Flood Investigation Report

Report Title:

Aspley Guise
Cranfield
Dunstable
Stotfold

Report Reference: CB/FLO/16/00001

Foreword

Since the report has been finalised it is understood that work to address some of the issues contributing to the flood event has been undertaken by Central Bedfordshire Council, Anglian Water, the Internal Drainage Board and the Local Communities.

As the organisations involved begin to respond to the issues identified throughout the course of the investigation, and due to the timescales of this report, there may be some information or delivery of actions that we have not been able to capture in the written report. This includes inspection, maintenance and improvements to the highway and sewerage network, as highlighted and recommended in this report. Central Bedfordshire Council is also in the process of securing funding through the Regional Flood and Coastal Committee to deliver further investigation in the area of Stotfold.

Central Bedfordshire Council will continue to work with partners and the local community following the publication of this report to monitor the delivery of its recommendations. See Section 8 for full recommendations.

Report status

	Name	Date
Prepared by:	Matt Tandy (RAB)	07/11/2016
Checked by:	Ray Pickering (RAB)	08/11/2016
Approved by:	Peter Keates (CBC)	22/02/2017

This Section 19 Flood Investigation was undertaken by RAB Consultants Ltd. in partnership with Central Bedfordshire Council.

Version Control

Version	Issued to	Date
Draft 1.0	Alys Bishop (CBC)	31/10/2016
Draft 1.1	Key stakeholders	08/11/2016
Draft 1.2	Alys Bishop (CBC)	09/12//2016
Draft 1.3	Alys Bishop (CBC)	22/02/2017

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Abbreviations

BLEVEC	Bedfordshire Local Emergency Volunteers Executive Committee
BLRF	Bedfordshire Local Resilience Forum
CBC	Central Bedfordshire Council
IDB	Internal Drainage Board
LLFA	Lead Local Flood Authority
PRM	Property Resilience Measures
SuDS	Sustainable Drainage Systems
The Act	The Flood and Water Management Act 2010

1 Purpose of the report and how to use it

1.1.1 Central Bedfordshire Council (CBC) as the Lead Local Flood Authority (LLFA) for its area has a responsibility to record and report flood incidents under requirements set out in Section 19 of the Flood and Water Management Act 2010 (the Act).

1.1.2 CBC will investigate flooding and fulfil the requirements of Section 19 of The Act where: there is a risk to life or serious injury; internal flooding of five or more residential or commercial properties in one event; re-occurring internal flooding to less than five properties; and/or flooding impacting on critical services or designated sites. This is In line with the adopted criteria set out in the Local Flood Risk Management Strategy (adopted 2014),

1.1.3 If initiated, a formal investigation will establish the role and response of the Risk Management Authorities within Central Bedfordshire to the flood event (these are the Environment Agency, Highway Authorities, Water and Sewerage Undertakers, Internal Drainage Boards).

1.1.4 After a formal flood investigation has been carried out, CBC will publish a summary of the results of its investigation on its website and notify any relevant Risk Management Authorities and relevant local stakeholders. This report has been written to fulfil that requirement.

1.1.5 The flood incident considered within this report met CBCs threshold for triggering the undertaking of a formal flood investigation, as:

- More than five properties were reported to have flooded internally.
- Flooding impacted critical services.
- Reports indicate flooding of a similar nature has occurred at some of the locations before.

1.1.6 This report provides a concise review of the rights and responsibilities of all Risk Management Authorities relevant to the event, and an outline of their past or proposed actions, if any. It also makes recommendations that should be considered by all relevant parties to manage the risk of repeat flooding in the future.

1.1.7 Chapter 8 of this report outlines our recommendations, in line with the requirements of the Act, to mitigate the risk of flooding as far as possible in the future.

1.1.8 Although not a requirement of a formal investigation under Section 19 of the Act, the report will also review the responsibilities and steps that could be taken by the wider community, including the Town and Parish Council and riparian owners, to better manage their risk of flooding in the future.

1.1.9 A Jargon Buster has been provided in Chapter 9 for key terms and phrases used in the report.

2 Executive summary

2.1.1 A Flood Investigation Report has been completed to fulfil the statutory duties of CBC as a LLFA following flooding that occurred across Central Bedfordshire from the 7th to 12th June 2016. The report focuses on four areas; Aspley Guise, Cranfield, Dunstable, and Stotfold.

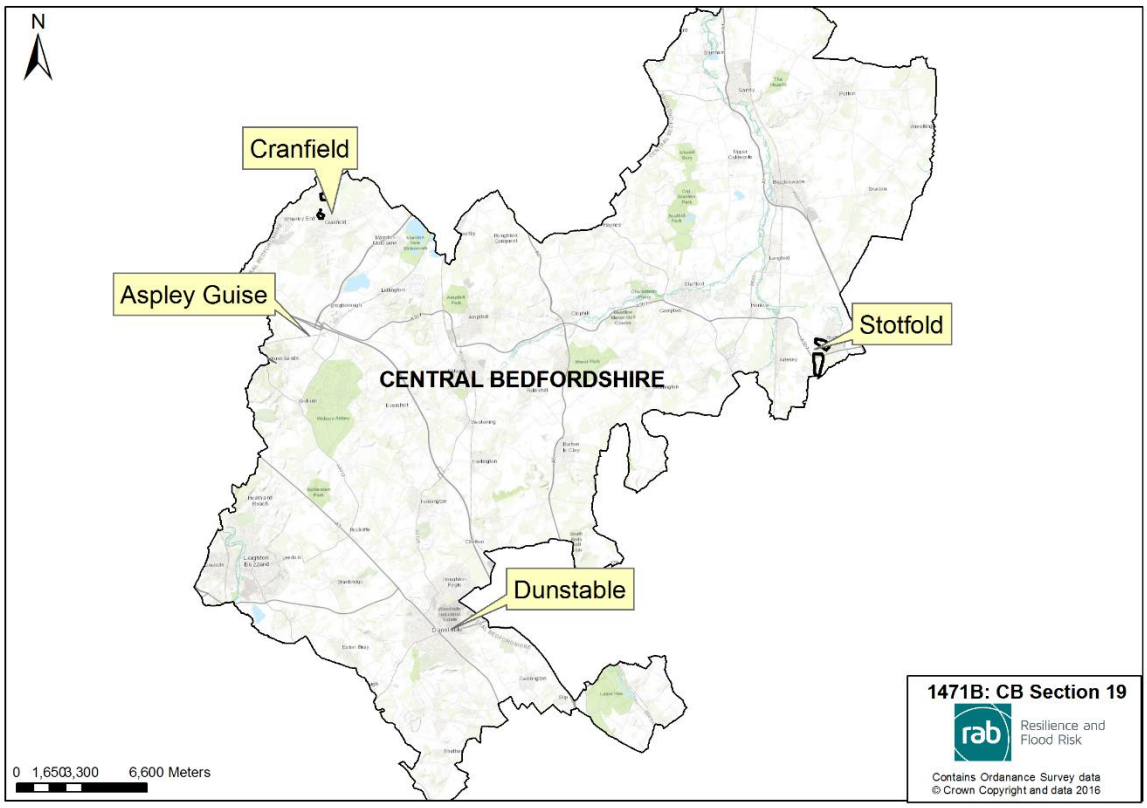


FIGURE 1: OVERVIEW MAP OF CENTRAL BEDFORDSHIRE AND THE FOUR AREAS CONCERNED IN THIS REPORT

2.1.2 The event has been estimated as having a 3.33% probability of occurring in any given year, based on best available data from rainfall gauges and information relating to the local area.

2.1.3 According to the reports received by CBC and partner organisations, approximately 137 properties were directly affected by flooding, 94 of these were reportedly flooded internally. 58 of the internally affected properties reported were residential. It is important to note these are spread across Central Bedfordshire with concentrations in four areas. The key summary statistics for the four areas are shown in the table below.

