

Appendix C

Flood Investigation Report

Section 19, Flood & Water Management Act (2010)

Upper Calder Valley – 6-9th July & 25th August 2012

Flooding Incidents

Control Sheet

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Executive Summary

On the 6-9th July & 25th August, storm cells brought heavy rainfall to the Pennine region. In Calderdale, the upper valley area was badly affected by flooding from a variety of sources. The communities and infrastructure worst affected by the flooding were principally those located in the Upper Calder Valley immediately adjacent to the River Calder, Hebden Water and the Rochdale Canal. The towns and villages impacted the most were Hebden Bridge, Mytholmroyd, and Eastwood, Todmorden. The key infrastructure affected was the Rochdale Canal, Network Rail, Burnley Road (A646) and Nutclough Reservoir.

In response to the flood event this Section 19 - flood investigation report has been completed by Calderdale Metropolitan Borough Council (CMBC) as the Lead Local Flood Authority (LLFA), under the duties set out in Section 19 of the Flood & Water Management Act (2010). It was deemed necessary to complete an investigation as properties and infrastructure were badly affected throughout the borough.

A large data collection exercise was undertaken between key stakeholders, CMBC and third parties to understand the flood mechanisms, extent of flooding and an assessment of the damage created.

Approximately 300 properties have been directly affected by the flood event. The report has identified the key areas that were mainly affected and the mechanisms that caused the flooding in those areas.

The main flood mechanisms have been identified as;

- Nutclough Reservoir unable to control excess rainfall,
- Subcatchment watercourses overtopping due to excess rainfall,
- Rainfall and surface water exceeded the design capacity (1 in 30 year event) of the sewers and highway drainage, although the sewerage infrastructure suffered little damage,
- Excess surface water entering the Rochdale Canal resulting in the canal overtopping,
- Hillside runoff caused significant damage to drainage and highway infrastructure, properties and footpaths.

A full hydrological report has been completed by the Environment Agency (EA) for this storm event. The report should be reviewed in line with the findings of this report.

This report has identified the relevant risk management authorities and their roles and responsibilities for flooding, according to the Flood & Water Management Act (2010). This report summarises the activities risk management authorities have undertaken according to these roles and responsibilities.

All flood risk management authorities, strategic partners and community groups have undertaken activities to restore the Upper Calder Valley to a working order. All short-term mitigation measures have been implemented. Capital works or investigations have been identified and are subject to resource and availability of funding. These are likely to continue through 2013 and beyond.

This report shows the significant contribution each risk management authority, volunteer groups, community groups and local businesses have made during and post-flood event. It is hoped that all parties continue to build on these relationships for a speedy recovery.

In response to the series of summer storms 2012 Flood Steering Groups have been set up to understand and manage the residual flood risk within the Upper Calder catchment. The Steering Groups consist of risk management authorities and third parties.

The Rochdale Canal and the sewer network have played a pivotal role in the flood events. The EA, in collaboration with risk management authorities, is developing a hydraulic model to better understand flood risk within the catchment. The results of the modelling are expected in the summer of 2013.

Acknowledgements

The Council would like to thank Yorkshire Water Services Ltd, the Environment Agency, Network Rail, Canal & River Trust and the National Flood Forum for their assistance in this investigation.

The Council would like to thank members of the Calderdale community, businesses and community groups for their on-going assistance and support in the aftermath of the flooding during the summer 2012.

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1 Introduction

1.1 Background

An investigation into the flood events on the 6-9th July and 25th August 2012 is required as approximately 300 properties were affected by the flooding in the Calderdale area. The main affected areas in the July event were Mytholmroyd and Hebden Bridge. The main affected areas in the August event were Blackshaw Head and Eastwood. There was significant disruption and damage to properties and key infrastructure including highway, drainage infrastructure and a reservoir.

Calderdale Metropolitan Borough Council (CMBC) as the Lead Local Flood Authority (LLFA) has a responsibility to record and report flood incidents in accordance with Section 19 of the Flood and Water Management (2010) Act:

- (1) On becoming aware of a flood in its area, a LLFA must, to the extent that it considers it necessary or appropriate, investigate -
 - (a) Which risk management authorities have relevant flood risk management functions, and
 - (b) Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.
- (2) Where an authority carries out an investigation under subsection (1) it Must –
 - (a) Publish the results of its investigation, and
 - (b) Notify any relevant risk management authorities.

This report summarises the extent, flood mechanism and impact of the flooding in Mytholmroyd and Hebden Bridge. This report outlines the basic responsibilities of the risk management authorities involved, outlines their response to the flood event and identifies any potential future actions.

1.2 Flooding Location

The communities and infrastructure worst affected by the flooding were principally those located in Mytholmroyd, Hebden Bridge, Blackshaw Head and Eastwood immediately adjacent to the River Calder and the Rochdale Canal (see Figure 1).

The key infrastructure affected was the Rochdale Canal, Network Rail, Burnley Road (A646) and Nutclough Reservoir.

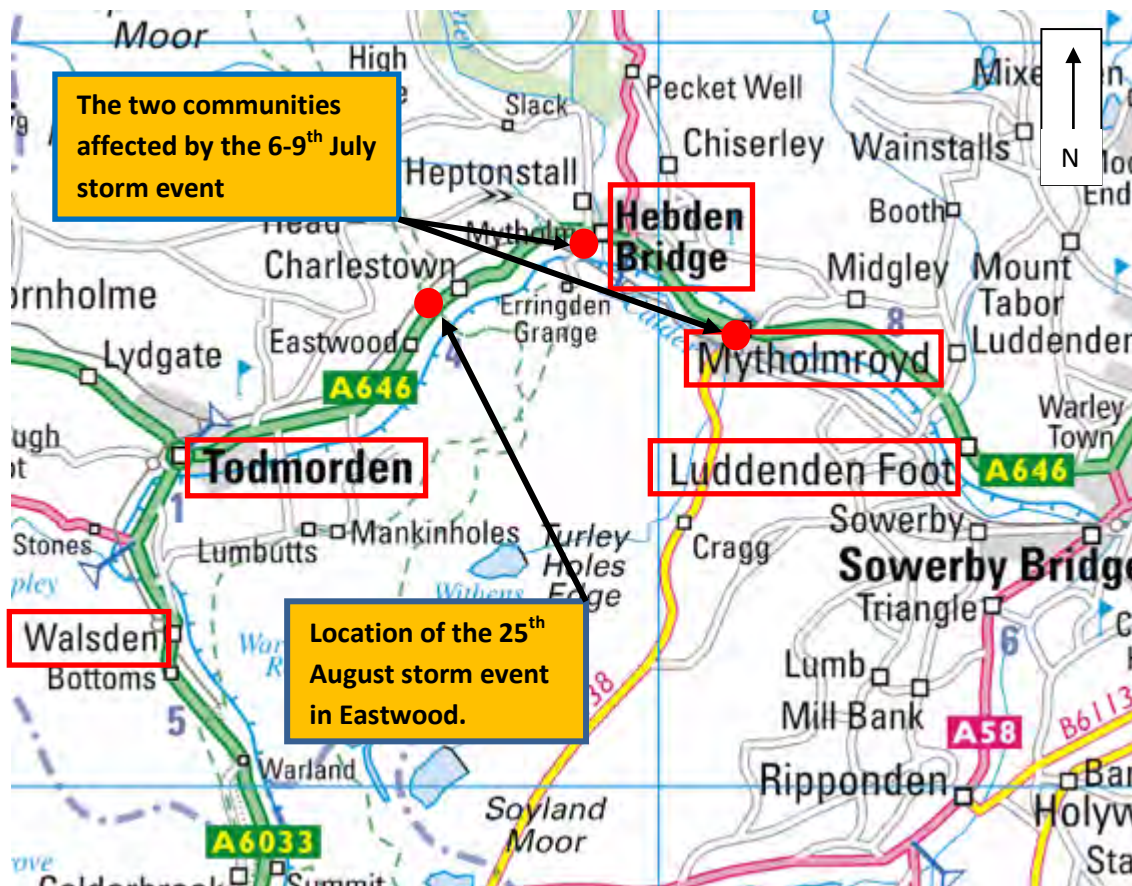


Figure 1 – Location of the communities affected by July & August flooding (Source: streetmap.co.uk)

