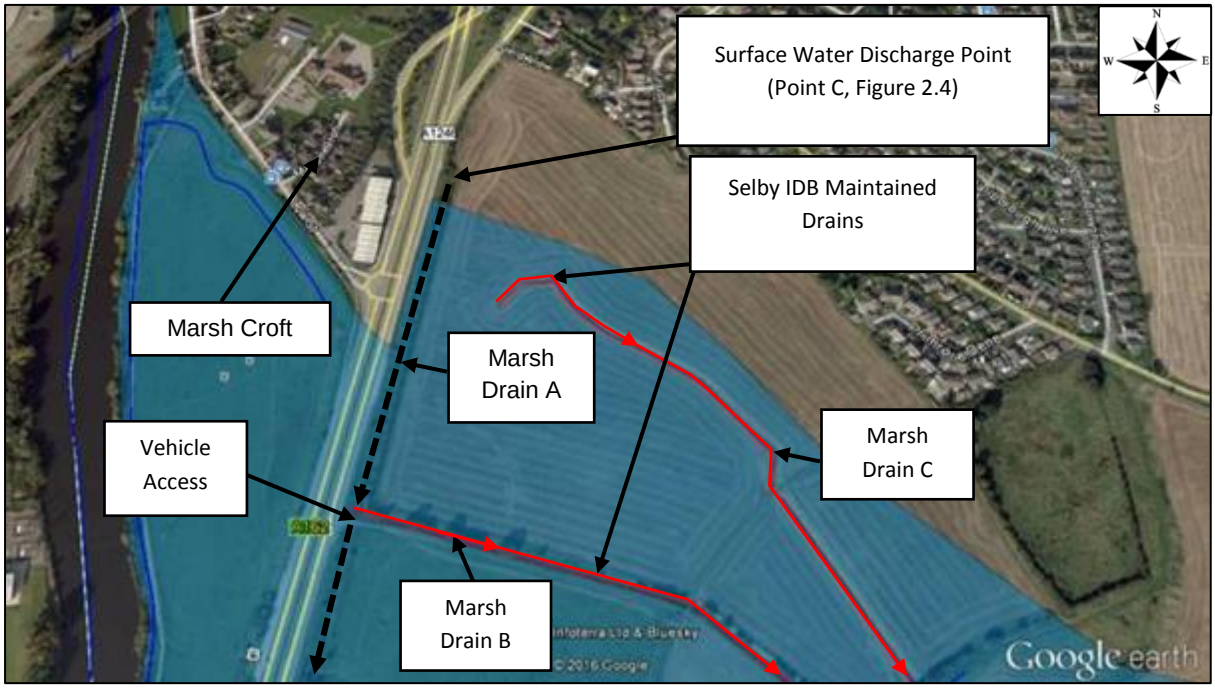


Figure 2.8 Selby Area Internal Drainage Board proximity to Brotherton (Source: Shire Group IDBs)

Marsh Drain A is currently very overgrown, as shown in Figure 2.9.

Figure 2.9 Photograph showing the current condition of Marsh Drain A

3 Flood Event

3.1 Rainfall data

3.1.1 Meteorological Conditions

The rainfall event was characterised by two distinct rainfall systems. The first rainfall system was Storm Eva which brought high winds and a band of rain which spread across the country on the 23rd & 24th December. The second system was a slow moving low pressure system and warm frontal zone, moving across the region from the west, on the 25th and 26th of December. The rainfall which caused the flooding was brought on by the weaker second low pressure system[14].

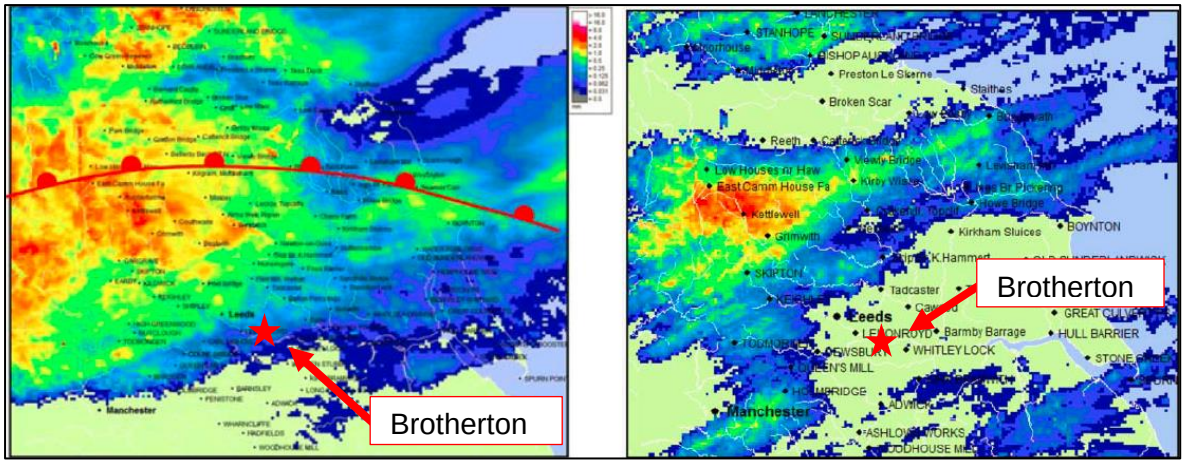


Figure 3.1 Radar image with overlaid front as of 18:00 on 25th December 2015 (left) and 01:00 on 26th December 2015 (Right) Copyright Meteorological Office

A warm frontal zone passed over the UK during the morning of 25th December, bringing scattered showers with it, and by midday there was a blanket of rainfall covering Yorkshire. During the evening of the 25th December an occluded front had set over the north-west and north-east and it was this front which produced the more intense storms. There were two main pulses of heavy rainfall that led to the flooding experienced over Yorkshire. The first pulse occurred once the occluded front had formed during Christmas Day afternoon and evening. The second pulse occurred in the early morning of Boxing Day. The two main pulses of heavy rainfall were mainly confined to the upper catchment of rivers Aire, Calder, Wharfe and Swale[14].

3.1.2 Antecedent conditions

A data set from the National Climate Information Centre (NCIC) shows the wettest rankings for November 2015. The percentage of the Long Term Average (LTA) rainfall in the wettest catchments exceeded 200%, with the Aire catchment reaching 234% in November 2015. This indicates that the ground was already saturated from rainfall in November, prior to the exceptionally wet December 2015[14].

From the 1st to the 24th December, before the event, the northern and western catchments of Yorkshire had generally received more than the LTA rainfall for December, particularly in the upper catchments. The catchments were already saturated before the Christmas Day and Boxing Day rainfall event[14].