	Aspley Guise	Cranfield	Dunstable	Stotfold
Total properties affected	16	80	30	11

TABLE 1: KEY SUMMARY STATISTICS

3 Locations of flooding incidents

3.1 Aspley Guise

3.1.1 Aspley Guise is located in the west of Central Bedfordshire, south west of junction 13 of the M1.

3.1.2 The area of flooding is located mainly on Bedford Road, The Square and West Hill.

3.1.3 There is an ordinary watercourse between Bedford Road and the M1 which flows north towards the River Great Ouse.

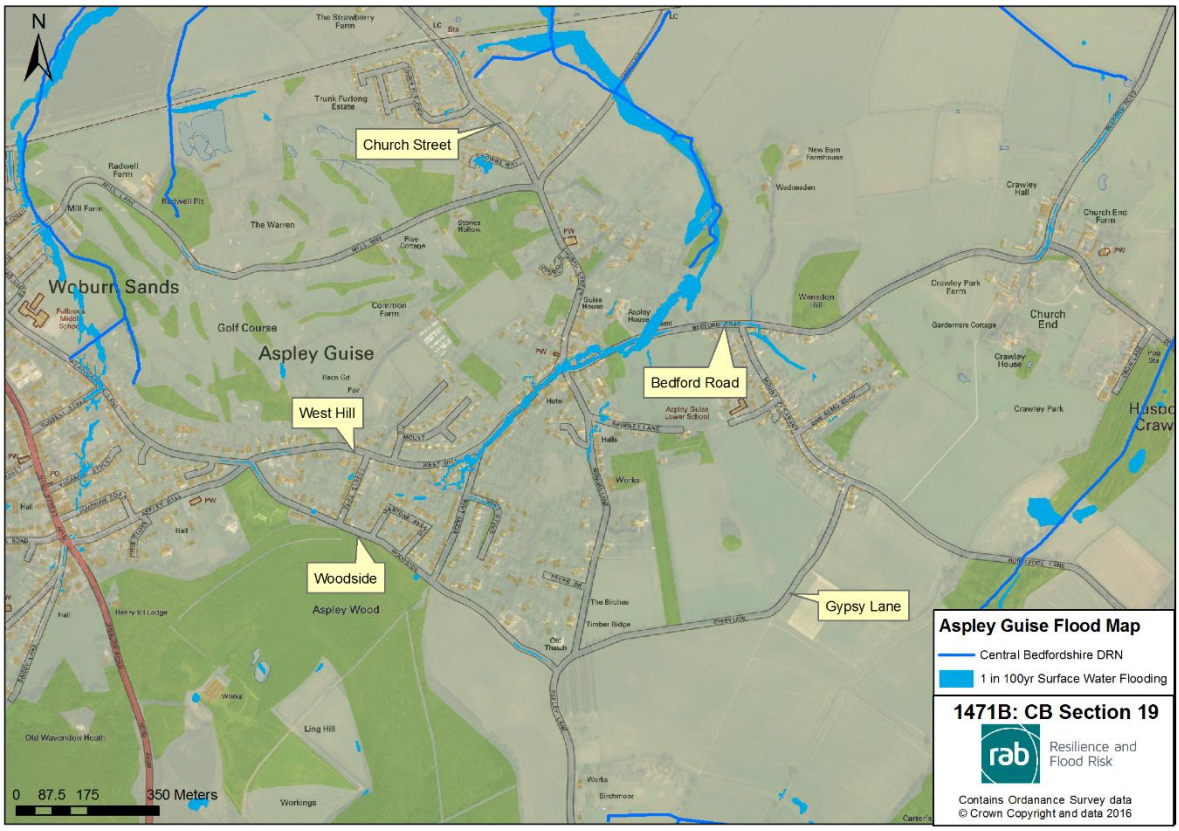


FIGURE 2: ASPLEY GUISE LOCATION PLAN

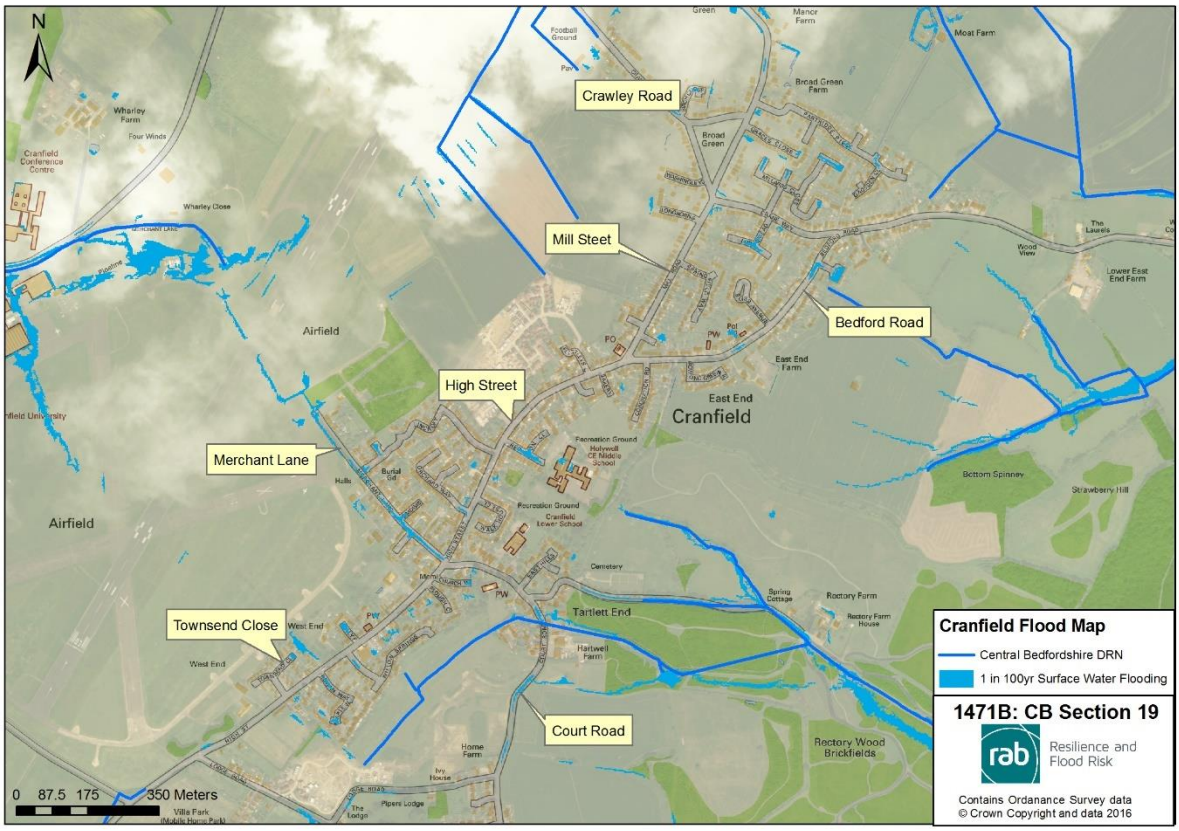
3.2 Cranfield

3.2.1 Cranfield is located between Bedford and Milton Keynes, north of the M1 and west of the A421. It benefits from a University and Airfield within the village.

3.2.2 There were three distinct areas of concentrated flooding reports; one around the High Street and Merchant Lane area, one within Cranfield University Campus, and the other along Crawley Road.

3.2.3 The majority of internal flooding was reported along High Street, Merchant Lane, Maltings Close and Cranfield University.

FIGURE 3: CRANFIELD LOCATION PLAN



3.3 Dunstable

3.3.1 Dunstable is situated in the south of Central Bedfordshire, immediately to the west of Luton and shares its boundary with Hertfordshire.

3.3.2 The town is one of the two largest urbanised area in Central Bedfordshire and located west of the M1 with the A5 running through the town.

3.3.3 The majority of internal flooding was reported along High Street and Westfield Road, with some properties reporting water in excess of 1m within basements.

3.3.4 The A505 also experienced flooding under the busway.

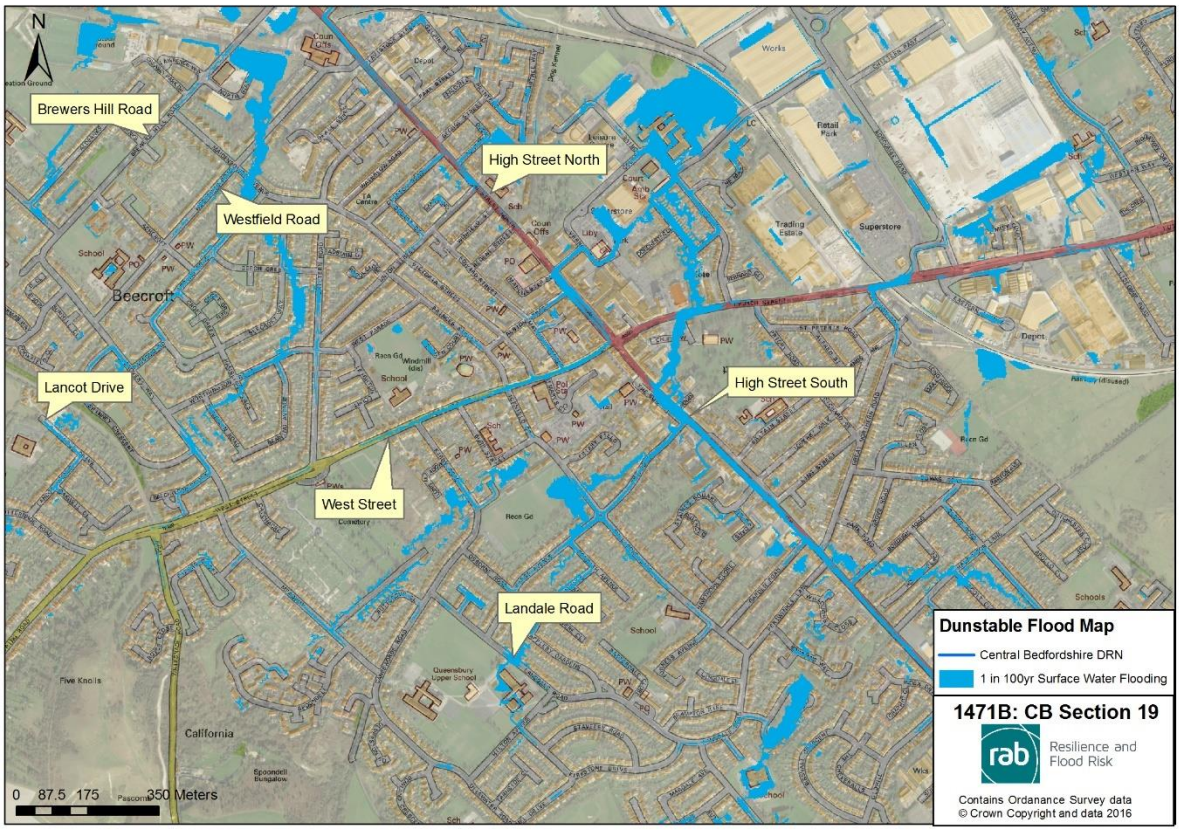


FIGURE 4: DUNSTABLE LOCATION PLAN

3.4 Stotfold

3.4.1 Stotfold is located in the east of Central Bedfordshire, close to the A1 and A507.

3.4.2 The Pix Brook flows in a northerly direction towards and through the village of Stotfold and meets the River Hiz north of Arlesey.

3.4.3 Parts of Stotfold fall within the Bedford Group of IDBs Drainage District. The Pix Brook is managed by the Bedfordshire and River Ivel Internal Drainage Board (IDB).