1.3 History of Flooding

Calderdale has a long history of flooding from a variety of sources including surface water flooding (pluvial), river (fluvial) or a combination of these. Significant fluvial and pluvial flooding has occurred in the recent past particularly 2000, 2006, 2007, 2009 and 2011. Due to the nature of the topography in the Upper Calder and Walsden Valleys, surface water collects quickly in the valley bottom because of steep valley sides and rapid runoff from thinly vegetated and impermeable surfaces. The two main areas affected by flooding in this event have been affected by similar flooding in previous events and most recently in June 2012. What distinguishes this flood event from the historic flooding is the flood mechanism which is discussed in Section 3.

The majority of the historical pluvial and fluvial flooding has occurred in the winter and has been the result of a period of prolonged heavy rainfall. However, more frequent annual surface water and fluvial flooding has occurred in the summer months as a result of short duration, high intensity storm events. The extent of the flooding in this event is within the areas

indicated on the Environment Agency (EA) Flood Maps for Surface Water and fluvial flooding.

2 Flooding Incident

2.1 Flood Warnings and Alerts

A number of flood warning communications were received by CMBC and the local community prior to the 6-9th July flood event. The key communications are summarised below:

- **5th July 10:30hrs** – The Met Office (Flood Forecasting Centre) issued a Flood Guidance Statement (FGS) indicating the river and surface water flood risk is Medium (significant disruption) for eastern, central and northern England on Friday and northern England on Saturday. There is potential to increase the flood risk for Friday / Saturday.
- **6th July 09:00hrs** – The Met Office (Flood Forecasting Centre) issued a Flood Guidance Statement (FGS) indicating a severe disruption due to river and surface water impacts for the 6th & 7th July. Heavy and persistent rain expected in parts of central and northern England. There will be a HIGH risk of surface water flooding in the South Pennines and north east Midlands. Calderdale region was on a RED warning.
- **6th July 12:00hrs** – The Met Office (Flood Forecasting Centre) issued a Flood Guidance Statement (FGS) indicating there was still a RED warning indicating significant disruption due to river and surface water impacts.
- **6th July 15:00hrs** – The Met Office (Flood Forecasting Centre) issued a Flood Guidance Statement (FGS) indicating there was no change and a RED warning remained in place for the Yorkshire region.
- **7th July 09:00hrs** – The Met Office (Flood Forecasting Centre) issued a Flood Guidance Statement (FGS) indicating that the persistent and heavy rain has cleared from the Midlands and South Pennines however a MEDIUM risk of river flooding remains. Isolated, heavy showers are likely across the region bringing a LOW risk of surface water flooding.

For the remainder of the weekend into Monday the Met Office (Flood Forecasting Centre) issued Flood Guidance Statement (FGS) indicating that there would be only occasional, heavy showers forecast for the next few days.

Flood sirens in the Upper Calder did not sound as the trigger levels were not reached in the watercourses.

For the 25th August flood event there were no flood warnings issued. The Met Office issued a FGS indicating that there would be heavy, localised showers.

EA flood warnings are available on the Calderdale Website, please use the following link;

<http://www.calderdale.gov.uk/advice/emergencies/flooding/index.html>.

2.2 Risk Management Authorities Immediate Response

A summary of the activities risk management authorities undertook during and immediately after the 6-9th July and 25th August Flood Events is given below:-

2.2.1 6-9th July Flood Event

Calderdale Metropolitan Borough Council

CMBC implemented relevant emergency plans during and after the flood event. On the advice of the Flood Forecasting Centre the decision was taken to open the Council control room in Halifax Town Hall on the morning of Friday 6th July. Representatives from all emergency services, Stakeholders and CMBC teams were present to coordinate a proactive response to the rainfall. Additional Council resources were retained throughout the weekend to support the post clean up operation.

Drainage contractors were deployed across the borough during and immediately after the peak of the flood event to assist in the clean up operation. 24 hours following the flood event Council Services were dealing with an exceptionally high volume of flooding issues ranging from collapsed culverts to internal flooding to gully defects. Drainage gangs worked to unblock drainage infrastructure across the borough.

Sandbags were deployed in line with Council policy at properties in the centre of Mytholmroyd and Hebden Bridge throughout the day. The majority of those were deployed in Hebden Bridge. In many locations sandbags were already in place due to the flood risk posed in the 22nd June flood event.

The Customer First teams acted as a point of contact for people after the floods. Offices in Todmorden and Hebden Bridge were open for extended hours and provided a weekend service. Customer First organised many activities including disposal of flood damaged items, logging flooding problems affecting customers and referral to specialist agencies for re-housing.

CMBC operatives worked over the weekend to sweep and clear debris/discarded household items from the affected areas. Throughout the working week members of the Upper Valley team, Countryside and Countryside volunteers assisted in the clean up operation.

CMBC Officers from the Environmental Health and Housing team dealt with and supported a wide range of activities including; sourcing and distributing cleaning materials, database and co ordination support, advice to the public (individuals and businesses), distribution of de humidifiers, electrical checks on

donated goods, management of donated goods, procurement and distribution of sandbags.

Neighbourhood Team members were on the ground immediately helping wherever they could. Their role developed into one of volunteer support, access to supplies and support and general 'fixer' for issues that emerged. Community Wardens from across the borough were based in the Upper Valley and provided support to individuals.

Flood wardens were on the ground providing advice and support and took an active part in the operational recovery group.

Calderdale teams provided care and assistance to those people who were particularly vulnerable through old age or disability. Council Officer's arranged and co-ordinated activities for those affected by the floods.

Faith groups and voluntary and community groups were active in the response and continue to be during the on-going recovery phase, and many businesses also supported the voluntary effort providing food, shelter and equipment/vehicles.

Vulnerable Care Homes and Schools were alerted in the affected areas. Rest Centres were placed on standby in the event that the flooding intensified. Care homes that were affected include Hazelroyd Nursing Home, Waterside Lodge and Cloughside. A GP practice, Valley Road Medical Centre in Hebden Bridge was affected by the flooding.

The Police closed Burnley Road between Mytholmroyd and Todmorden. Police also closed New Road. The Police, EA and Council engineers were in attendance in the affected areas. CMBC highway contractors were checking and cleaning drainage systems and strategically placing sandbags in areas known to be vulnerable.

Train and bus services were severely disrupted in the area. School pupils were kept in schools until transport routes were able to re-open and parents able to collect their children safely.