[14] Hydrology of the December 2015 Floods in Yorkshire, Environment Agency

3.1.3 Brotherton Rainfall Event

YWSL has provided rainfall radar data for the rainfall event in the Brotherton area[15]. This shows that the peak rainfall fell on Boxing Day producing a rainfall depth of 22mm in 8.5hours. Environment Agency tipping bucket rain gauge (TBR) rainfall data has been provided for Bramham 18km away from Brotherton. The rainfall data is illustrated in Figure 3.2. The data from the TBR shows two rainfall events, on the 25th and 26th of December 2015[16]. The rainfall event on the 25th started at 11am and finished at 11pm. The rainfall event on the 26th started at 2am and finished at 2pm reaching a peak at 8:30am. Comparison of the data from Bramham with rainfall radar data from YWSL shows a good match with the Bramham data also indicating 21mm of rainfall in the same period.

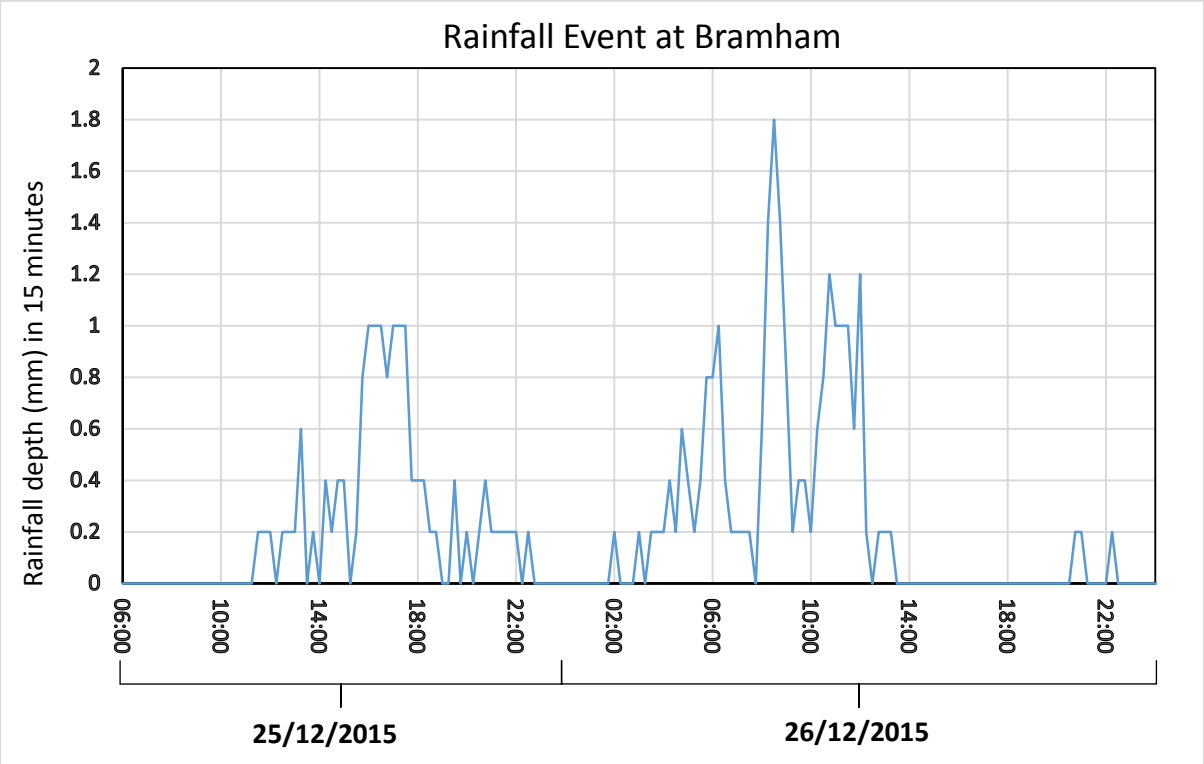


Figure 3.2 Rainfall Data for Bramham on the 25th and 26th of December.

3.2 River Aire Levels

Low flows dominated the late spring and early autumn, with flows increasing above normal in late November. During November near continuous wet weather already falling on saturated ground, ensured river flows increased between “above normal” to “exceptionally high”. Immediately before Christmas day the Yorkshire Rivers were notably “high” or “exceptionally high[14].

Record peak river levels were evident along the west Pennine catchments, with near record peaks tracking northeast over North Yorkshire. The response of the west Yorkshire Rivers levels (Aire & Calder) were driven from the rainfall in the uppermost catchments[14].

[15] Rainfall Radar Data, Yorkshire Water Services Ltd
[16] Hydrometric Data, Environment Agency

The river levels for the River Aire on the upper and middle catchments show a quick sharp reaction, changing to a longer drawn out response in the lower reaches, as shown in Figure 3.3. The two pulses of heavy rainfall were evident within the catchment as water levels rose quickly, with the initial peak being observed in the late evening of Christmas Day in the upper catchment. The water levels then rose quickly again during the morning of Boxing Day[14].

According to EA analysis as the flows progressed downstream, the water levels rose less quickly and sustained peak levels over a longer period due to the effects of washlands filling and emptying in the lower catchment, as shown in Figure 3.3. The peak levels recorded on the river Aire at Beale were 4.13m at 23:45 hrs on 27th December 2015. These are the highest recorded levels for this location[14].