3.4.4 The majority of affected properties were situated on Coppice Mead and Brook Street.

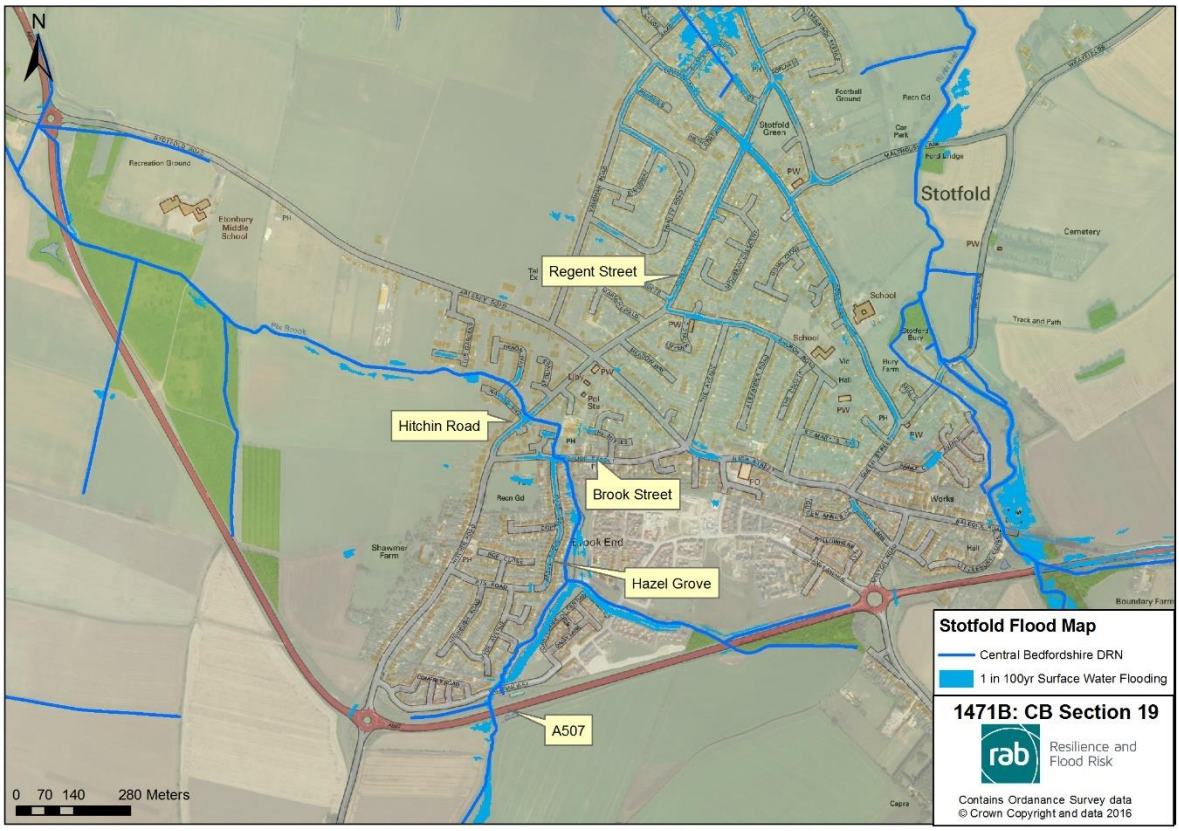


FIGURE 5: STOTFOLD LOCATION PLAN

4 Summary of flood incidents as recorded

This section of the report outlines the reports of flooding as CBC received them at the time of the event.

4.1 Weather and Flood Warnings

4.1.1 The Met Office issued a Yellow Warning of Rain (low likelihood/impact) at 10:51 Monday 6th June 2016 and then updated this warning at 10:33 on the 7th June 2016. The warning covered most of the South East of England and London.

4.1.2 The warning was widespread and indicated that heavy rainfall could have hit anywhere in Central Bedfordshire or passed by completely.

4.1.3 A Yellow warning and low likelihood/impact did not meet the trigger level for the activation of a Multi-Agency teleconference and activation of the BLRF Adverse Weather Plan.

4.2 Aspley Guise

4.2.1 7th June:

- Bedfordshire Police and the Fire and Rescue Service informed CBC that they were attending to a number of incidents in Dunstable and Aspley Guise.
- Beds, Herts and Cambs 4x4 Response team members attended Aspley Guise after Police reports of two stranded vehicles. Observing floodwater or evidence of flooding was reported as difficult in the dark.

4.2.2 8th June:

- A member of the CBC Highways Team drove around Aspley Guise looking for impacts and assessing the state of the roads. Debris was identified and a Highways Maintenance Team swept the highway.

4.3 Cranfield

4.3.1 8th June:

- After becoming aware of flooding elsewhere in the area, CBC undertook an impact assessment following reports of flooding attended to by the Fire and Rescue Service. It was identified that Cranfield had been affected by flooding on the night of the 7th June.
- 25 residential and 19 commercial properties in Cranfield were visited and their occupiers offered assistance by CBC.
- Urgent cleaning of all the gullies in Cranfield was requested to CBC Highways.
- CBC Waste Team were deployed to Cranfield to undertake cleansing of High Street, Merchant Lane, Crawley Road and surrounding affected areas.

- It was reported that residents had contacted CBC through the Highways number on 7th June at the time of flooding and that these reports had not been responded to.

12th June:

- At 19:15 CBC was notified of further flooding in Cranfield.
- A single property on the High Street reportedly experienced some flooding but there was little evidence of any other properties being affected. A number of residents were spoken to and no assistance was required.
- Further urgent cleaning of all the gullies in Cranfield was requested to CBC Highways, which is understood to have been undertaken on 16th June.

4.4 Dunstable

4.4.1 7th June:

- Call received by the CBC CCTV Control Room in Dunstable notifying the Duty Officer and Emergency Planning of heavy rainfall and flooding starting to take place in Dunstable.
- The Duty Officer and Emergency Planning department liaised to discuss an initial plan of action and liaison took place with Fire and Rescue Service Control Room and Bedfordshire Police OSCAR 1 which established any Multi-Agency Command and Control.
- CBC was informed of a number of incidents being attended to by the emergency services. The areas reported as worst affected were; the A505 Church Street which was closed to traffic, and the A5 High Street South where a number of commercial businesses had suffered internal flooding.
- The Council deployed two Incident Liaison Officers, who were accompanied by a number of BLEVEC volunteers, to the A505 for an initial impact assessment.
- Damage to the road surface was found around two sewer manholes which was assessed by CBC Highways.
- The team removed abandoned vehicles and CBC Highways helped to clean up sewerage and debris.
- CBC made plans throughout the night to set up an emergency recovery team in the morning of 8th June along with the deployment of a full assessment team to Dunstable to assess impacts, offer advice, assistance and visit affected businesses.
- CBC Highways team cleansed all requested gullies in Dunstable and an action plan was put in place to rectify any identified problems.

4.5 Stotfold

4.5.1 12th June:

- Fire and Rescue Service updated the Bedfordshire Local Resilience Forum (BLRF) advising they were attending to flooding in Stotfold and impacts may occur around the Coppice Mead area.
- The IDB attended Stotfold to inspect the culverts along the immediate area of Pix Brook and assess Standalone Reservoir, which was found to be functioning as designed.
- CBC deployed a number of investigatory officers and volunteers to Stotfold for further liaison with the emergency services and residents.
- The decision to deploy aquasacs and sandbags was made at a strategic level by CBC and left for use by residents in Stotfold if required.
- Biffa waste management company was instructed by CBC to attend Stotfold to provide a clean-up service.
- At 22:00, the culverts at Hitchin Road were inspected by the IDB and their workforce removed some obstructions although the culverts were generally free flowing.
- The IDB workforce continued to check and clear the culverts between 08:25 and 12:30 whilst the IDB officer and Chairman liaised with the Fire and Rescue Service.
- At midnight, a teleconference was held between CBC, the Fire and Rescue Service and the Environment Agency to discuss any outstanding actions.
- Stand down for Stotfold was issued at 00:10 as no further actions were identified.

4.5.2 13th June:

- At 11:00am, a BLRF Multi-Agency weather teleconference took place with all partners being involved. It was decided that a further teleconference would be called if there were any further flooding incidents occurring.
- CBC visited Stotfold to undertake an initial assessment.
- The IDB attended site for three days to undertake inspections and remove blockages following the flood event.

4.5.3 15th June:

- Clean-up in Stotfold complete.

5 Summary of desk top study, site investigation and information received

5.1 General Observations

5.1.1 Site visits were undertaken on 5th, 7th and 14th October by CBC officers and RAB Consultants to gather further information and understand the affected areas in more detail.

5.1.2 Since the site visits, it is understood the Risk Management Authorities and stakeholders have undertaken further works to reduce the risk of future flooding. This has been detailed in Section 7.9.

5.1.3 CBC Highway officers explained, during the site visit, that gully emptying is operated on a three-yearly cycle with additional visits to a list of vulnerable sites (historically prone to clogging with leaves, silt, etc.). Prioritisation may be given to specific areas when requested.

5.1.4 Challenges to initiate the coordination of a Multi-Agency response were identified within the Post Incident Review undertaken by CBC Emergency Planning department.

5.1.5 CBC “Hotspots” are currently identified in the CBC adopted Local Flood Risk Management Strategy and are updated annually in line with the review of the Strategy. They take all sources of flooding into account and categorise CBC parishes as either low, medium or high risk. These are used to highlight known local flood risk areas and are used by the Planning Authority to consult the LLFA.

5.1.6 Rainfall data needed to estimate rainfall annual probability was obtained from four rain gauges; Gosmore, Odsey, Letchworth and Cranfield University. The data from Gosmore and Odsey provided daily rainfall totals, whilst Letchworth and Cranfield provided 15-minute data.

5.1.7 Cranfield University estimated the rainfall event on 7th June as having a 3.33% annual probability. This is based on data from their own gauge station, which recorded a peak intensity of approximately 42mm of rain in 45 minutes.