Network Rail

During the flood event, track engineers were on site investigating flooding reports and alleviating flooding on the track where possible. Several sections of the Trans-Pennine route were badly affected. Structural inspections and flood monitoring were required on the 6th & 9th July. Flood waters at Bridge 96, Walsden overtopped and flooded the track. There were also signalling problems on the line. Standing water was reported at Walsden station. Track engineers worked around the clock to restore the service in these locations.

All rail services between Hebden Bridge and Rochdale were cancelled due to flooding. Alternative services were arranged for passengers to continue their journey during the weekend.

Yorkshire Water

Yorkshire Water operational staff was on flood alert following the weather warnings in the week prior to the 6th July. YW engineers implemented appropriate measures in preparation for the heavy rainfall. YW contractors worked to remove silt / debris from sewer systems and maintain sewer capacity.

Environment Agency

The main river network was unaffected in the July flood event. The EA provided support and resources to help coordinate the emergency response and recovery plan during and after the flood event. The EA provided immediate financial and resource support to other risk management authorities.

Note: Canal & Rivers Trust is not identified as a risk management authority under the Flood & Water Management Act (2010) but it is a significant stakeholder and an essential contributor to the multi-agency response. The canal was affected during the flood event and therefore their response during the event has been summarised below;

Canal & River Trust (CRT) – formerly British Waterways

Prior to the 6th-9th July flood event all canal networks in the North of England were on high alert. Call out teams was occupied with managing the flooding between Mytholmroyd and Todmorden. Prior to the flood event CRT engineers implemented appropriate measures in preparation for the forecast heavy rainfall.

During the flood event the CRT emergency contact centre received a high volume of calls from across the network over the weekend. Engineers were then distributed to a number of locations across the canal network.

There were several overtopping incidents reported at the following locations;

- At the overflow weir at Stoodley (upstream of Lock 14) the river was back flowing up the weir apron and into the canal flooding the towpath.
- The volume of flow between Lock 16 & 17 exceeded capacity and overflowed onto towpath and onto weir apron downstream of lock 17.
- The pound upstream of the overflow weir at Kiln Hurst overtopped. This was as a result of large sandbags placed in the weir Apron, which

resulted in a limited discharge. Excess flow overtopped the weir and onto the adjacent road. The EA placed these sandbags to protect weir pumps.

- Overtopping occurred at the Marina onto New Road adjacent to Lock 9. Excessive rainfall and overland surface water flow entering the pounds between locks 8 and 9 (From Burnley road) and Locks 9 and 10 exceeded their capacity. This resulted in the towpath flooding and a Primary School being flooded adjacent Lock 9. It is reported that the Council placed sandbags along Shelf Lane and Horsehold Road, which diverted surface water flows into the canal upstream of lock 9.

There was significant erosion to the towpaths along the Rochdale Canal. This exacerbated the damage sustained to the canal during the June 22nd flood event.

There were no significant flooding incidents reported from the canal in Mytholmroyd. However, It has been reported that excess surface water from the canal spilled onto the J&I Nursery school playing fields in Mytholmroyd.

2.2.2 25th August Flood Event

Drainage contractors were deployed across the borough during and immediately after the peak of the rainfall event to assist in alleviating surface water ponding.

Jumble Hole Clough came out of channel at a constriction close to its confluence with the River Calder. It is not clear whether the constriction was the cause or whether the flows were heavy enough to cause flooding regardless of it. The fire service and CMBC attended properties at Sandbed Villas, Wood Villas in Eastwood and properties in Blackshaw Head. The fire service and CMBC drainage contractors removed large volumes of debris material from the highway and cleaned the drainage system. Emergency assistance was given to those properties that were flooded.

2.3 Data Collected

A data collection exercise was carried out after the flood event from the following partners:-

- The Environment Agency,
- CMBC,
- Emergency Services
- Network Rail,
- Canal & River Trust,
- Yorkshire Water Services,
- The Met Office Flood Forecasting Centre.

The data provided includes:

- Flood warning and guidance information,
- Hydrometric data – including rainfall depths, river flows and levels,
- Reports from officers and operatives of what happened during the flood event,
- Reports logged at the customer contact centre,
- Photographs and video footage – including footage from the internet,
- Surveyed flood levels taken from ‘wreck marks’ after the flood event,
- Online news reports,
- Flood extent outlines plotted from observed flood levels and local knowledge.

3 **Areas Affected**

High intensity, localised storms that fell on the 6th & 9th July had the greatest impact in Hebden Bridge and Mytholmroyd. A large number of residential and business properties were flooded from the Rochdale Canal, surface water overwhelming drainage and sewerage systems, a reservoir overflowing and from small watercourses. The impacts of the rainfall are examined in more detail below and illustrated in Appendix A.

3.1 **Hebden Bridge**

High intensity rainfall fell on Hebden Bridge approximately 1pm for about 1.5 hours on the 9th July. Less intense rainfall then fell for the remainder of the day.

High up the catchment north of Hebden Bridge, Keighley Road was acting as a conduit for a significant amount of surface water from adjoining roads intercepting hillside flows. The highway drainage system was totally overwhelmed by the volume of flow, which continued down the valley.

Popples Lane above Nut Clough Reservoir is a track that runs from the edge of the moorland area onto Lane Ends Lane. During the rainfall event the track acted as a conduit for hillside runoff from the moorland area. The track suffered significant erosion and flooded properties in a number of locations. The excess surface water and debris spilled onto Lane Ends Lane, Sandy Gate Lane and Rowland Lane, causing significant carriageway damage and collapse of a culvert.

The housing area at Dodd Naze below Rowland Lane suffered severe flooding, which is located on the same hillside.

3.3.1 **Nutclough Reservoir**

Nutclough Reservoir located north of Hebden bridge town centre was unable to retain the amount of rainfall that fell in the high intensity cloud burst. The flood mechanism is illustrated in Appendix C.

The reservoir spillway and overflow was unable to contain the flood water, which eventually split, part flowing down the adjacent access track (see Figure 2).

The culvert at the lower reservoir adjacent to Keighley Road blocked, filling up the reservoir which then spilled through 2 adjacent properties and into Keighley Road adding to problem in the highway and town centre.



Figure 2 - The access track adjacent to Nutclough Reservoir being eroded by floodwaters from the spillway, which flowed onto the A6033.

The surface water from Nutclough reservoir spilled onto Nutclough Road and onto the A6033 at approximately 2.30pm. The surface water carried a mixture of stone and tree debris, onto the A6033. Depth of water was estimated to be 200-300mm across the carriageway. Properties along the A6033 and Foster Lane at the junction with Nutclough Road required sandbag protection at doorways as flood waters reached threshold level of the properties. Approximately 11 properties and 1 commercial property were affected at the discharge point onto the A6033 (see Figure 3).

The A6033 is extremely steep as it descends into the centre of Hebden Bridge which carried the excess surface water from Keighley Road and Nutclough Reservoir at a significant velocity until it reached Commercial Street and Crown Street. The library was evacuated and closed on Commercial Street along with several properties on adjoining streets.



Figure 3 - Flood waters and debris from a combination of Nutclough Reservoir overflowing and Keighley Road.



Figure 4 - Flood waters from Nutclough Reservoir overflowed a retaining wall behind residential properties, flooding the properties and spilled onto the A6033. Depth of water in photograph is approximately 300-400mm.