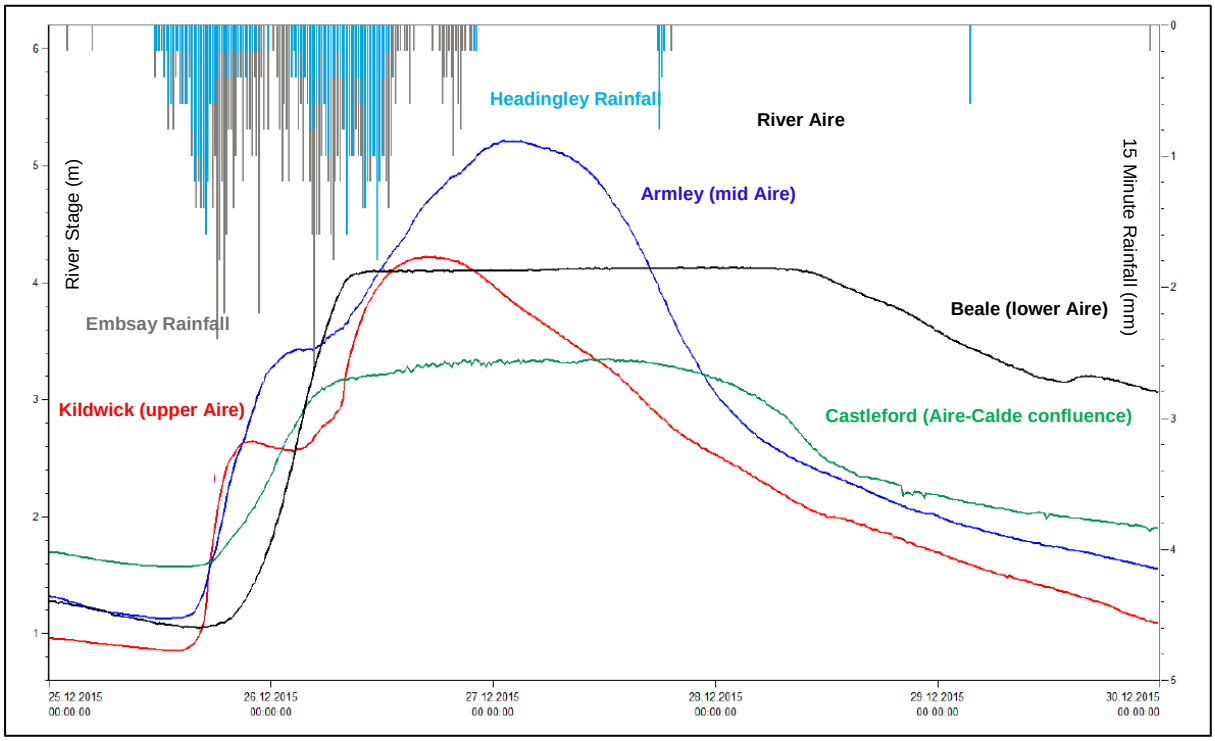
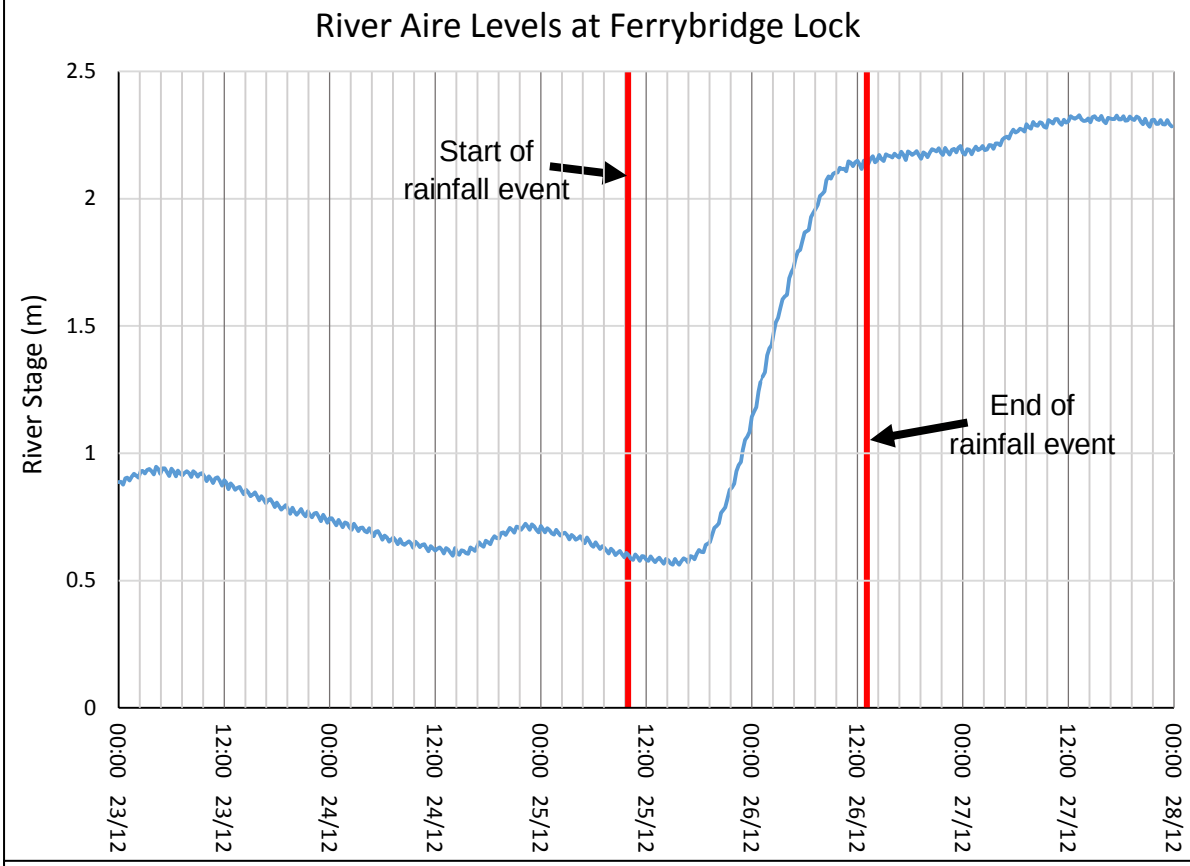


Figure 3.3 River response in the Aire Catchment (Source: EA)

The River Aire level at Brotherton during the flood event was said to be two thirds the way up the earth embankment[13], which has a crest between 10.67m and 11.31m AOD. The River Aire levels for Ferrybridge Lock[16] are shown in Figure 3.4. The River Aire level can be seen to rise sharply during the rainfall events on the 25th and 26th of December. This reflects the arrival of flows from upstream and the rainfall experienced at that time. This also shows river levels at Ferrybridge Lock were approximately 0.5m above normal levels during the afternoon of Christmas Day.



Note:

1. Ferrybridge Lock gauge (Grid Reference: SE4846524462) is located 125m down steam of the A162 River Aire Bridge. River Bed is at 8.5m above sea level.
2. The start and finish of the rainfall event, shown in Figure 3.2, is illustrated by the time the **Red** lines

Figure 3.4 River levels at Ferrybridge Lock

3.3 Description of Events

Flooding of properties along Marsh Croft has occurred 3 times during the 10 years preceding the flood event on Boxing Day 2015[13]. Brotherton was affected by surface water in the rainfall event on the 25th and the 26th of December 2015. This flood water was deeper and more extensive than previous flood events[13]. 14 properties were flooded in this event. The area where dwellings flooded in December 2015 is identified in Figure 3.5.