5.1.8 Using data collected from a rain gauge in Letchworth, the rainfall event on 12th June is estimated as having a 25% annual probability. This is based on a recorded 22mm of rain falling within 90 minutes. When this is considered in context of the area draining to the Pix Brook, it is estimated that there was a 3.33% annual probability flow within the watercourse.

5.2 Aspley Guise

5.2.1 According to the Surface Water Maps published by the Environment Agency, West Hill, Bedford Road and The Square are identified as being at ‘high risk’ of surface water flooding (meaning each year, the area has a chance of flooding of greater than 1 in 30 / 3.3%).

5.2.2 The local topography causes surface water to flow along Church Street, Woburn Lane and West Hill and towards the lower lying Bedford Road and The Square. Ultimately, these flows are heading toward the watercourse north west of the village centre.

5.2.3 16 properties were recorded as being affected by flooding. During the site visit nine residential properties were determined to have been affected by internal flooding, it was not possible to confirm how the other properties were affected.

5.2.4 Many affected properties were observed as having low thresholds compared to the external ground level (Figure 6). Surface water runoff from roads therefore has an unobstructed route to properties due to higher road levels and dropped kerbs (Figure 7).

FIGURE 6: TYPICAL PROPERTY THRESHOLD LEVEL, 2016

FIGURE 7: HIGHWAY SURFACE AND KERBING, 2016

FIGURE 8: POND REINSTATED IN GROUNDS OF ASPLEY HOUSE, 2016

FIGURE 9: RAISED HUMP TO DRIVEWAY ACCESS, 2016

5.2.5 During CBC investigations and maintenance activities after the flood event, a pond was uncovered and re-instated in the grounds of Aspley House (Figure 8). This is thought to provide a small volume of storage through an overflow pipe from the local drainage system. The ownership and purpose of the drainage system is largely unknown at the time of this report being published.

5.2.6 During the site visit sandbags were observed to still be in place, four months after the event, as an attempt to offer some protection against future events at a number of properties.

5.2.7 A number of properties were observed to have part/completed construction works. One property has increased the level of rendering up the external wall and constructed a raised hump to the driveway entrance (Figure 9).

5.2.8 A number of local residents reported foul loadings within the floodwater. An Anglian Water representative explained during the site visit that an obstruction to the foul sewer had been identified following recent investigations.

5.2.9 Correspondence was received by CBC on the 14th June from a resident on Bedford Road in Aspley regarding the flood event. No knowledge of flooding in this area was held by CBC up to this point, however residents state that they had contacted the Council previously.

5.3 Cranfield

5.3.1 There are approximately 80 properties recorded as being affected by flooding across Cranfield and on the Cranfield University campus, of which 59 are thought to have suffered internal flooding and 49 of these are understood to be residential. During the site visit, it was not possible to confirm how all the properties were affected

5.3.2 It was reported by residents that more properties would have been flooded if the community had not acted to keep floodwater out. It was also reported that a number of properties had previously been affected by flooding, this could not be determined by the time this report was finalised.

5.3.3 Cranfield University is identified at high risk of flooding according to the Environment Agency's Surface Water Flood Map. A number of buildings are shown to be at risk of flooding including College Road. The risk shown on the Environment Agency's Map is thought to actually be more representative of the risk posed from the watercourse running through the campus. The watercourse emanates within the airfield and flows west before becoming culverted under College Road and north to its ultimate discharge into the River Great Ouse. Flooding was reported on the Campus along University Way and College Road. Since the event CBC Highways have undertaken some main run clearance on University Way, there is a large system that seems to work now its cleared. It is understood that the University is investigating the flood event and measures to reduce its risk in the future. It is worth noting that Cranfield University is recognised nationally for its flood risk and associated subject matter research.

5.3.4 The Surface Water Flood Map shows some Medium risk of flooding to Merchant Lane and a small section of the High Street although this appears largely contained with the carriageway, there is some medium and high risk shown on the west side of Crawley Road. A 300mm diameter surface water sewer runs along Merchant Lane before discharging to a small vegetated ditch along the boundary with the airfield (Figure 10). This is then thought to discharge to a 150mm diameter pipe across the airfield toward an ordinary watercourse (Figure 3).

5.3.5 Surface water drainage of the airfield (to the west of Merchant Lane) is largely unknown. Given the topography of the airfield, it is likely that water would have partly runoff east towards Merchant Lane and then north easterly towards the receiving watercourse. Occupiers of Maltings Close explained that flood waters entered from the front and rear of the properties. A ditch was identified during the site visit along the boundary of properties along Maltings Close and the airfield. This was heavily vegetated during the site visit (Figure 11).

FIGURE 10: DITCH AT THE REAR OF THE PROPERTIES ON MALTINGS CLOSE

FIGURE 11: DITCH RECEIVING SURFACE WATER SEWER DISCHARGE

FIGURE 12: CONCRETE CHANNEL AT THE REAR OF THE FOOTWAY

5.3.6 The CBC gully cleansing machine attended Cranfield on 11th June where gullies along the High Street were emptied, gully connections were rodded and the majority confirmed to be working. The gully at the junction of High Street and Merchant Lane was recorded as defective, likely due to a broken connection. Some gully connections were also found to be obstructed with debris and construction like material, the origin of which was not established. Speed tables have been constructed in the High Street at the Merchant Lane junction. In rainfall events, speed tables may block the flow of surface water along the road causing it to accumulate behind the speed table and flood lower sections of the carriageway. It was not possible to determine during the site visit to what extent this may have exacerbated the flooding on the 7th, further investigation would be needed.

5.3.7 Properties on the High Street appear to be lower than the carriageway and surrounding land. Residents also suggested that cars driving through standing water on the High Street at the time might have caused it to exceed the carriageway at low points, it was thought that the volume of traffic through the village may have been increased due to other routes being closed or impassable due to flooding elsewhere in the area. Attempts have been made to provide some protection to properties previously, it is thought by CBC Highways (Figure 12).

5.3.8 The properties affected in Crawley Road appear to be within a natural low spot. Runoff from land to the south of Crawley Road was reported by property owners to have presented a risk of flooding to their properties. A historic ditch is reported to have been situated along the boundary of the highway verge and residential properties, an undulation was observed during the site visit but no further evidence was apparent. During the site visit the highway drainage system was reported to suffer from broken connections at a number of points along Crawley Road. These may be related to recent service ducting work in the area. A number of ditches appear to drain the land to the south of Crawley Road heading north westerly towards the receiving watercourse. It was reported by residents that a number of these ditches may have been filled in over time or culverted in pipes below the ground as development in the local area took place.

5.4 Dunstable

5.4.1 There are 30 properties recorded as being affected by flooding, of which 20 are thought to have suffered internal flooding; 10 residential and 10 commercial.

5.4.2 According to the Environment Agency's Surface Water Flood Map, High Street South and Church Street are at high risk of flooding. A surface water flow path can be identified running north along High Street South, through the commercial properties, across Church Street, and north toward the Leisure Centre. The surface water seems to follow the local topography and is flowing under gravity to the lowest points.

5.4.3 There are few reports of previous flooding in Dunstable although affected business owners explained external flooding can occur following "heavy rainfall".

5.4.4 Typically, thresholds of properties on High Street South were level with the footway (Figure 13) and some had lower ingress routes including basement entrances. One property was observed to have a flood gate fitted to the front door (Figure 14). It is believed that the property still experienced flooding to the basement which suggested other routes of ingress.

FIGURE 13: TYPICAL THRESHOLD LEVELS

FIGURE 14: FLOOD GATE INSTALLED ON PROPERTY

5.4.5 The A5, High Street South is currently maintained by Highways England and due to be transferred to CBC in the future.

5.4.6 The A505, Church Street under the busway is significantly lower than the surrounding area (Figure 15). During the flooding, water was deep enough to strand cars and the road was closed to the public. Surface water was able to enter the public foul sewer, which is thought to have caused overloading of the system and foul flooding under the busway (Figure 17).

5.4.7 A pumping house next to the busway was observed during the site visit (Figure 15). Anglian Water has confirmed ownership although it is unclear exactly what drainage this serves at the time of this report being published.

5.4.8 A large number of gullies were observed along Church Street and Luton Road, which is often a technique used to collect more surface water runoff on sloping roads.

5.4.9 Residential properties were affected internally by flooding across Dunstable. Typically, these properties were lower than the road and had impermeable driveways sloping towards the property. Drainage channels, additional gullies and raising of kerbs have been installed by CBC Highways in some of these locations as an attempt to offer some protection against frequent flooding (Figure 16).

5.4.10 Other areas that experienced flooding include Bullpond Lane, Wingate Road, Langdale Road, Lowther Road, Langridge Court, Salford Road, West Street, Lancot Drive, Brewers Hill, Southwood Road and Meadway.

FIGURE 15: VIEW OF CHURCH STREET LOOKING EAST AND PUMP STATION

FIGURE 16: EXAMPLE OF FOOTWAY DRAINAGE

FIGURE 17: FOUL AND SILT DEBRIS FOLLOWING FLOODING

5.5 Stotfold

5.5.1 On the 12th June 2016 flooding occurred to Brook Street and Coppice Mead due to out of bank flows from the Pix Brook. 11 properties were recorded as being affected by flooding, of which at least 6 are thought to have suffered internal flooding and are used for residential purposes.

5.5.2 Stotfold has been subject to numerous flooding incidents associated with the Pix Brook in the 1960s, 1970s, 1990s, 2000s and 2010s, and more recently 2015 and 2016.

5.5.3 The Pix Brook flows from south to north then west through the town of Stotfold and outfalls to the River Ivel. The River Ivel is known to be a relatively fast responding catchment, meaning it is vulnerable to flash flooding following a significant rainfall event.

5.5.4 The Pix Brook orientates 90 degrees west at Brook Street before returning north at the culvert entrance. Further downstream the Pix Brook passes under Hitchin Road. Both Hitchin Road and Brook Street comprise a box and circular culvert. After the June 2016 flood event, debris was photographed at the face of the box culvert at Hitchin Road.