The culvert discharging water from Nutclough Reservoir to the Hebden Water, became blocked and flood waters built up against the retaining wall behind

residential properties. At approximately 2.30pm property 4 & 4a Keighley Road was inundated with flood waters, which flowed down the A6033 into the town centre (see Figure 4).

The drainage system, already full to capacity, along the A6033 had insufficient capacity to accommodate the excess flow and subsequently the drainage system, road kerbs and road surface sustained damage.

3.3.2 Burnley Road

A small watercourse adjacent to the junction of the A646 and Station Road, became blocked and spilled onto both these roads. Excess rainfall on this small, flashy catchment had resulted in a significant amount of flow, which mobilised a large volume of debris in the watercourse (see Figure 5). The watercourse feeds into a drainage system, which flows under the A646. The entrance to the culvert became blocked with debris, which resulted in the majority of the flow bypassing the culvert entrance and flowing onto the A646, across Princess Bridge and onto Station Road.



Figure 5 – Watercourse opposite Station Road overtopping flooding Burnley Road and depositing a significant volume of debris on to the highway.



Figure 6 – Police, Amey LG and Calderdale Council cleaning up the debris and repairing the damage after the peak of the rainfall on the 9th July.

A significant amount of debris was transported and deposited onto the highway resulting in the road being closed (see Figure 6). The excess surface water flowed onto the two adjoining roads, onto the playing fields and alongside Mayroyd Cottage. Flood waters also directly entered the canal. Highway drainage systems along the A646 towards Mytholmroyd discharge surface water to the Rochdale Canal. The excess surface water from the small watercourse on A646 in part flowed back into the Rochdale canal putting pressure on the capacity of the adjacent pound.

3.3.3 St Georges Square & New Road

The high intensity rainfall and the overtopping of Nutclough Reservoir caused localised flooding on St Georges Square and New Road. Figure 7 below shows that the drainage system on the corner of St Georges square was unable to cope with the heavy downpour.

Surface water and debris from Nutclough Reservoir started to enter the square at approximately 3pm exacerbating the flooding in this location. The two separate sources of surface water flooded St Georges Square and adjoining roads flooding property and businesses.



Figure 7 - Picture taken from Camera 84 at the corner of St Georges Square, Hebden Bridge.

3.3.4 New Road

High intensity rainfall overwhelmed drainage systems along New Road resulting in the build up of surface water on the highway. The Rochdale Canal adjacent to the Hebden Bridge Visitor and Canal Centre and Marina overtopped the towpath and flowed onto New Road. A significant volume of flow spilled onto the highway contributing to the flooding in this location. New Road was flooded to a depth of approximately 600-700mm in places. Properties and businesses along New Road were flooded and subsequently closed (See Figure 8).



Figure 8 - Extent of flooding on New Road

3.3.5 Market Street

The south hillside above Market Street is prone to discharging huge flows of surface water onto Palace House Road and Horsehold Road. During the July flood event this resulted in flooding of properties at Hebble End before flowing into Market Street depositing large quantities of silt and debris (see Figure 9).

Surface water building up on Market Street flooded properties and businesses. Flood water on the street is estimated to be between 400-500mm in depth in places.

Public Rights of Way and tracks intersecting the hillside above Palace House Road concentrated hillside runoff and debris onto Shelf Road. Several properties along Palace House Road and Shelf Road suffered property flooding.

The flood waters from New Road spilled into the Rochdale Canal upstream of Hebble End Bridge. The significant volume of surface water entering the canal overwhelmed the capacity of the two downstream pounds. The overflow weir downstream of Hebble End Bridge overtopped and flooded the adjacent road and Primary School off New Road.



Figure 9 - Extent of flooding on Market Street.

3.2 Mytholmroyd

On the 6th July flood waters spilled out of the White Lee Clough culvert entrances at the top of the catchment onto Midgley Road. The flood waters flowed down Midgley Road and ponded at White Lee Bridge. Three properties were affected at the White Lee Bridge. In addition to the overland flow a manhole on the White Lee Clough culvert disintegrated immediately above the White Lee Clough Bridge, which exacerbated the flooding in this location (see Figure 10).

On the 9th July high intensity rainfall affected the main town at approximately 12.30pm. Surface water was ponding on Burnley Road at approximately 3.30pm through the middle of Mytholmroyd slowing traffic. However this did not reach above kerb height. By 5pm the rain had ceased and Burnley Road was free of surface water.

The culvert at the top of White Lee Clough on Midgley Road blocked again and spilled surface water down Midgley Road and ponded at White Lee Bridge.



Figure 10 - Shows the aftermath of the flooding at White Lee Bridge.

Surface water affected the highway at Nest Estate, Thrush Hill Road and Caldene Avenue. Significant damage was caused to the highway on Scout Road from hillside runoff and surface water drainage systems becoming overwhelmed.

3.3 Cragg Vale

Flooding occurred on the highway at several points along Cragg Vale on the 6th & 9th July. Several watercourses flowing from moorland areas intersect the highway and pass under the highway through culverts. Many of these systems became blocked or were overwhelmed with debris and flood waters, which spilled onto the highway (see Figure 11).



Figure 11 - A typical example of a watercourse in Cragg Vale bypassing the drainage system flooding the highway.

Minor localised flooding occurred in other areas throughout the borough, however these were not as significant as Hebden bridge or Mytholmroyd. At Todmorden and Mytholmroyd traffic and bus services were diverted to avoid Hebden Bridge as this road remained closed.

3.4 Blackshaw Head & Eastwood

On 25th August a high intensity, localised storm event centred over the Hippins Clough and Jumble Hole Clough catchments. Heavy rainfall fell onto Blackshaw Head areas and overwhelmed highway and land drainage systems on Badger Lane, Staups Lane, Davey Lane and The Long Causeway. Excess flood waters flooded several properties in this area. Highway, tracks and Rights of Ways were severely damaged. A map illustrating the flood extents can be viewed in Appendix A.

Staups Moor Goit overtopped and spilled onto adjacent land. Reports indicate that landowner interference exacerbated the flooding along the Goit. The excess flood waters spilled into Hippins Clough and spilled onto highway and flooded nearby farms.

A land slip on Jumble Hole Clough mobilised a significant amount of debris into the watercourse. The intense rainfall was greater than the capacity of the watercourse, which resulted in flood waters spilling onto Jumble Hole Road. The flood waters also damaged a retaining wall upstream of the railway underpass. The flood waters and debris flowed down Jumble Hole Road and

flooded Halifax Road. A significant volume of water, mud and debris was deposited on Halifax Road, in the gardens of adjacent properties and into a commercial property on Jumble Hole Road (see Figure 12).



Figure 12 – The rack mark on the property door shows the height the flood waters reached at the peak of the rainfall event.

A significant amount of debris was deposited in the River Calder. A large section of the drainage system on Halifax Road was blocked with debris, which was removed immediately after the event. Properties at Sandbed Villas and Wood Villas suffered internal flooding, some to depths of over 1.2m to the lower ground floor occupied areas.

4 **Rainfall Analysis**

The 6-9th July storm was a significant rainfall event that resulted in extensive surface water flooding but insignificant river levels. The localised and intense storm was part of a series of storms that across Lincolnshire to the Mersey. The heavy, short duration, high intensity storms that occurred throughout June and early July meant that the rain storm on the 6th July fell on an already saturated catchment.