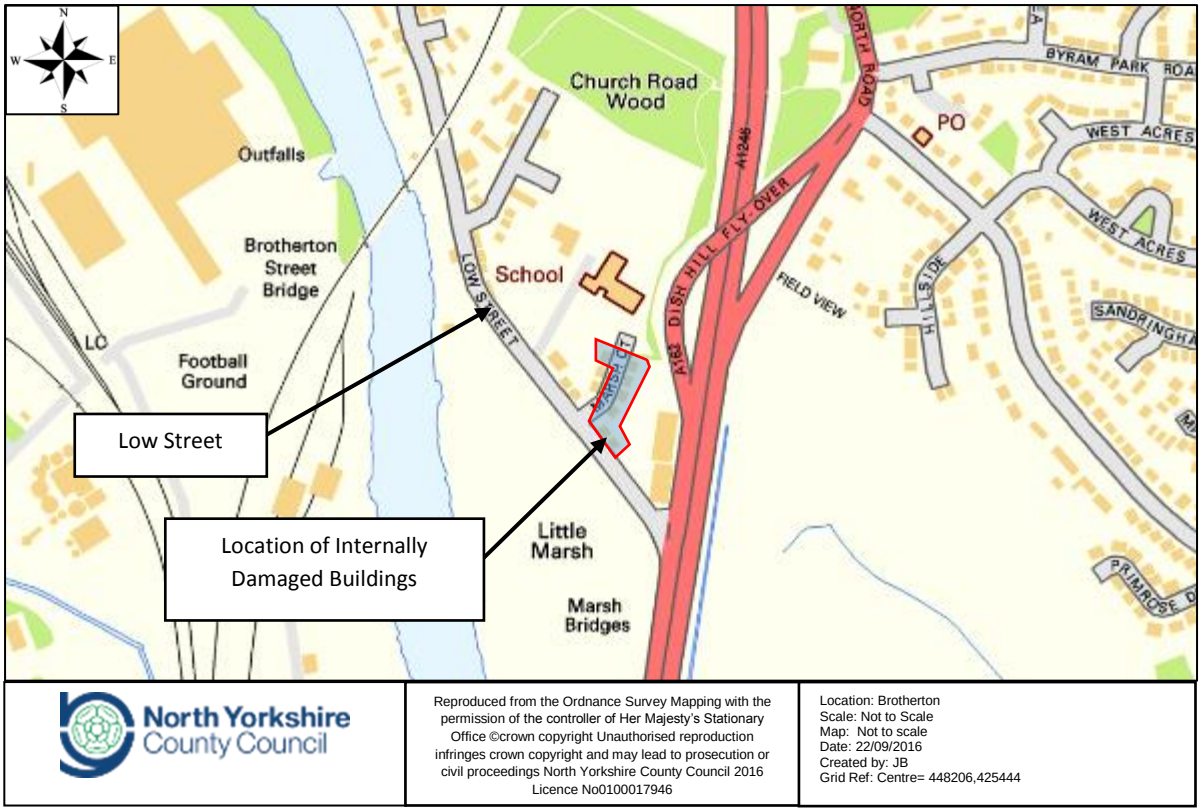


Figure 3.5 Area of internal property damage (Source: NYCC)

As levels rose on the River Aire the river banks were overtopped and Floodplains X and Y became inundated with river water, shown in Figure 3.6. The earth embankment on Floodplain X forms the outer limit of the floodplain and provided effective protection against river flooding for Brotherton. There are no reports that the penstock in the earth embankment was operating either during or after this flood event.

In Floodplain Y the flood water from the River Aire overtopped flood defences and proceeded north eventually submerging the discharge point of the surface water system, from Marsh Croft and the Academy, as shown in Figure 3.6.

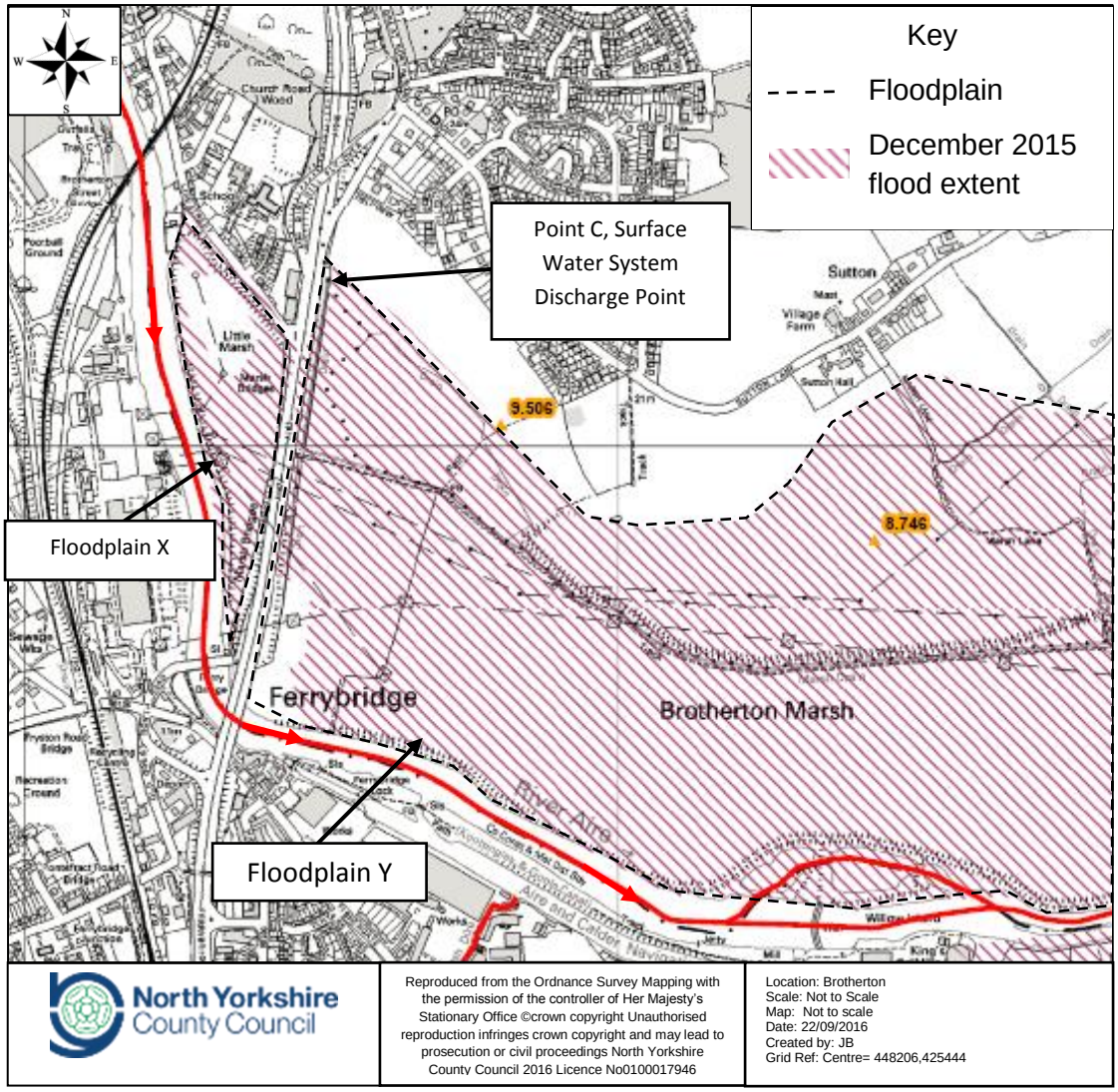


Figure 3.6 Extent of River Aire flooding in Brotherton on the 26th of December 2015 (Source: EA)

In the early hours of the 26th December the second intense pulse of heavy rainfall overwhelmed the drainage systems in Marsh Croft and Low Street. There are three distinct surface water flooding mechanisms:

1. Overwhelmed highway drainage on Marsh Croft (illustrated in Figure 3.7).
2. The inability of the surface water system to discharge (illustrated in Figure 3.8).
3. Highway runoff on Low Street flooding properties (illustrated in Figure 3.9).

The sequence for flooding on Marsh Croft and Low Street is illustrated in Figure 3.7, 3.8 and 3.9, and the ponding on Marsh Croft is shown in Figure 3.10.