5.5.5 A previous section 19 report was compiled by CBC in response to flooding experienced in Stotfold on 4th July 2015. During this event debris was conveyed along the Pix Brook which overwhelmed and blocked the trash screen located on the upstream side of brook street, causing water levels upstream to rise rapidly and flood the local area. In the 2015 report debris was found to mainly consist of)watercress plant (figure 20), which is fast growing in the spring and it is thought nutrients from the sewage treatment works to the south of Stotfold increased its growth within the Pix Brook. Under instruction by the Police following the 4th July 2015 flood event, the IDB removed the trash screen at Brook Street. Flooding occurred again on 17th July 2015 when the Hitchin Road culverts became partially blocked with vegetation and debris.

5.5.6 The IDB perform annual watercourse maintenance of the Pix Brook and monthly checks on known 'flood hot-spots' including the Brook Street twin-culverts. Since the July 2015 flood event, the IDB have increased their inspection frequency and maintenance regime including extra in-channel vegetation control in the flood meadows.

5.5.7 The IDBs workforce are under instruction to carry out inspection and maintenance activities in accordance with their associated risk assessment and method statement, as there is a possible risk to life for their operatives when undertaking such activities.

FIGURE 18: POINT OF PIX BROOK SPLITTING INTO TWO CHANNELS NEAR VALERIAN WAY

FIGURE 19: EXAMPLE OF EROSION PROTECTION WORKS

FIGURE 20: WATERCRESS PLANT OBSTRUCTING DEBRIS SCREEN AT BROOK STREET DURING THE 2015 FLOOD

5.5.8 Anglian Water operate the Letchworth Sewage Treatment works to the south, which has a base flow of treated waste water into the Pix Brook and has storm water tanks that operate in times of flood to store excess foul water until it is treated. An Anglian Water pumping station overflow pipe discharges at the face of the Hitchin Road culverts.

5.5.9 Between Letchworth and Stotfold there is a Flood Attenuation Reservoir at Standalone Farm. The purpose of this is to restrict flows from the urban areas of Letchworth. The reservoir was enlarged and recommissioned in 2005 by the IDB, with contributions from Anglian Water and the developers of Fairfields hospital and associated site. In 2011 a study was undertaken by the IDB which identified scope to optimise the existing infrastructure by improving the automated operational regime. The flow passing the Reservoir was reduced from its original design of 6 m3/s to a reduced 3.1 m3/s to optimise the filling of the 52,000 m3 reservoir.

5.5.10 During the 2016 site visit, evidence of erosion protection was observed at a number of locations downstream of the confluence of the old and new Pix Brook channels (Figure 19). A number of properties on Coppice Mead were also observed to have built brick walls along the left bank of the Pix Brook (Figure 21).

5.5.11 Residential development has taken place along the right bank of the Pix Brook off Valerian Way. This required alterations to the Pix Brook including the construction of a new channel and using the old channel as an overflow (Figure 18). Hydraulic modelling of the Pix Brook, including the alterations, was undertaken by the developer. The modelling is accepted to show realistic flood outlines by the IDB, which shows there is no increased risk of flooding for 1% annual probability event.

5.5.12 A redevelopment off Brook Street, which was largely unoccupied during the flood event, appears to have suffered flooding with water-marks evidenced up to the air bricks (Figure 23). This area of Stotfold was highlighted by the IDB in their 2015 post-flood report as an area at risk of flooding and it also appeared as such on the Environment Agency's indicative flood map prior to April 2010.

5.5.13 The current publicly available Flood Map for Planning on the Environment Agency's website shows minimal risk of flooding in Stotfold. Areas that were affected by the flooding in 2016 are not shown to be at risk.

5.5.14 The IDB has undertaken their own modelling of the Pix Brook which includes blockage scenarios. The IDB district does not extend beyond Standalone Reservoir and so modelling was not undertaken of the wider catchment. The IDB raised concerns to the Environment Agency regarding the representation of Flood Zones in Stotfold on the Flood Map for Planning. Details of this are in the IDB report produced following the August 2010 flooding.

5.5.15 The Flood Risk Assessment that supported the 2014 planning application (ref: CB/14/01589/FULL) for the new development at Brook Street, mentioned above, used flood model data provided by the Environment Agency. The Flood Risk Assessment did not consider the potential for blockage of the Brook Street culvert. It suggests that the floor levels be constructed 150mm higher that the 0.1% annual probability flood level plus an allowance for climate change, given that floodwater reached the airbricks in the 2016 flood event it suggests that the event was in that order of magnitude. An initial analysis of the rainfall event based on a rain gauge at Letchworth (see paragraph 6.2.5) estimates that the flow in the Pix Brook was in the order of 3.33% AEP. There is therefore a potential risk to new developments if the representation of flooding associated with the Pix Brook as identified by the Environment Agency Flood Map for Planning is used in isolation from contextual information about how the area has flooded in the past.

5.5.16 During the site visit residents raised concerns with the communication between RMAs and the community during flood events.

FIGURE 21: BRICK WALLS CONSTRUCTED ALONG THE BANK OF PIX BROOK, 2016

FIGURE 22:BOX CULVERT AT HITCHIN ROAD PARTIALLY BLOCKED BY DEBRIS, 2016

FIGURE 23: WATER MARKS LEVEL WITH AIR BRICKS ON NEW PROPERTIES, 2016

6 Investigation findings

6.1 Impacts of flooding

6.1.1 Following the investigation into flooding, impacts are summarised in Table 2 using the information available at the time of undertaking this investigation.

6.1.2 The impact categories are defined as:

- **Risk to Life** – any risk to loss of life, injury or health implications. Factors to consider include whether there have been any reported cases of personal injury, the nature of the injury, the number of people injured.
- **Internal Flooding** – flooding inside of the habitable part of a property (above ground floor level and/or below ground level where used as basement accommodation).
- **External Flooding (gardens/ grounds**) – flooding which has not entered the habitable part of a property, and/or flooding of a garden or other open space.
- **Critical infrastructure** – internal flooding of critical services/installations where a loss of service impacts upon the local community; or where causing pollution to internal premises; or where in-operable due to a lack of access; or where vulnerable people are placed at risk.
- **Obstruction of Access** – any section of a national category 3 or above road made impassable due to flooding; or to a minor road cutting off effective access to a village; or where blocking a designated bus route.
- **Repeat Event** – flooding has occurred previously, causing damage or posing a public nuisance.

	Aspley Guise	Cranfield	Dunstable	Stotfold
Risk to Life	x	x	✓	✓
Internal Flooding	✓	✓	✓	✓
External Flooding	✓	✓	✓	✓
Critical infrastructure	x	x	x	x
Obstruction of Access	✓	✓	✓	✓
Repeat Event	✓	x	x	✓

TABLE 2: FLOODING IMPACTS SUMMARY

6.2 What caused the flooding – summary of the event

6.2.1 The events on the 7th and 12th are considered to have been caused by localised rainfall.

6.2.2 The primary source of flooding in Aspley Guise, Cranfield and Dunstable was surface water; Stotfold was related to out of bank flows from the Pix Brook.

6.2.3 It is difficult to estimate the exact magnitude of the rainfall event that occurred on 7th and 12th June due to the limitations of available data from rain gauges local to all the affected areas.

6.2.4 Cranfield University have their own rain gauge and have estimated the rainfall event having a 3.33% annual probability. This is based on a recorded intensity of approximately 42mm of rain in 45 minutes.

6.2.5 Using data collected by rain gauges in Letchworth, the rainfall event on 12th June is estimated as having a 25% annual probability. When this is considered in context of the area draining to the Pix Brook, this is estimated as a 3.33% annual probability flow within the watercourse. This based on a recorded 22mm of rain falling within 90 minutes.

6.3 Aspley Guise

6.3.1 The flood event on the 7th June 2016 occurred due to rainfall that resulted in surface water runoff along West Hill and Bedford Road from the surrounding area due to the natural low topography.

6.3.2 The surface water flowed in a north easterly direction, ultimately toward the watercourse north east of the village. The route of this flow path is not formally defined.

6.3.3 The highway drainage system in the area is likely to have been overwhelmed by the rainfall event as these systems are usually designed to more routine rainfall events.

6.3.4 Anglian Water does not hold records of a surface water sewer in Aspley Guise. It is believed that surface water from properties likely discharges into the public foul sewer network, which would not have been designed to deal with these additional flows. This will have further exacerbated the risk of flooding posed by the obstruction found in the foul sewer.

6.3.5 The surface water flows and floodwater emanating from the surcharged drainage networks was not contained within the carriageway due to low kerbing and high road levels.

6.3.6 Many properties do not benefit from raised thresholds therefore not providing protection from internal flooding.

6.3.7 Surface water entered foul drains and exceeded the capacity, allowing a combination of surface and foul water to enter the highways. Overtopping the kerb and flooding the pavement, foul and surface water flooded properties internally and externally.

6.3.8 The significant rainfall and consequent overland surface water flows combined with the highway and public foul sewer exceeding their capacity caused Aspley Guise to flood.

6.4 Cranfield

6.4.1 The flood event on the 7th June 2016 occurred due to the severity of the rainfall event experienced in the area, this was exacerbated in certain locations by the factors listed below.

6.4.2 The condition of the highway drainage system in the High Street is thought to have affected its ability to effectively drain surface water from the area. Lack of capacity in these drains to take water away may have been exacerbated by the speed tables, which could have raised the levels of ponding in discrete locations, this then exceeded the carriageway at susceptible points. Traffic flow through the village may also have caused water to escape the highway.

6.4.3 The source of flooding at Merchants Lane/Maltings Close area is likely to be runoff from the Airfield and surface water ponding on the carriageway. Surface water runoff from the Airfield was unlikely to be able to drain effectively into the ditch along its boundary due to its vegetation condition. Furthermore, the hardstanding areas between the Airfield and the properties offer little opportunity for infiltration.