Rainfall totals for locations throughout the catchment were high but not exceptional. The only unusual rainfall intensity recorded was at Gorpley rain gauge which recorded 23.8mm of rain. This equates to a nine year return period. At Gorple short duration, high intensity rainfall was recorded early on the 6th July followed by a less intense but longer duration rainfall in the evening. On the 9th & 10th July a similar high intensity rainfall event was also recorded. In contrast rain gauges at Walshaw Dean, Gorple, Halifax and Ringstone recorded less significant rainfall totals. Gorple rain gauge, closest to Hebden Bridge, recorded a peak total of 4.2mm. A correlated radar estimate of the peak rainfall intensity over Hebden Bridge was 43mm in an hour and 70.4mm over a twelve hour period. This equates to a return period in the region of 75 years.

In the remainder of the catchment the rainfall intensities were significantly lower. In Mytholmroyd the peak rainfall intensity was 22.5mm in one hour. This equates to a return period of 10 years. At Sowerby Bridge the peak rainfall intensity was 9.9mm in one hour.

In Todmorden radar estimates of rainfall were considerably lower than at Hebden Bridge. However intense rainfall was recorded in the Midgelden area. Approximately 1500GMT on the 6th July a peak rainfall intensity of 20mm was reported in 15mins and 36mm for the remainder of the hour.

The radar illustrates the highly localised nature of the storms between the 6th & 7th July. The storm over Hebden Bridge and Todmorden was so localised that the rain gauges in these areas were unable to accurately record the high intensity rainfall.

A more detailed assessment of rainfall intensities for the 6-9th July flood event can be found in the Hebden Bridge Flood – 9th July Hydrological Report produced by the Environment Agency¹.

No rainfall analysis has been undertaken for the 25th August event rainfall.

¹ January 2013 Hebden Bridge Flood – 9th July 2012 Hydrological Report. Yorkshire & North East Hydrology, Environment Agency.

4.1 River Levels and Flows

River levels in watercourses throughout the borough were high however no main river flooding was recorded during the rainfall event. The high river levels seen during June and early July were as a result of longer duration rainfall events with high intensity bursts. In this event the localised nature of the storm and the short intensity resulted in a limited response from the main watercourses in the catchment.

The pattern of heavy, short duration, high intensity showers throughout June and July meant that the catchment was saturated prior to the storm event. This resulted in quick runoff and a rapid rise in river levels.

River level data from the EA shows that although the intensity of the rainfall in Hebden Bridge was higher than that of the June 22nd rainfall event, the duration was short, it was not widespread throughout the catchment, therefore volumes were smaller and the response of the River Calder was much lower.

A more detailed assessment of rainfall intensities for the 6-9th July flood event can be found in the Hebden Bridge Flood – 9th July Hydrological Report produced by the Environment Agency¹.

During the 25th August, river levels in Jumble Hole Clough and Hoppins Clough exceeded the capacity of the channel in some locations. This could be due to blockages at culverts and an increase in the stream bed due to the landslide material and movement of bed material generally. The River Calder river level was reported to be low during the rainfall event.

5 Roles, Responsibilities and Post Flood Event Activities

Local flood risk in Calderdale is managed by the Risk Management Authorities (RMAs) as defined in the Flood and Water Management Act (2010). Each RMA has specific responsibilities in relation to flood risk management and should co-ordinate their activities with each other. The RMAs have been contacted as part of the ongoing flood investigation and will contact relevant stakeholders and third parties depending on the identified source of the flooding.

The Risk Management Authorities are:-

- Calderdale Metropolitan Borough Council
- The Environment Agency
- Yorkshire Water

The roles and responsibilities of the RMA's are identified and discussed below. Canal & River Trust are a Navigation Authority, Network Rail are a significant transport authority and they have both been included in this section, as they have an important role in helping to manage flood risk and are both members of the multi-agency project group formed to respond to these events.

5.1 Lead Local Flood Authority

The Council is the LLFA and has flood risk management goals and permissive powers to manage flood risk within its boundary from ordinary watercourses, groundwater and surface water run-off. It is the landowner's responsibility to maintain and manage water related assets on their land with the exception of public sewers and private sewers for which the householder will have partial responsibility.

CMBC are also responsible for development of the Local Flood Risk Management Strategy, Asset Plans and Investigations.

According to the roles and responsibilities identified above CMBC has undertaken the following activities in response to the flood events:-

In the 6-9th July flood event CMBC received and responded to approximately 300 cases from members of the community, stakeholders, landowners and internal departments. A breakdown of the cases is summarised below;

- 162 calls relating to blocked gullies and assistance with post flood recovery clean up.
- 83 cases required detailed investigations to identify flooding problem and identify solution.

- 39 cases of infrastructure damage and problems relating to watercourses.
- 16 cases related to damage walls and slips

Calls received from the customer contact centre were filtered as high, medium and low priority. High priority cases, such as internal property flooding, have been addressed first. Major works / detailed studies have been identified and will be dealt with when funding and resource has been identified.

The Council's Highways Term Maintenance Contractor, Amey LG, began deploying sandbags to the pre-determined vulnerable locations shown in the Highways Service Emergency Manual. Due to the 22nd June flood event sandbags were already deployed in many locations across the borough.

During and after the flood event Amey LG and other local drainage contractors undertook gully cleaning and repairs to the highway drainage system where possible.



Figure 12 - Drainage contractor unblocking the highway drains in Hebden Bridge.

There was severe damage to several culverts across the borough. These were assessed and prioritised. The unnamed watercourse opposite Station Road, Hebden Bridge was cleared. The culvert entrance at White Lee Clough and at Nutclough reservoir has been cleaned of debris. The White Lee Clough culvert collapse was repaired. All other works to culverts identified for repair in the aftermath of the flooding has been completed.

The White Lee Clough culvert has contributed to a number of flooding incidents during summer 2012 and other historic events. The problems are

recognised and CMBC has been actively pursuing solutions which will help to resolve the flooding problems to Midgley Road and Burnley Road.

Nutclough Reservoir is under review and awaiting further repairs to the reservoir spillway and culverts. A more detailed study of the flood mechanisms and reservoir structure in this location is being discussed

Planning and Highways undertook condition assessments of the carriageways and bridges as necessary throughout the borough and prioritised any emergency works accordingly. Several minor roads suffered carriageway damage and minor works was undertaken in these locations. Immediate works include replacement of a wall and carriageway on New Road and Shelf Road. The New Road and Market Street drainage system is currently under review.

Several Public Rights of Way were damaged, small contractors, landowners, volunteers and CMBC undertook repairs to reinstate or reduce further deterioration of the footpaths. This work is ongoing and will take several months to complete.

5.2 Water and Sewage Company

Yorkshire Water Services is the statutory sewerage undertaker for Calderdale with a duty to effectively drain sewers in accordance with the Water Industry Act (1991) and the Flood and Water Management Act (2010).

Up to the time of finalising this report the Council has been unable to obtain details of problems caused or activities undertaken on the sewer network from Yorkshire Water in response to the 6-9th July and 25th August flood event.

5.3 Environment Agency

The EA is responsible for managing flood risk from Main Rivers, the sea and reservoirs including coastal erosion risk management. The EA has permissive powers to maintain Main Rivers, overview of all forms of flooding and development of a National Flood Risk Strategy.

The EA will encourage third party asset owners to maintain their property in an appropriate condition and take enforcement action where it is appropriate. The EA may undertake maintenance or repair of third party assets only where it can be considered justified in the interests of public safety and there is no alternative option.