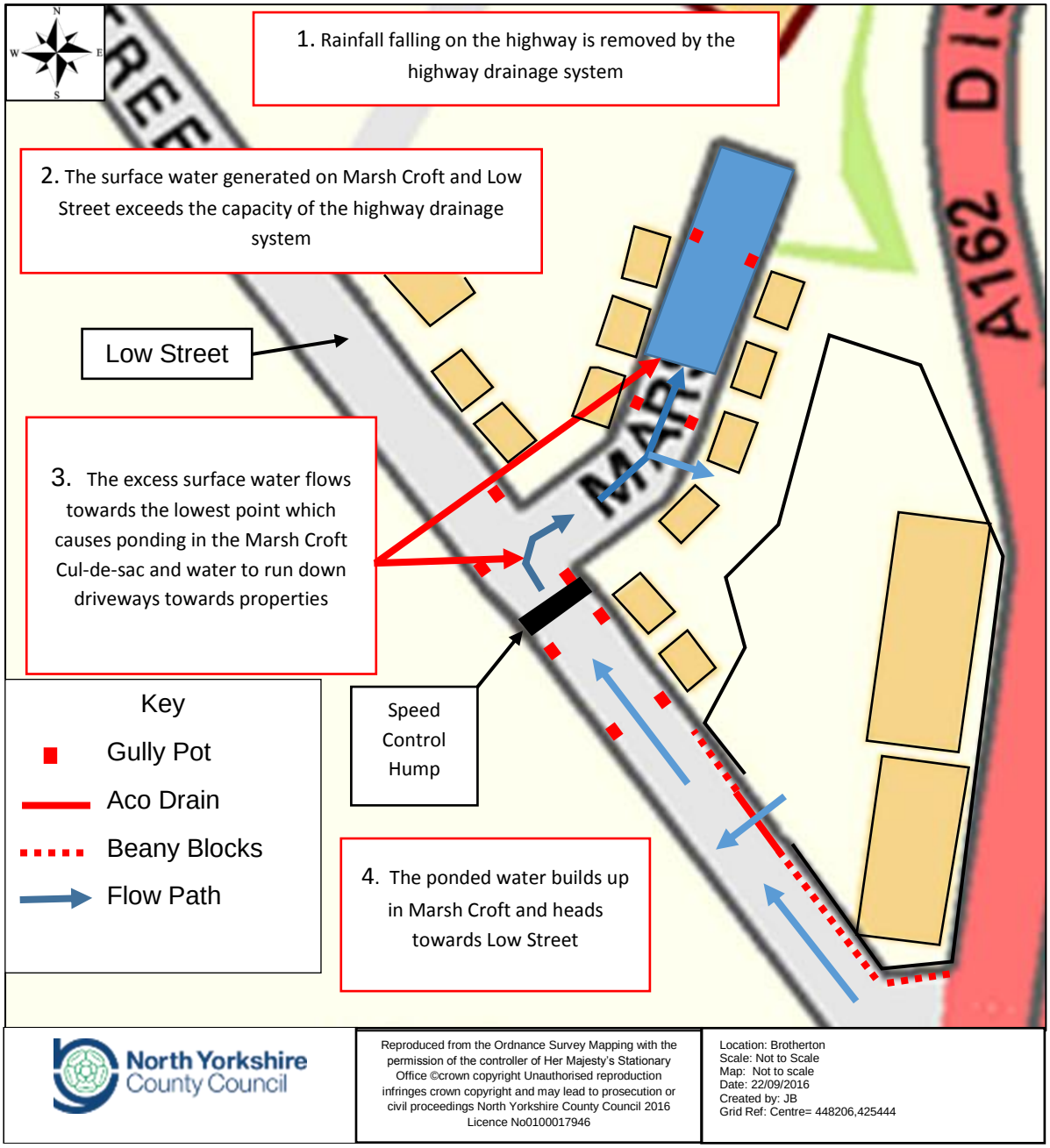


Figure 3.7 Overwhelmed highway drainage Mechanisms of flooding (Source: NYCC)

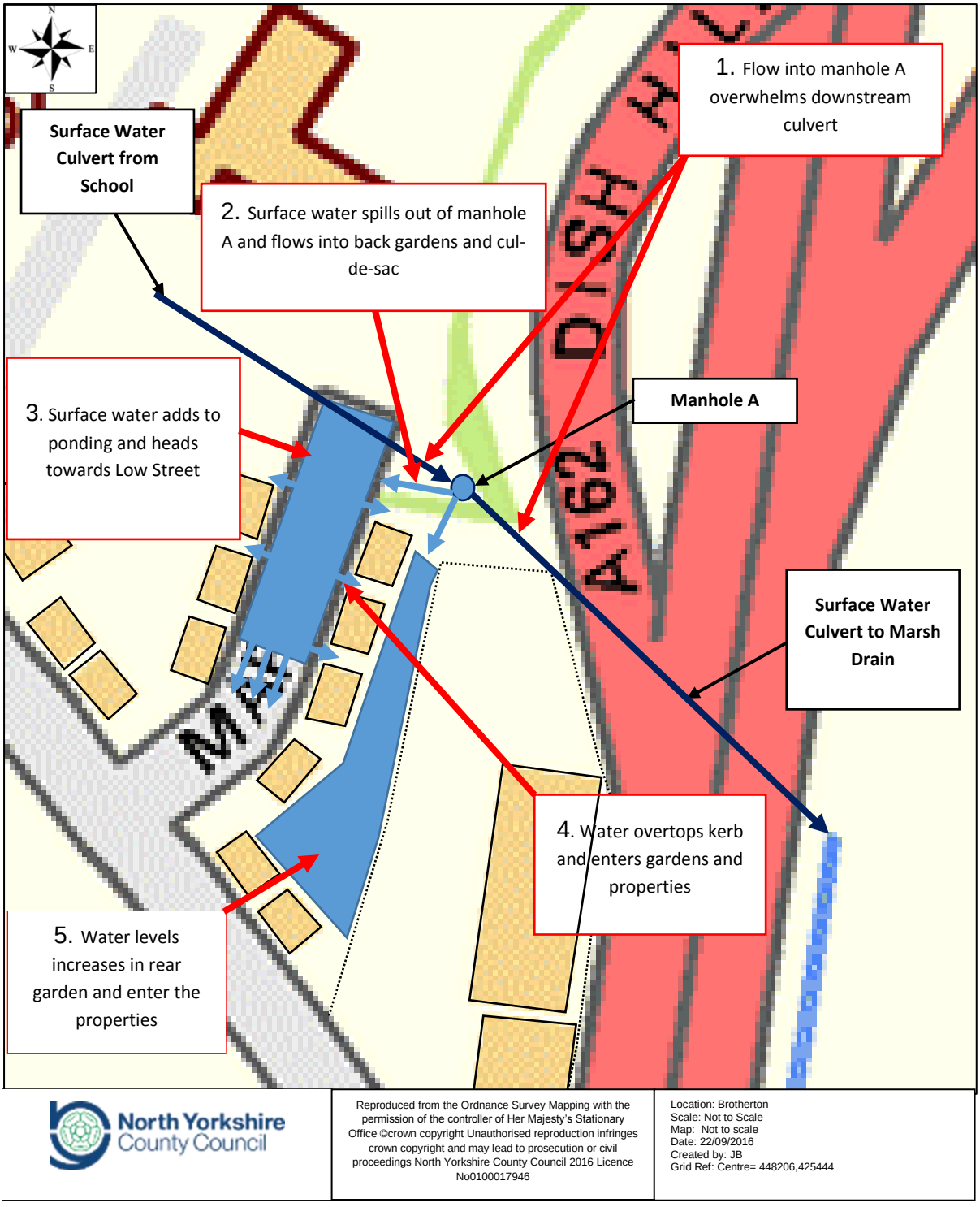


Figure 3.8 Surface water system Mechanisms of flooding (Source: NYCC)