6.4.4 At Crawley Road, the sources of flooding include runoff from the land to the south and surface water ponding on the carriageway. The capacity of the highway drainage would have been exceeded given the severity of the rainfall event, causing water to collect along Crawley Road. The loss of historic ditches and the poor condition of the existing ditches will have prevented run off routes from the carriageway, and this combined with a likely blockage and/or broken connection in the drainage system will have caused the flooding around Crawley Road.

6.4.5 The flooding at Cranfield University is thought to have been caused by capacity exceedance of the watercourse on site and the campus' drainage systems due to the severity of the rainfall event.

6.5 Dunstable

6.5.1 The source of flooding in Dunstable was predominantly surface water due to the rainfall event experienced within the area.

6.5.2 The local topography promotes a flow path along High Street South and through the affected properties.

6.5.3 The kerbs along High Street South provide a small uplift to the footway therefore only a small volume of water can be retained within the road during rainfall events.

6.5.4 Commercial properties have thresholds level with the footway that offer little protection to any depth of flood water.

6.5.5 Vehicles continued to use the road, driving through flood water and causing bow waves towards the properties which caused further flooding.

6.5.6 Under the busway on the A505, Church Street is significantly lower than the surrounding area which results in a large amount of surface water ponding.

6.5.7 The capacity of the highway drains and surface water are likely to have been exceeded given the severity of the rainfall event.

6.5.8 Surface water was able to enter the foul public sewer which is thought to have caused overloading of the system and foul flooding under the busway.

6.6 Stotfold

6.6.1 Due to the rainfall event on 12th June, the flow within the Pix Brook at the time was estimated have to a 3.33% annual probability.

6.6.2 The twin culverts at Hitchin Road have a maximum capacity at which they are able to pass water. It is understood that the flow of water within the Pix Brook was partially restricted at this point due to debris, which caused water levels to rise upstream.

6.6.3 The culvert at Brook Street presents another point of restriction to the flow of water in the Pix Brook which is likely to result in localised flooding, particularly when water levels are already raised downstream.

6.6.4 The course of the Pix Brook immediately up and downstream of Brook Street is unnatural and likely to reduce flow within the channel. 90 degree changes in direction of flow heighten water levels, increase the potential for deposit of silt and debris and result in out of bank flows.

6.6.5 Areas between Stotfold and Letchworth are relatively rural which presents a greater opportunity for debris and vegetation to fall into the Pix Brook. Post the flood event, debris was found at the face of the box culvert at Hitchin Road that would have raised the water level upstream and increased the risk of flooding.

6.6.6 Ultimately the capacity of the Pix Brook was exceeded and water flowed out of channel at susceptible locations.

7 Who has responsibilities to manage the causes of the flood?

7.1 Summary of responsibilities

7.1.1 The responsibilities of key stakeholders for managing the causes of flooding have been detailed in Sections 7.2 to 7.7.

7.2 Central Bedfordshire Council;

7.2.1 The Lead Local Flood Authority is a designated Risk Management Authority under Part 1 of the Flood and Water Management Act 2010. It has responsibilities to: assess reports of flooding and undertake investigations where flooding is deemed significant; to evaluate significance of drainage assets and structures within its area; and build partnerships to ensure effective working between authorities that have control over flood risks.

7.2.2 The local Highway Authority is a designated Risk Management Authority under Part 1 of the Flood and Water Management Act 2010. It is an asset owner for designated highway bridges and road drainage and has a responsibility for providing and managing highway drainage and roadside ditches under the Highways Act 1980.

7.2.3 Emergency Planning have a responsibility to assist the emergency services when responding to a flood event and to and record the extent of flooding .

7.2.4 Central Bedfordshire has no duty to provide flood defences such as sandbags and will not provide these upon request, however may distribute these as part of a strategic response on a case-by-case basis.

7.3 The Environment Agency

7.3.1 The Environment Agency is a designated Risk Management Authority under Part 1 of the Flood and Water Management Act 2010.

7.3.2 The Environment Agency is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion.

7.3.3 It has responsibilities for managing the flood risk from main rivers, the sea and reservoirs (as defined by the Act). It may maintain a designated main river using permissive powers.

7.3.4 The Environment Agency also issue Flood Warnings and Alerts in some locations identified at risk of flooding from the river or sea.

7.4 Water and Sewerage Companies

7.4.1 Anglian Water Services is a designated Risk Management Authority under Part 1 of the Flood and Water Management Act 2010.

7.4.2 It is a statutory sewerage undertaker with responsibility for the public sewer network under the Water Industries Act 1991.

7.4.3 Where there is frequent sewer flooding (sites included on the ‘Flooding Register’) sewerage undertakers are required to address this through their capital investment plans, which are regulated by Ofwat.

7.5 The Internal Drainage Board

7.5.1 The IDB is a designated Risk Management Authority under Part 1 of the Flood and Water Management Act 2010.

7.5.2 The IDB has permissive powers to maintain watercourses within their internal drainage district under the Land Drainage Act 1991.

7.5.3 Stotfold is the only location in this report which falls within the IDBs Drainage District.

7.6 Highways England

7.6.1 Responsible for providing and managing highway drainage on motorways and major A roads. They operate the A5 running through Dunstable, an area which was heavily flooded.

7.7 Riparian Owners

7.7.1 Whilst not a Risk Management Authority named under the Flood and Water Management Act 2010, any person who owns land adjacent to a river or watercourse is considered a riparian owner.

7.7.2 Riparian owners are those who own land or property that adjoins a watercourse. They have rights and responsibilities relating to the management of that watercourse, including to receive and pass on a flow of water in its natural state, without undue interference in quantity or quality; to maintain the bed and banks of an open or culverted watercourse and any trees/shrubs growing on the banks; clearing of any debris even if it did not originate from their land; keeping any structures that they own clear of debris.

7.7.3 If they do not carry out their responsibilities they may face action under the Land Drainage Act 1991.

7.7.4 The Environment Agency's guide 'Living on the edge' explains rights and responsibilities of riverside ownership in more detail.

7.8 Property owners

7.8.1 Whilst not a Risk Management Authority named under the Flood and Water Management Act 2010, any person who owns a property has the responsibility to protect it from flooding. They should also acquire buildings and contents insurance for their home and take actions to prepare for flooding.

7.8.2 Property owners are responsible for maintaining any private drainage and making sure it drains effectively, including: gullies and drains on shared private access roads or courtyards; and any external pipework up to the water company's stop tap or the edge of the highway or pavement.

7.9 What was the response of the relevant authorities in relation to the cause of the flood?

7.9.1 A summary of the responses from relevant authorities has been identified in Table 3:

TABLE 3: SUMMARY OF RESPONSES FROM THE RELEVANT AUTHORITIES AND STAKEHOLDERS

Response	Aspley Guise	Cranfield	Dunstable	Stotfold
Central Bedfordshire Council	• Liaised with other Category 1 and 2 responders. • Assessed the extent of flooding and associated impacts including volunteers. • Arranged for cleaning of sewage and debris on footpaths and highways. • Cleansed gullies. • Investigated and cleared drains at Aspley House. • Deployed sandbags. • Representatives from various departments have attended site visits and supported the Section 19 Investigation. • Subsequently amended information on its website to provide clear guidance on who to contact in a flood event. • Setup a Public Helpline for	• Assessed the extent of flooding and associated impacts including volunteers. • Deployment of officers following the event to review the impact of flooding and provide advice. • Cleansed gullies. • Representatives from various departments have attended site visits and supported the Section 19 Investigation. • Subsequently amended information on its website to provide clear guidance on who to contact in a flood event. • Setup a Public Helpline for assisting residents and businesses with waste collection. • Investigated performance of existing highway	• Liaison with other Category 1 and 2 responders. • Full assessment team deployed to assess impacts, offer advice and assistance, and visit affected businesses. • Assessed damage to the road and manhole covers. • Arranged clean-up of sewerage. • Removal of abandoned and flooded vehicles. • Representatives from various departments have attended site visits and supported the Section 19 Investigation. • Subsequently amended information on its website to provide clear guidance on who to contact in a flood event. • Setup a Public Helpline	• Liaison with other Category 1 and 2 responders. • Full assessment team deployed to assess impacts and offer advice and assistance including volunteers. • Placed sandbags at the affected area • Highways team sent grabber lorry to remove debris. • Cleansed and removed debris in affected areas. • Representatives from various departments have attended site visits and supported the Section 19 Investigation. • Initiated the creation of a resident action group. • Initiated the creation of an Emergency Action Plan. • Subsequently amended information on its website

Response	Aspley Guise	Cranfield	Dunstable	Stotfold
	assisting residents and businesses with waste collection. • Exploring options to investigate the drainage system going forward.	drainage and cleansed gullies. • Raised orders to install new gullies in various locations. • Raised kerb heights in various locations.	for assisting residents and businesses with waste collection. • Investigated performance of existing highway drainage and cleansed gullies.	to provide clear guidance on who to contact in a flood event. • Setup a Public Helpline for assisting residents and businesses with waste collection. • Assisted creation of a local community flood action group. • Bid with partners for regional funding to undertake a study to appraise remedial options.
Environment Agency	N/A	N/A	N/A	• Issued a Flood Alert for the River Ivel in Hertfordshire and Central Bedfordshire. • Took part in a Multi-Agency teleconference.
Internal Drainage Board	N/A	N/A	N/A	• Deployed IDB officers to inspect culverts on Pix Brook in the immediate area and removed debris. • Standalone Farm Reservoir was visited and assessed to be functioning as designed.