According to the roles and responsibilities identified above the EA has undertaken activities post flood event in response to the flood event. However, as there was very little fluvial flooding the EA has provided mainly a support role for stakeholders, landowners and third parties to help speed up the post flood recovery.

5.4 Riparian Owners

Riparian landowners are those who own land adjoining a watercourse. They have rights and responsibilities as detailed within the EA document 'Living on the Edge'. A riparian owner's basic responsibility is to maintain the free flow of the contents of the watercourse. This could involve all or any of the following:-

- Maintain the bed and banks of the watercourse, and also the trees and shrubs growing on the banks;
- Clear any debris, even if it did not originate from their land. This debris maybe natural or man-made;
- 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 1991 Land Drainage Act and other legislation;
- Riparian landowners must understand and act upon these responsibilities.

5.3.1 Network Rail

Network rail are the riparian landowner for a number of third party assets on ordinary watercourses and land drainage systems. According to the roles and responsibilities identified above Network Rail has undertaken the following activities, which are discussed below.

During the flood event, track engineers were on site investigating flooding reports and alleviating flooding on the track where possible. Track engineers walked over the network post-flood event to survey defects / damage along the line. Maintenance and bridge inspections have been undertaken on culverts and bridges along the network.

The stretch of rail track between Summit Tunnel and Walsden Station has been badly affected by the flooding during the summer in 2012. Network rail and their consultants are currently undertaking a drainage and flooding assessment of the area to examine the flooding mechanism (s) and to identify solutions.

5.3.2 Canal & River Trust

Canal & River Trust (CRT) is the riparian landowner and a Navigation Authority for a number of third party assets on ordinary watercourses and land drainage systems. In addition, they are responsible for maintenance and management of the Rochdale Canal. According to the roles and responsibilities identified above CRT has undertaken the following activities:

Following the flood event throughout the summer the Canal & River Trust engineers identified 32 defects requiring attention. CRT's term contractor is working on addressing all the damage caused and it is estimated that it will take a number of weeks/months to complete the works for the most affected areas.

The principal tasks that the CRT contractors have been undertaking are:

- Repairs to collapsed masonry walls along the canal - these are generally cosmetic and provide protection to the clay liner from boat wash and impacts;
- Culvert blockages will be removed - there are 17 control structures between Littleborough and Sowerby Bridge. The culvert at Beaumont Clough (above Lock 12) and Birks Clough were particular problem areas. CRT have spent £50k removing the debris from the culvert under the canal on Birks Clough;
- Sections of eroded tow path are being reinstated - the canal network between Lock 19 to 11 received the most damage to the towpath as it is un-surfaced. It is likely that the recent erosion will not be addressed in the short term;
- Debris accumulation in the canal will be removed - a lot of debris entering the canal and in places there is limited draft for the boats; However, the canal remains navigable at present.

The CRT, in conjunction with the EA and CMBC, is reviewing the operational performance of the canal, locks, intakes and by-washes across the network.

6 Additional Activities

6.1 Flood Steering Groups

The EA are updating the River Calder river model, which will be used to replicate the June 22nd flood event and identify any significant changes to the river channel. In addition, the EA are working with CRT to better understand the interaction between the Rochdale Canal and Main River.

6.2 National Flood Forum

The National Flood Forum caravan visited communities throughout the borough to provide advice and collate information on the flooding that occurred on the 22nd June and 9th July. Representatives from key stakeholders attended the caravan to discuss the flooding with the affected communities. Information and advice on flooding can be found at <http://www.floodforum.org.uk/>.

6.3 Community and Business Groups

The Council established the RISE (Recovery Investment for a Stronger Economy) grant scheme, with a total fund of £250,000 available to businesses. So far 147 applications have been received from businesses, and £210,000 has been paid out. Around 90% of businesses have now re-opened.

The Council provided business rates relief for a period of 3 months to around 30 businesses.

Three public drop-in events were organised by the Council, in partnership with the Community Foundation for Calderdale (CFFC), Environment Agency, Yorkshire Water, National Flood Forum and Voluntary Action Calderdale, to provide information on 'who does what' in floods and give advice on how to make homes and business premises more resilient. The events were held at Todmorden on 13th October, Hebden Bridge on 29th October and Mytholmroyd on 3rd November, over 250 people attended. Events were publicised in the press and via a mail-shot to 6,500 properties.

7 **Conclusions**

Note: Due to the complex nature of the flood event it is difficult to confirm responsibilities until the hydraulic modelling being undertaken by the Environment Agency in liaison with Yorkshire Water, the Council and Canal & River Trust. The modelling is programmed for completion summer 2013 and the report will then be updated.

1. The flooding on the 6-9th July significantly affected the key communities of the Hebden Bridge and Mytholmroyd. Historic flooding and flood risk mapping show that these communities are at significant risk of flooding from a variety of sources.
2. The flood event on the 6-9th July was as a result of two distinct high intensity, short duration storm cell centred on Hebden Bridge. The rainfall on the 9th July fell on a saturated catchment and caused the most damage to property and infrastructure.
3. The rainfall event on the 25th August as a result of a smaller high intensity, short duration storm cell centred on Eastwood, Todmorden. Significant damage was caused to properties and highway along Halifax Road
4. As a result of the June 25th flood event the borough was already on high alert therefore all parties were able to provide a more proactive response to flood risk.
5. The main flood mechanisms were;
 - Nutclough Reservoir unable to control excess rainfall,
 - Subcatchment watercourses overtopping due to excess rainfall,
 - Rainfall and surface water exceeded the design capacity (1 in 30 year event) of the sewers and highway drainage, although the sewerage infrastructure suffered little damage,
 - Excess surface water entering the Rochdale Canal resulting in the canal overtopping,
 - Hillside runoff caused significant damage to drainage and highway infrastructure, properties and footpaths.
6. The Environment Agency, in collaboration with Yorkshire Water, the Council and Canal & River Trust are developing a model to study the river network and the interaction between the Rochdale Canal, main rivers, sewer and surface water systems. This will improve risk management authorities' current understanding of flood risk in the Upper Calder valley.
7. Risk management authorities and the National Flood Forum have provided flood advice and support, via a series of flooding workshops, in the affected communities.

8. All risk management authorities and other strategic partner organisations and stakeholders have provided useful information to help identify the flood extents, mechanisms and damage caused. Cooperative working should continue to share knowledge and information on actions that are undertaken.
9. A full hydrological report is to be completed by the EA for the 6th – 9th July storm event. The report should be reviewed in line with the findings of this report.
10. The location and number of rain gauges in the River Calder catchment should be reviewed to ensure they are appropriately located and that there is an adequate number to effectively measure rainfall.
11. All risk management authorities and strategic partners are collaborating to identify required investment to return watercourses, property and infrastructure to their condition prior to the flood event and go forward to reduce flood risk generally in the valley. A significant amount of work has been undertaken to restore the towns worst affected. The majority of the immediate post flood recovery has been completed. New works identified will continue into 2013 and beyond depending on secured finance. This will form part of the Environment & Infrastructure Group work in helping to develop the Overall Flood Recovery Plan currently in preparation.
12. It is essential that riparian owners are identified and flood risk assets in the Upper Valley are suitably maintained, to reduce flood risk in future significant rainfall events.
13. Property owners should continue to be made aware of the flood resistance and resilience measures available. The LLFA and EA should provide support and advice to the community on property level protection, where appropriate.