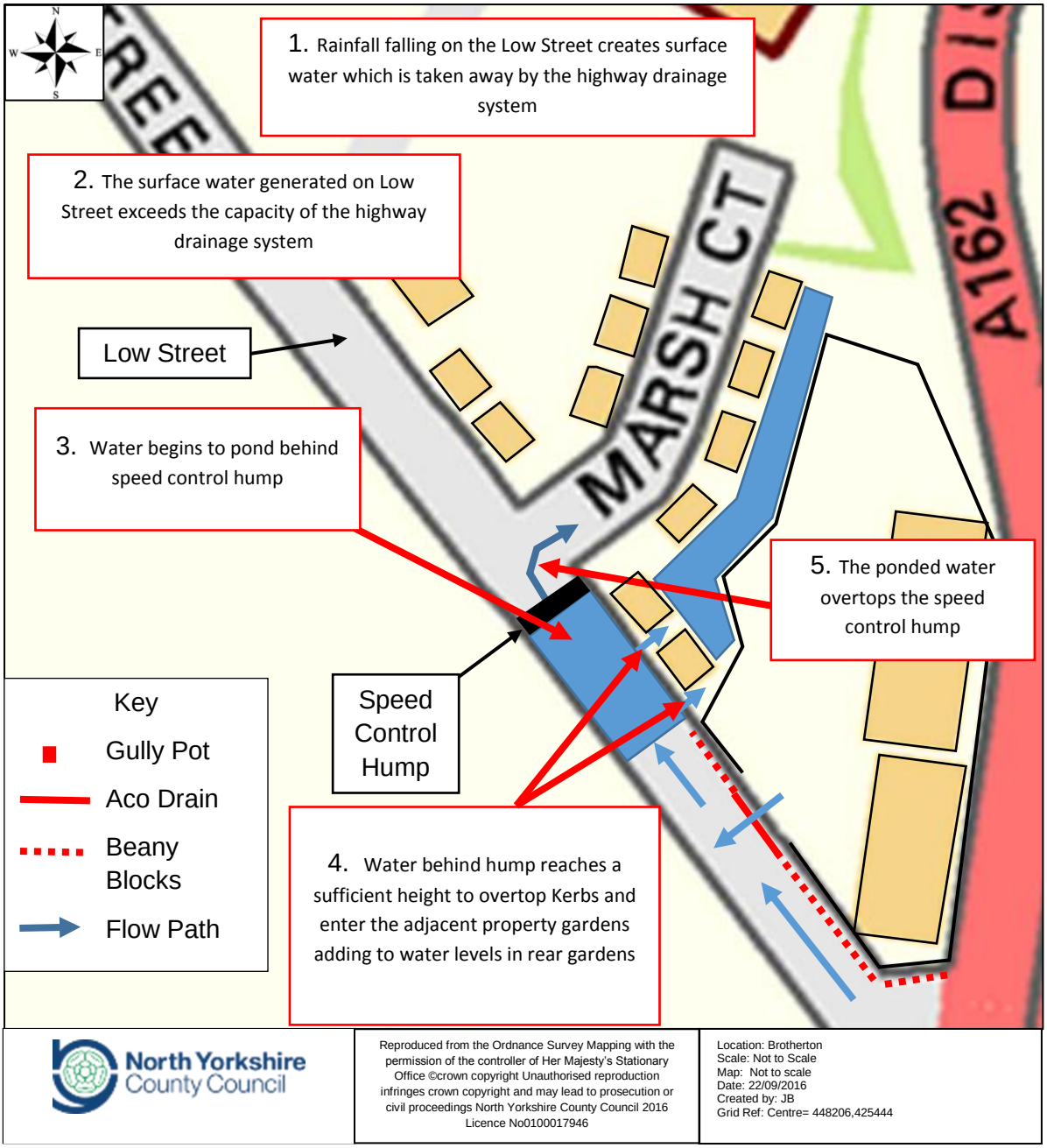


Figure 3.9 Highway runoff on Low Street drainage mechanisms of flooding (Source: NYCC)

3.10 Photograph showing ponding on Marsh Croft

Surface water built up on Marsh Croft as a result of the highway drainage being overwhelmed and unable to discharge to the sewer. The kerbs on Marsh Croft are designed to allow for two way vehicle passage, therefore, are lower than standard road kerbs. In this instance, they were ineffective in containing surface water on the highway and consequently allowed excess surface water to overtop and spill into adjacent land as illustrated in Figure 3.11.

Figure 3.11 Photograph showing flow path over kerb (source: Google Maps)

In addition, the surface water system from the Academy and Marsh Croft properties was unable to discharge fully into Floodplain Y because the culvert outlet was submerged. The excess surface water closed the non-return valve in manhole A, which resulted in surface water discharging from the manhole.

Excess surface water was unable to discharge into Low Street highway drainage which resulted in a build-up of surface water on the highway, exacerbated by speed control humps, as shown in Figure 3.12. This flood water then spilled into adjacent property gardens and Marsh Croft.

Figure 3.12 Photograph showing lack of edge treatment

The ability of the surface water system to discharge into Marsh Drain A was impeded by the vegetation present in the channel, as shown in Figure 3.13, and the silt in the Culvert, as shown in Figure 3.14.

Figure 3.3 Photograph showing silted up culvert under A162

Figure 3.3 Photograph showing vegetation at discharge point of culvert under A162

Flood water on Marsh Croft entered via the air bricks filling subfloor void space[13]. Progressively the flood water depth increased reaching a depth of approximately 400mm inside the properties[17]. These events caused the occupants to be evacuated. The combination of highway runoff from Low Street and Marsh Croft combined with excess surface water from manhole A, flooded the properties along Marsh Croft and Low Street.

It is unknown at this stage if the pumping station at the Academy suffered any damage or operational problems during the flood event. However, it has been reported that there was contamination[13] of the flood waters that could have emanated from the combined or foul sewer systems on Low Street and Marsh Croft.

Residents were evacuated to the Academy which is a designated evacuation centre in accordance with the local emergency plan.