Response	Aspley Guise	Cranfield	Dunstable	Stotfold
				• Attendance by IDB representatives throughout the event. • Assisted CBC with bid for regional funding to undertake a study to appraise remedial options.
Anglian Water	• A representative has attended site visits for the Section 19 Investigation to support and gather evidence. • Responded and investigated reports of foul flooding. • Maintenance work undertaken post flooding and removal of an obstruction to the foul sewer.	• A representative has attended site visits for the Section 19 Investigation to support and gather evidence. • Post-event have investigated performance of their systems and arranged for clearing of surface water sewer outfall in Merchant Lane. • Introduced a 6 monthly planned preventative maintenance schedule.	• A representative has attended site visits for the Section 19 Investigation to support and gather evidence. • Reviewed telemetry data and analysed performance of assets to determine their performance at the time of the event.	• A representative has attended site visits for the Section 19 Investigation to support and gather evidence.
Fire and RescueService	• Attended to emergency call and provided assistance.	• Attended to emergency call and provided assistance.	• Attended to emergency call and provided assistance.	• Attended to emergency call and provided assistance.
Riparian/ Land owners	• Cleaning and repairing of property. • Undertaken unquantified	• Cleaning and repairing of property. • Undertaken unquantified	• Cleaning and repairing of property. • Provided information to	• Cleaning and repairing of property. • Undertaken unquantified

Response	Aspley Guise	Cranfield	Dunstable	Stotfold
	improvements in an effort to protect property. • Provided information to authorities following the event.	improvements in an effort to protect property. • Provided information to authorities following the event.	authorities following the event.	improvements in an effort to protect property. • Provided information to authorities following the event.

8 Recommendations

8.1.1 Strategic recommendations are identified below and consider the response and management of a flood event across Central Bedfordshire. General and specific recommendations for each area affected on 7th and 12th June 2016 have been identified in the tables that follow.

8.1.2 It must be noted that although CBC has a duty under the Flood and Water Management Act 2010 to publish the results of its investigations and notify any relevant risk management authorities of this, the Act does not provide CBC with the mandate or funding to rectify the identified causes of flooding.

8.1.3 Partnership working across all agencies is therefore key to delivering against the recommendations, in order to avoid duplication and ensure best use of resource, including viewing the local community as a key stakeholder.

8.1.4 The method for prioritising works will vary for each Risk Management Authority involved and will be dependent on factors such as resource availability, operational area, and interpretation of flood risk. It is therefore important that all Risk Management Authorities are open and honest with the community about what actions will or won't be taken, and why.

8.1.5 The recommendations are referenced against the factors detailed above and should not be considered in isolation of these.

8.2 Strategic Recommendations

These recommendations are common to all of the four areas under consideration in this report and focus on the response to reports of flooding in the area:

8.2.1 CBC should review how information is recorded and shared between authorities when collated from members of the public. This will ensure that information is forwarded to relevant officers, departments and other responding agencies and lead to a more effective response and recovery. An improvement measure may include the provision of scripts to CBC contact centre staff or revision of these, to use when recording a report of flooding. It must be noted however that CBC does not have a dedicated out of hours flood response unit and, in the event of an emergency, those affected by flooding should contact the Fire and Rescue Service, or the Highway Authority where flooding is associated with the road network.

General communication between Risk Management Agencies could be improved following the flood incident. An improvement may look to establish a post flood event "Flood Risk Management Agency debrief" to raise awareness and share information. This should be led by CBC in its role as a LLFA, and involve all relevant agencies. This should not replace the Civil Contingencies Debrief led by Category 1 responders.

8.3 General Recommendations

These recommendations are common to the following stakeholders for all four areas:

8.3.1 **CBC Lead Local Flood Authority**: Work with stakeholders to identify a package of agreed improvement measures to manage flood risk and opportunities to deliver these, and support measures that would empower the local community to increase their resilience against flooding.

Review their "Flooding Hotspots" as set out in the adopted Local Flood Risk Management Strategy, using information from the Section 19 Flood Investigation. These should be used by the Local Planning Authority when considering planning applications to ensure that flood risk is fully considered and surface water is managed sustainably, in accordance with the National Planning Policy Framework and Planning Practice Guidance. The Action Plan in the Local Flood Risk Management Strategy, which sets out objectives for the Council to manage risk in their area, should also be updated to take account of the recommendations made in this report. This includes review of the CBC Flood Asset Register

8.3.2 **CBC Highways Authority**: CBC Highways should consider a proactive and more frequent approach to inspection and maintenance of highway assets, particularly in areas identified at risk from flooding or those that have experienced flooding previously. Proactive maintenance would provide a better opportunity for assets to perform effectively and show a CBC presence in these areas.

8.3.3 **CBC Emergency Planning**: The Post Incident Report completed by CBC Emergency Planning Team, highlights challenges with initiating and formalising Multi-Agency Command and Control arrangements during the flooding. A review of relevant plans should be undertaken to determine if:

- Appropriate Multi-Agency procedures exist to respond to flooding of this nature and;
- Any actions that may be required to ensure that plans are in place, updated and tested.

8.3.4 **CBC Local Planning Authority**: should note the findings and summaries of this report when considering planning applications in the future within the areas of Aspley Guise, Cranfield, Dunstable and Stotfold to ensure that flood risk is managed sustainably. Liaison should be sought with the LLFA, IDB and Anglian Water to make sure new development is engaged on local flood risk issues, including surface water management, and maximises opportunities to reduce the risk wherever possible.

8.3.5 **Parish and Town Councils**: should continue to engage with the wider community and support the creation of a community flood response group and Emergency Action Plan, or where applicable consider approaching existing locally organised groups to encourage local action to improve flood resilience. This should include improving awareness of riparian owners and their responsibilities. Any action taken by the Parish or Town Council should be informed by this report and advice from CBC to ensure any measures taken are safe and legal.

8.3.6 **Land and property owners**: should consider what measures they could take to protect their own premises including, for example, installing flood gates; flood doors; air brick covers; raising electrical sockets; and fitting non-return valves on waste pipes. Properties with basements should also consider tanking with a waterproof material to a suitable height. Such measures should be informed by a scheme/property specific survey and where possible coordinated with neighbours. Contact should be made with CBC at an early stage to discuss potential resilience measures. Further measures to reduce surface water runoff and/or diversion of surface water to the public system (in particular the foul system) should be considered, for example permeable paving, raingardens and soakaways.

8.3.7 **Property owners**: can take actions in preparation of a flood such as by moving valuable items to higher ground, storing and deployment of sandbags/aquasacs, and working with a community action group to create/deliver an Emergency Action Plan. Advice should be sought from CBC to ensure any measures taken are safe and legal.

8.3.8 **Property owners (affected by flooding)**: should try to document as much information about the incident as possible. The relevant authority should be contacted so that a record of the event can be made, and where appropriate provide a coordinated response. In a flood emergency where there is a potential risk to life the Fire and Rescue Service should be contacted.

8.3.9 **Riparian owners**: must be aware of their responsibilities to maintain the beds and banks of the ditches, watercourses and culverts adjacent to or within their property, and to keep them clear of obstructions such as vegetation and any other debris. This may include cutting back vegetation, removing blockages, ensuring that rubbish and garden waste is not stored along the banks of the watercourse where it can fall in were the water level to rise.

8.3.10 **Riparian owners**: must not build a new structure (for example a culvert, bank protection, planting and decking) that encroaches upon the watercourse or that alters the flow of water without first obtaining permission from the IDB. The Land Drainage Act 1991 Section 23 prohibits any person from causing an obstruction to flow in any ordinary watercourse. This is applicable to both permanent and temporary works. Applicants for Consent must also comply with local drainage Byelaws, which protect the water corridor to ensure the watercourse is accessible for inspection and maintenance. Riparian owners must not carry out work without consent, if they do the IDB may reclaim from them the cost of removing, altering or pulling down the works.

8.4 Site Specific Recommendations

8.4.1 The tables below detail the site-specific recommendations for each of the four locations considered in this report.

TABLE 4: RECOMMENDATIONS FOR AUTHORITIES AND STAKEHOLDERS AT ASPLEY GUISE

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Aspley Guise
CBC: Emergency Planning	Work with stakeholders to support measures at Aspley Guise that would empower the local community to increase their resilience against flooding through an Emergency Action Plan (subject to available funding and prioritisation).
CBC: Lead Local Flood Authority	Continue to keep a record of all reported flood incidents and any significant flood risk assets within the area.
	Continue to work with residents and riparian owners to make them aware of their responsibilities under the Land Drainage Act 1991. Enforcement action could be taken using the permissive powers under this Act where the LLFA feels appropriate to manage the risk from flooding.
	Continue to work with residents to improve their understanding of appropriate measures they could take to protect their property. This could include Property Resilience Measures (PRM), particularly in The Square, West Hill and Bedford Road, which some residents have already progressed with using a piecemeal approach. PRM requires residents to work together and detailed surveys undertaken to ensure measures are identified that are fit for purpose and deliver benefit. A coordinated approach, supported in partnership with CBC LLFA, would be very advantageous to promote a successful scheme.
	To coordinate an investigation into the culvert running through West Hill, Bedford Road and Aspley House through liaison with CBC Highways and riparian owners.
CBC: Highways Authority	Further investigate, and undertake maintenance where appropriate, on the highway drainage system within The Square, West Hill, Bedford Road and surrounding areas.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Aspley Guise
	Investigate an option of increasing kerb heights along The Square, West Hill and Bedford Road to provide some protection to properties. Further works downstream would be required to collect and discharge the water retained within the road. SuDS should be incorporated into any improvement works where feasible.
Anglian Water	To inspect and maintain the foul water sewer serving Aspley Guise to ensure the system is returned to operating condition.
	To consider liaison with residents regarding the existing discharge of surface water from their properties into the foul sewer, which may otherwise lead to overloading and foul flooding.
	To restrict new connections or discharge into the public foul system, where practical.
	To monitor the frequency of foul flooding and consider improvements to the network or prevention of surface water entering the system. This should be developed through collaboration with stakeholders and consideration of a future scheme under AMP6/7 to retrofit SuDS within the area under to reduce surface water runoff and manage it more sustainably.