8 References

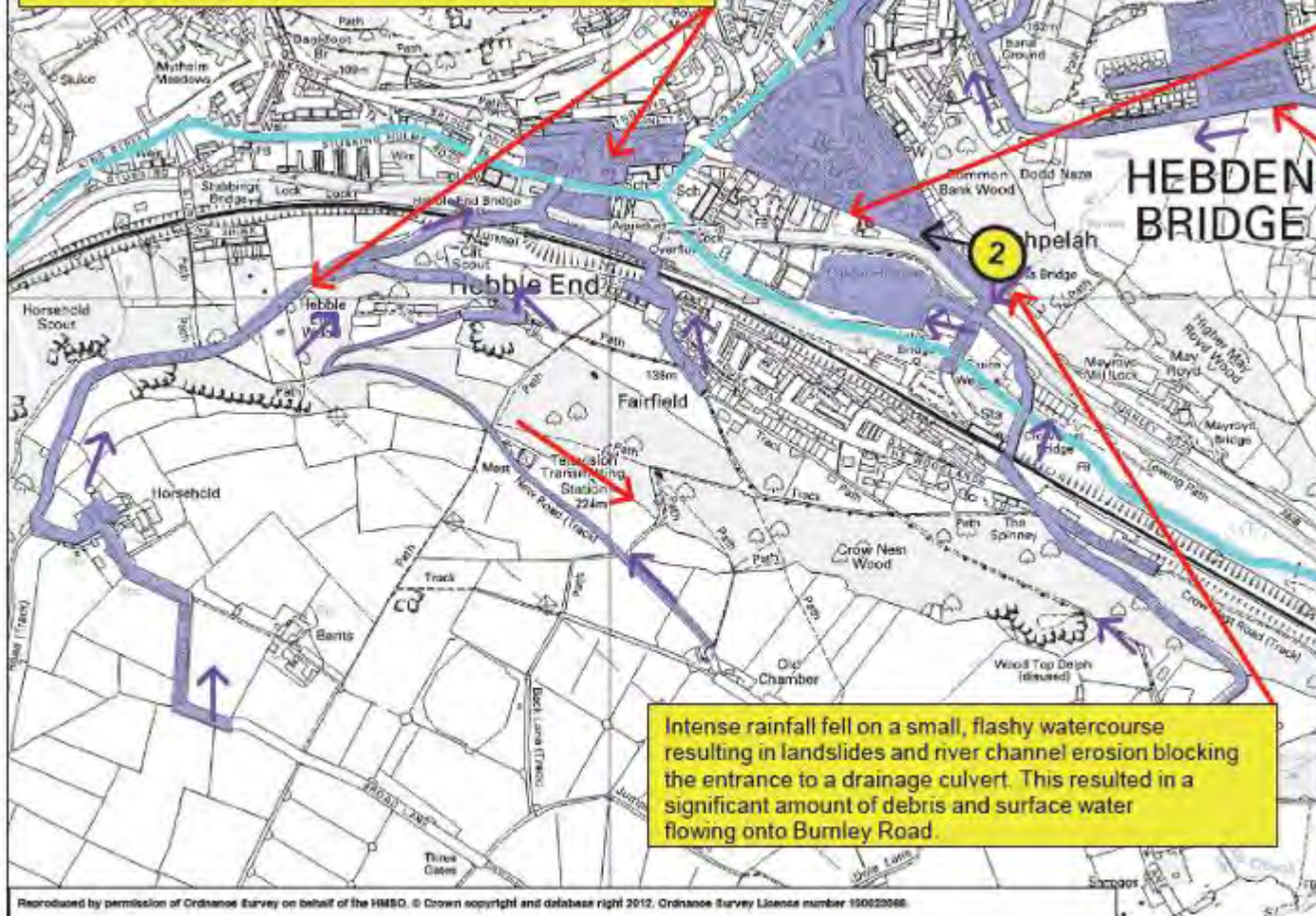
- 1 January 2013, Hebden Bridge Flood – 9th July 2012, Hydrological Report.
Yorkshire & North East hydrology, Environment Agency.

Appendix A: Flood Maps



Photograph 1 - Flood waters from Nutclough Reservoir overflowing onto Keighley Road

Intense rainfall caused excess hillside runoff, which collected on tracks, paths and highway resulting in a significant amount of surface water flooding properties and highway in the town centre. New Road and Shelf Road were greatly affected and Market Street was flooded up to a depth of 500mm (approx) in places. A significant amount of mud and debris blocked drainage systems resulting in surface water building up on Market Street.



Hillside runoff from moorland areas and agricultural land caused severe erosion and flooded properties along Lane Ends Lane and Sandy Gate Lane. Floodwaters continued down the hillside to the town centre.

Nutclough Reservoir was unable to manage the volume of flow from hillside runoff, which resulted in flood waters spilling onto an adjacent access track causing severe erosion. In addition, the culvert adjacent to Nutclough House became blocked and was unable to discharge to Main River. Floodwaters built up and overtopped a boundary wall flooding properties and resulted in a significant amount of surface water onto Keighley Road.

Excess surface water entering the canal resulted in the canal overtopping at the Marina in the centre of Hebden Bridge. This contributed a significant volume of surface water onto New Road.

Hillside runoff flooded properties and highway at Dodd Naze and continued to flow down Wadsworth Lane towards the town centre.

Intense rainfall fell on a small, flashy watercourse resulting in landslides and river channel erosion blocking the entrance to a drainage culvert. This resulted in a significant amount of debris and surface water flowing onto Burnley Road.



Photograph 2 - New Road in Hebden Bridge flooded from a number of sources

Notes:

1. The flood extents have been generated from a number of sources as part of the data collection exercise for the Section 19 Flood Investigation Report.
2. The information provided is the best available information at the time of writing. The collection of flood data will continue after the report has been published.

Legend:

- Flood extents
- Flow Direction
- 1 Photograph location & direction
- River Calder & Hebden Water