[17] Flooding Photographs

4 Risk Management Roles, Responsibilities and Actions

4.1 RMA Responsibilities

4.1.1 Environment Agency

Under the FWMA the Environment Agency (EA) has a strategic overview role for all sources of flooding as well as an operational role in managing flood risk from Main Rivers, reservoirs and the sea. As part of this role the EA have developed a National Flood and Coastal Erosion Risk Management Strategy for England – 'Understanding the Risks, Empowering Communities, Building Resilience.'

This national strategy outlines the EA's strategic functions as:

- Ensuring that flood risk management plans (FRMPs) are in place and are monitored to assess progress. The plans will set out high-level current and future risk management measures across the catchment.
- Publishing and regularly updating its programme for implementing new risk management schemes and maintaining existing assets.
- Supporting risk management authorities' understanding of local flood risk by commissioning studies and sharing information and data.
- Supporting the development of local plans and ensuring their consistency with strategic plans.
- Managing and supporting Regional Flood and Coastal Committees and allocating funding.

The EA's operational functions include:

- Risk-based management of flooding from main rivers including permissive powers to do works including building flood defences.
- Regulation of works in main rivers through the consenting process.
- Regulation of reservoirs with a capacity exceeding 10,000m3.
- Provision of a flood forecasting and warnings service, working with the Met Office Hazard Warning Service.
- The maintenance and operational management of Main River assets including flood defences.
- Statutory consultee to the development planning process.
- The power to serve notice on any person or body requiring them to carry out necessary works to maintain the flow in Main Rivers.

'Main Rivers' are defined through an agreed map which is updated 2-3 times per year to reflect changes in the designation of a watercourse or in the environment. These Main Rivers tend to be the larger rivers in the country, though some smaller watercourses in sensitive locations are also defined as 'Main Rivers'.

The EA are also category 1 responders regarding flood risk (Civil Contingencies Act 2004). They are required to warn and inform of flood risk.

4.1.2 Water Company

Water companies in England and Wales are named as a Risk Management Authority under the Flood and Water Management Act 2010 and must have regard to the Local Strategy of the LLFA. They are required to manage risks associated with assets or processes that may cause or be affected by flooding, and must share relevant data with other flood risk authorities.

They also have flood risk management functions under the Water Resources Act (1991). Relevant actions of water companies include: the inspection, maintenance, repair and any works to their drainage assets which may include watercourses, pipes, ditches or other infrastructure such as pumping stations.

The Civil Contingencies Act 2004 (CCA) also designates water and wastewater undertakers as statutory category 2 responders to national disasters and emergencies, placing on them duties to share assured information with other responders in an appropriate manner.

4.1.3 North Yorkshire County Council (NYCC)

NYCC, as LLFA, has flood risk management functions which include (but are not limited to);

- Provision of a Local Flood Risk Management Strategy (LFRMS).
- Designation and maintenance of a register of structures or features that have a significant effect on flood risk.
- Consenting and enforcement works on Ordinary Watercourses.
- Responding to statutory consultations on drainage proposals in planning applications.
- Undertaking Section 19 investigations.

NYCC also has responsibilities as a Highways Authority and as an Emergency Responder (under the Land Drainage Act 1991 and the S19 Flood Investigation Report Civil Contingencies Act 2004 respectively) which may relate to flooding.

Highway Authorities are responsible for providing and managing highway drainage which may include provision of roadside drains and ditches, and must ensure that road projects do not increase flood risk.

The Highways Authority has a duty under the Highways Act 1980 to maintain highways that are maintainable at public expense. This includes a duty to maintain existing highways drainage. Highway drainage systems are designed to take highway surface water. Highway drainage systems are not designed as “storm drains”, and do not have the capacity for the level of rainfall from an extreme flash flood. The Highway Authority has powers to improve drainage systems but no duty to do so.

Roadside gullies are subject to routine maintenance in accordance with the NYCC Highway Asset Management Plan. The frequency of cleaning is dependent on an

evidence based categorisation of risk, determined by factors relating to the consequence of failure and a range of other operational factors.

4.1.4 District or Borough Council

District and Borough Councils are named as Risk Management Authorities within the Flood and Water Management Act 2010, and are required to comply with the LLFA Local Strategy. Through the planning processes, they control development in their area, ensuring that flood risks are effectively managed.

In addition, in relation to the Civil Contingency Act (2004), the District Council:

- Is a Category 1 Responder. On a priority basis, they will provide sandbags to residents and businesses where property is at risk of flooding.
- Supports the Emergency Services on request by providing Incident Liaison Officers.
- Provide emergency accommodation – i.e. set up rest centre as required and other welfare provision.
- Assist with arranging transport or evacuating areas.
- Participate in vulnerable people searches.
- Assist with co-ordination of recovery.

The NYCC Emergency Planning Unit provides support to the District Council.

4.1.5 Internal Drainage Board

Internal Drainage Boards (IDBs) are local operating authorities established in areas of special drainage need (typically low lying areas) in England and Wales. Their primary role is to manage water levels and reduce the risk from flooding within their designated drainage districts. Their work includes;

- Maintenance and improvement works on watercourses and related infrastructure.
- Consenting works on Ordinary Watercourses.
- Responding to consultations on drainage proposals in planning applications.
- Exercising permissive powers to undertake works where appropriate.

In managing water levels IDBs also have an important role in reducing flood risk in areas beyond their administrative boundary.

4.1.6 All Risk Management Authorities

All RMAs under the Flood and Water Management Act (2010) have a responsibility to cooperate and coordinate with regards to their flood risk management functions, including raising awareness of flood risk and the sharing of information.

4.1.6 Riparian Owners

Landowners whose land is adjacent to a watercourse are known as ‘riparian owners’.

A landowner can be an individual e.g. home owner or farmer, private business or an organisation e.g. the district council as park owner, on school grounds the county council as property owner.

A watercourse is defined as every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and feature through which water flows, but which does not form part of a Main River.

Riparian owners have legal duties, rights and responsibilities under common law and the Land Drainage Act 1991 for watercourses passing through or adjoining their land. These responsibilities are to:

- Pass on the flow of water without obstruction, pollution or diversion affecting the rights of others.
- Accept flood flows through their land, even if these are caused by inadequate capacity downstream.
- Maintain the banks and bed of the watercourse and keep structures maintained.
- Keep the bed and banks free from any artificial obstructions that may affect the flow of water including clearing litter, heavy siltation or excessive vegetation.

Guidance on the rights and responsibilities of riparian ownership are outlined in the Environment Agency publication ‘Living on the edge’, available at

http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx

5.0 Actions and Responses to December 2015 Floods

5.1 North Yorkshire County Council as Lead Local Flood Authority

The Flood Risk Management (FRM) Team provides an overarching view on flood risk management activities within the county. The FRM team has supported the residents at Marsh Croft and Low Street, in conjunction with Selby District Council, in obtaining Flood Resilience Grants.

Local area officers have coordinated with other Risk Management Authorities to investigate the flood event that occurred in Brotherton.

5.2 North Yorkshire County Council as Highway Authority

The Highway Authority carries out regular maintenance of the highway drainage system. NYCC Highway Authority has undertaken maintenance activities such as jetting and repair of gully pots post flood event, along Low Street and Marsh Croft.

Following publication of this report, NYCC in its capacity as Highway Authority will consider options to reduce the amount of water flowing towards the housing by introducing potential improvements to the highway.

5.3 Highways England as Highway Authority

The Highway Authority carries out regular maintenance of the highway drainage system.

5.4 The Environment Agency

The EA will continue with its programme of inspections and maintenance of flood defences around Brotherton.

There are no proposals to undertake any works to the floodplain flood defences around Brotherton.

There is a flood warning zone identified for Brotherton however Marsh Croft is not included within this area.

5.5 Yorkshire Water Services Ltd

YWSL has undertaken the following post flood event activities:

YWSL undertook de-silting activities to remove flood debris from the sewer system.

YWSL undertook asset inspections of the sewer system to identify any defects.

No other defects have been reported on the sewer system and to the Brotherton Depot Pumping Station.

5.6 Selby District Council

Selby District Council (SDC) has undertaken the following post flood event activities:

- SDC officers were in attendance during the flood event, coordinating and assisting residents in evacuating properties along Marsh Croft and Low Street.
- SDC has supported and coordinated repairs to damaged properties such as removing damaged furniture, fixtures and fittings and replacing electrical wiring.
- SDC secured flood resilience grants for Marsh Croft to install property level protection measures such as filling the sub-floor areas with concrete, install flood proof air bricks, flood doors and raising electrical boxes above flood level.

Repair works to restore the properties are still underway. The cost of repairs to the properties on Marsh Croft was £262,068.

5.7 Selby Area IDB

Selby IDB maintains Marsh Drain in Floodplain Y (as illustrated in Figure 5.1). Records indicate that scheduled maintenance has continued to be delivered.

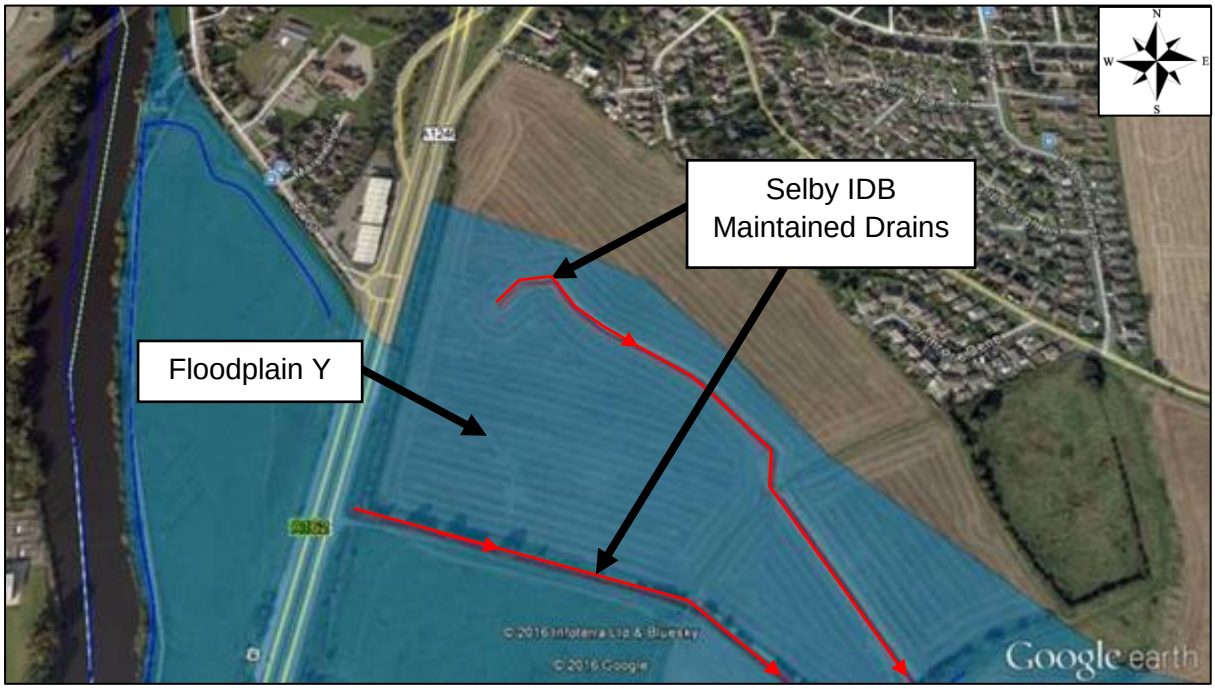


Figure 5.1 Selby Area Internal Drainage Board proximity to Brotherton (Source: Shire Group IDBs)

6.0 Conclusions

The flooding which affected 14 properties on Marsh Croft, Brotherton on 26th December 2015 was a result of rainfall exceeding the capacity of local drainage arrangements. Despite proximity to the river Aire the flooding did not come from the river, but the inundation of the floodplain downstream of the A162 meant that surface water drains could not discharge as designed.

Marsh Croft has suffered from three significant flood events in recent years and there are significant challenges in preventing flooding from happening again. This is because Marsh Croft is in a dip, where water naturally accumulates, and the houses are mainly below the level of the road meaning that water runs from the road towards the houses.

Given that this report has highlighted the contribution to flooding by water coming onto Marsh Croft from Low Street, it is important that some thought is given to reducing the potential for this to happen. This could involve making alterations to the kerbs and speed hump on Low Street, placing a hump across Marsh Croft at the junction with Low Street and raising the kerbs or the thresholds of the drives on Marsh Croft to prevent water flowing towards the houses.

The location and local topography around Marsh Street mean that flooding will remain a possibility, no matter how well the local drainage performs. With this in mind property level

protection has a vital role to play, and it is noted that Selby DC have taken advantage of the resilience grant scheme. Property level resilience requires maintenance and can always be improved it would be advantageous were this to happen.

The flooding experienced on Boxing Day 2015 would not have been prevented had all existing drainage been in perfect working order, as the system could not discharge into the inundated flood plain. Nevertheless, it is important that existing drainage arrangements are properly maintained, to reduce as far as possible the extent and duration of flooding and reduce risk from more minor events in the future. This report has highlighted maintenance issues on the receiving water body for surface water, and the on the culvert under the A162 leading to it.

7.0 Recommendations

To reduce the risk of future flooding in the location, the following recommendations are made:

- NYCC in its capacity as Highway Authority to consider options to reduce the amount of water flowing towards the housing by introducing potential improvements to the highway.

- SDC as landlord to investigate the potential to raise threshold of drives, to prevent water flowing towards affected properties from Marsh Croft.

- NYCC in its capacity as Lead Local Flood Authority to progress work with the riparian (private) owner and IDB to bring drainage ditch (Marsh drain “A”) into maintenance.

- YWSL to clear silt from the culvert under the A162, and from the chamber leading to it.

- SDC to maintain existing property level protection measures, and seek to implement additional measures where possible.

North Yorkshire County Council as Lead Local Flood Authority will continue to work with all relevant risk management authorities to address the issues highlighted in this report.