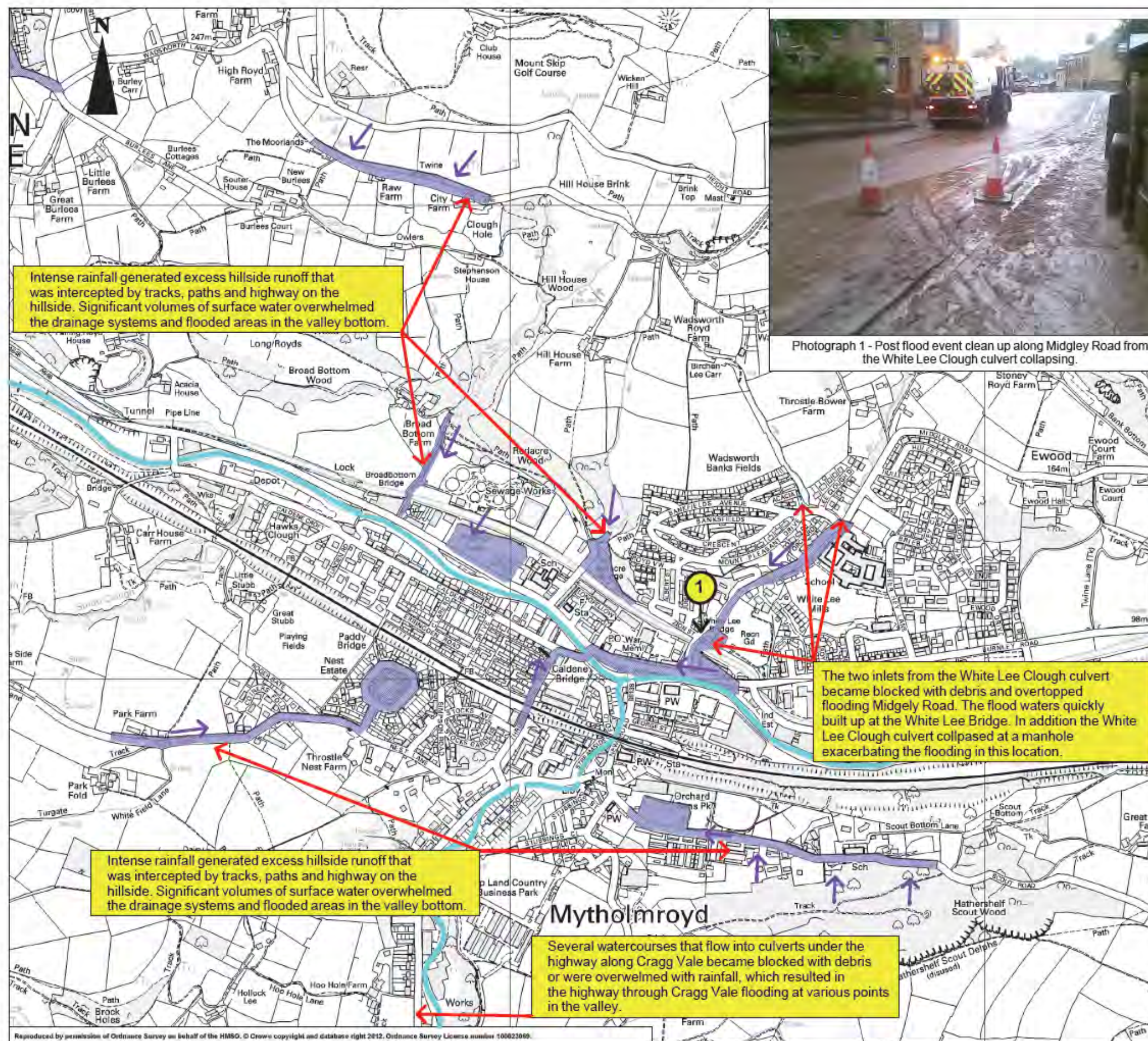
2	28.02.13	Final
1	10.02.13	Draft
REV	DATE	REMARKS



Section 19 - July 9th Flood Investigation Report

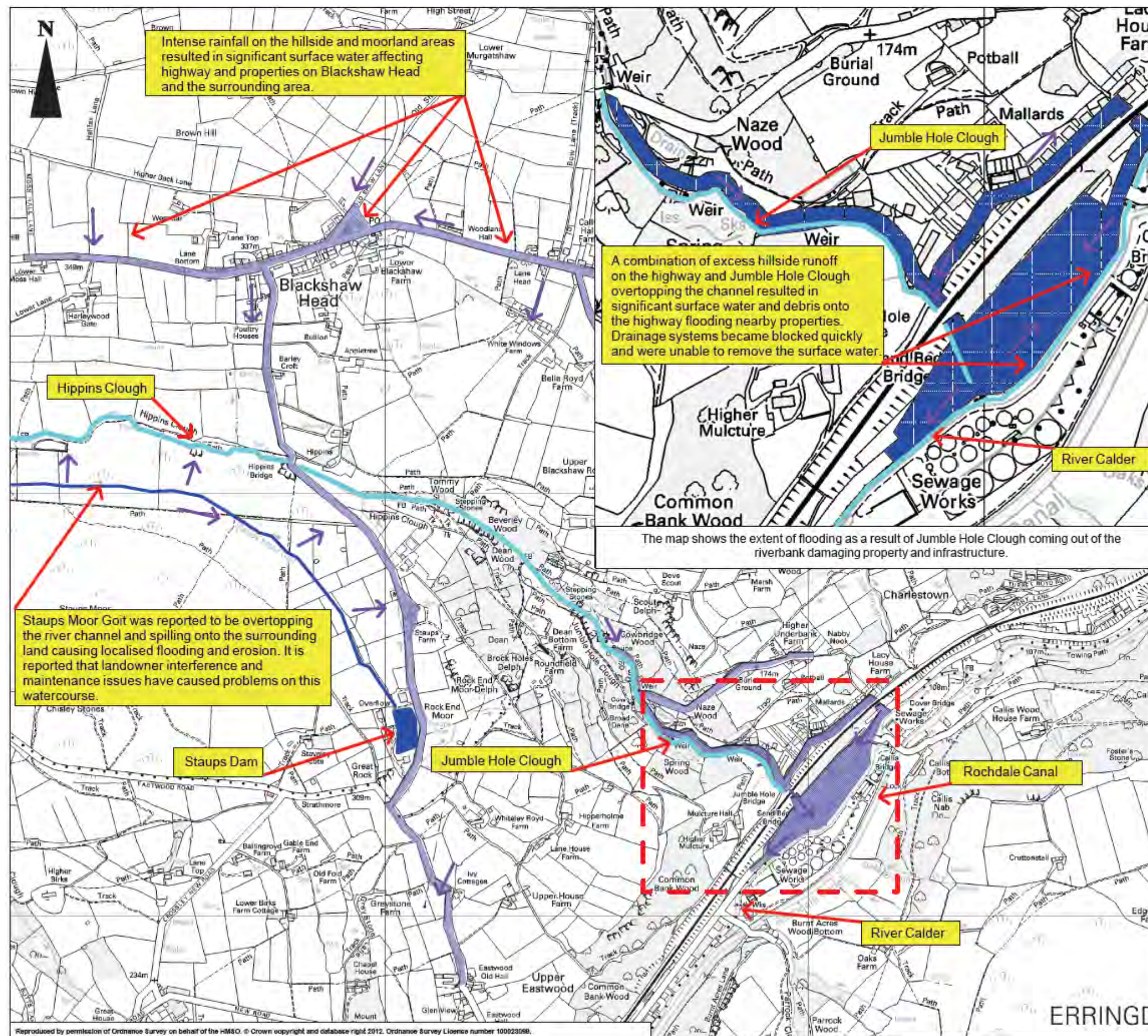
Appendix A1 - Hebden Bridge Flood Extents

Date of Issue: 11.03.13



Notes:

1. The flood extents have been generated from a number of sources as part of the data collection exercise for the Section 19 Flood Investigation Report.
2. The information provided is the best available information at the time of writing. The collection of flood data will continue after the report has been published.



Notes:

1. The flood extents have been generated from a number of sources as part of the data collection exercise for the Section 19 Flood Investigation Report.
2. The information provided is the best available information at the time of writing. The collection of flood data will continue after the report has been published.

Legend:

- Flood extents
- Flow Direction
- Watercourses

2	28.02.13	Final
1	10.02.13	Draft
REV	DATE	REMARKS



Section 19 - August 25th Flood Investigation Report

Appendix A3 - Eastwood Flood Event

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Sustainable Environment Group
Planning and Highways
Huddersfield Road
Elland
HX5 9JR

Telephone: 01422 392929

Fax: 01422 377600

Email: highwaysandengineering@calderdale.gov.uk