TABLE 5: RECOMMENDATIONS FOR AUTHORITIES AND STAKEHOLDERS AT CRANFIELD

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Cranfield
CBC: Emergency Planning	Work with stakeholders to support measures at Cranfield which would empower the local community to increase their resilience against flooding through an Emergency Action Plan (subject to available funding and prioritisation).
CBC: Lead Local Flood Authority	Continue to keep a record of all reported flood incidents and any significant flood risk assets within the area.
	Continue to work with residents and riparian owners to make them aware of their responsibilities under the Land Drainage Act 1991. Enforcement action could be taken using the permissive powers under this Act where the LLFA feels appropriate to manage the risk from flooding. This should be considered where ditches and watercourses have been identified as heavily vegetated, altered, or lost. Restoring lost ditches to the south of Crawley Road and incorporating SuDS within new development should be encouraged.
	Work with Cranfield University and Airport to improve their knowledge and understanding of the drainage and riparian assets within the University Campus and Airport grounds. Encourage SuDS to be retrofitted within the campus and Airport to improve the management of surface water and reduce runoff to the receiving system.
	To continue to work with residents to improve their understanding of appropriate measures they could take to protect their property.
CBC: Highways Authority	To further investigate and undertake maintenance where appropriate on the highway drainage system within High Street, Merchant Lane, Church Walk, Crawley Road and surrounding areas. Priority should be given to known defects, for example those associated with service ducting within High Street and Crawley Road.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Cranfield
	Investigate options to increase kerb heights along High Street to provide some protection to properties. Investigate the effect of speed tables on surface water flows and any options available to reduce the frequency of surface water ponding. This should not be considered in isolation from the nearby property thresholds. Any improvement scheme would require a detailed design to ensure the risk from flooding was not increased.
	Review of gully cleaning schedule to increase frequency in the areas identified at higher risk of flooding.
CBC: Local Planning Authority	To consult the LLFA on any planning application affecting land to the south of Crawley Road to ensure the development proposals include SuDS and fulfil the opportunity to provide betterment to the local area. This includes restricting surface water runoff to greenfield rates and promotion of reinstating more natural land drainage.
Riparian owners	Riparian owners should consider rehabilitating the natural land drainage through the removal of culverts and reinstating ditches. All existing ditches and watercourses should be maintained to a good standard and ensure “the proper flow of water” by preventing any obstructions. The LLFA and IDB should be consulted and Consent under the Land Drainage Act 1991 applied for.
	Cranfield University should undertake maintenance to the ditch along Merchant Lane to ensure the surface water sewer has a clear outfall and overland flow from the airfield can be collected. The culverted sections of watercourse within the airfield and campus should be identified and their condition assessed. Where necessary, maintenance should be undertaken to ensure unrestricted flow given the importance of these land drainage systems for the local area of Cranfield. Improvements to the ordinary watercourses should be considered through liaison with the LLFA and IDB to ensure consideration are given to wider objectives for managing the risk from flooding.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Cranfield
Anglian Water	To inspect and maintain the surface water sewer outfall in Merchant Lane to ensure it has a free discharge.
	To understand the impact the small ditch discharge pipe has on the operation of surface water sewers.
	To work in partnership with other stakeholders to identify opportunities for improvements to the network, and receiving systems where necessary, particularly along Merchant Lane and High Street.

TABLE 6: RECOMMENDATIONS FOR AUTHORITIES AND STAKEHOLDERS AT DUNSTABLE

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Dunstable
CBC: Emergency Planning	Work with stakeholders to support measures at Dunstable which would empower the local community to increase their resilience against flooding through an Emergency Action Plan (subject to available funding and prioritisation).
CBC: Lead Local Flood Authority	Continue to keep a record of all reported flood incidents and any significant flood risk assets within the area.
	To continue to work with residents and riparian owners to make them aware of their responsibilities under the Land Drainage Act 1991.
	To continue to work with occupiers to improve their understanding of appropriate measures they could take to protect their property. This could include property-level flood resilience (PRM) measures at High Street South particularly given the interest from commercial entities and the potential to part fund from them and Anglian Water. PRM requires residents to work together and detailed surveys undertaken to ensure measures are identified that are fit for purpose and deliver benefit. A coordinated approach, supported in partnership with CBC LLFA, would be very advantageous to promote a successful scheme.
	To coordinate an investigation into the pump station adjacent to the bus way to establish ownership, purpose and capabilities.
	To work with CBC Highways in establishing a Flood Response Plan for Church Street.
CBC: Highways Authority	To further investigate, and undertake maintenance where appropriate, in particular the highway drainage system within Church Street, Luton Road and surrounding areas.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Dunstable
	Reconsider the development of a scheme to improve the highway drainage system within Church Street and High Street South. A scheme may look to include: additional or larger gullies to improve collection of runoff; above ground alterations, such as raised humps, to slow runoff and improve the collection of it; improved carrier drain with online storage; retrofitting of SuDS to better manager surface water. Should a drainage scheme not be possible, a Flood Response Plan could be developed at Church Street to manage a flood event as it happens. This could include automated road closure signs to warn drivers the road is unpassable and reduce response costs from sending operatives to site.
	Discuss the transfer of responsibly for the A5, High Street South with Highways England and the possibility of improvements given the flooding event. Drainage records should be requested and Highways England asked to survey the area if not available.
Anglian Water	To inspect the surface water and foul sewers within Church Street to their outfall and undertake maintenance where required. The capacity of these sewers could be identified to inform future decisions when considering new connections. The functionality and capacity of the pump station and associated storage shaft should be further understood and the findings shared with the LLFA and CBC Emergency Planning team.
	To consider a future scheme under AMP6/7 to retrofit SuDS within the area to reduce surface water runoff and manage it more sustainably.
	To continue to work with occupiers to improve their understanding of appropriate measures they could take to protect their property. This could include Property Resilience Measures (PRM) at High Street South particularly given the interest from commercial entities. Consideration should be given to supporting a potential scheme through funding contributions. Liaison with the LLFA and occupiers should be sought.
	To work partnership with other stakeholders to identify and develop opportunities to improve the sewer and/or receiving systems at High Street South and Church Street.

TABLE 7: RECOMMENDATIONS FOR AUTHORITIES AND STAKEHOLDERS AT STOTFOLD

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Stotfold
CBC: Emergency Planning	Emergency Planning could work with stakeholders to support measures at Stotfold which would empower the local community to increase their resilience against flooding through an Emergency Action Plan (subject to available funding and prioritisation).
CBC: Lead Local Flood Authority	Continue to keep a record of all reported flood incidents and any significant flood risk assets within the area.
	To continue to work with residents and riparian owners to make them aware of their responsibilities and to improve understanding of appropriate measures they could take to protect their property.
	To improve communication between CBC, the IDB, local residents and councillors.
	Given the history and complexities of flooding along the Pix Brook and the need for a better and consistent understanding of flood risk within Stotfold and other at-risk areas, the LLFA should lead on a catchment-wide study of the Pix Brook to further understand the flood mechanisms and identify possible solutions. The study should look to: • Include the catchment area upstream within Hertfordshire. • Understand how the Pix Brook reacts to a range of flood events including the impact of climate change and map the associated risks and hazards. • Improve and/or validate current modelling. • Identify and assess the operating instructions for the Standalone Farm Flood Storage Reservoir • Identify the impact that recent and planned development has had and will have on catchment response.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Stotfold
	• Understand land management practices and the impact these may have on flood risk. • Identify and assess flood risk management and mitigation options. • Provide an evidence base to inform future development in the area.
CBC: Highways Authority	CBC Highways to consider their emergency response capabilities to possible debris blocking of highway assets on Pix Brook and any other relevant assets.
	Consideration of alterations to the culvert at Brook Street and Hitchin Road should be evaluated with consideration given to any effects this would have on downstream water levels and associated flood risk.
	An inspection of all CBC Highway assets on Pix Brook within Stotfold should be completed and maintenance works undertaken where deemed necessary. Any works within the Pix Brook should be done following liaison with the IDB.
CBC: Local Planning Authority	It is highly recommended that the Environment Agency, LLFA and IDB are consulted on all minor and major developments within Stotfold, given the frequency and potential for flooding and the inconsistent understanding of flood risk across the organisations. This is to ensure development proposals are appropriate for the location and the risk to people and property is sufficiently mitigated with no increase elsewhere.
Environment Agency	Should consider the need for a review of the representation of flood risk on the Pix Brook within the Flood Map for Planning and its supporting modelling, in partnership with the IDB and CBC.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Stotfold
IDB	Support the LLFA to deliver a catchment-wide study of the Pix Brook through the provision of advice, technical data, information and funding; where possible.
	To share the operating procedure of the Standalone Reservoir with other Risk Management Authorities so they can better understand its functionality.
	Liaise with land owners of the conservation woodland area adjacent to the Pix Brook, which has been identified as a prime source of debris including watercress. This should endeavour to establish a maintenance procedure to reduce wood branches on the ground in the immediate vicinity of the watercourse, and to establish a process to monitor and control watercress growth in this area. They should also review additional land owners that could be engaged, such as the Anglian Water sewerage works and adjacent farmlands.
	Review the current inspection and maintenance regime to: • Manage debris sources, as identified in this report, along the corridor of the Pix Brook between the conservation wood and Hitchin Road. • Reduce possible debris sources along the back channel that runs parallel with the gardens of Brook Street. • If necessary, remove unconsented tree planting (and 3rd party structures) and increase vegetation maintenance to an appropriate standard. This would help to reduce fallen debris and prevent this from accumulating and entering the watercourse during flood flows. Any proposed trash screen along the Pix Brook or alternative locations, must be shown to follow the Environment Agency Trash and Security Screen Guidance 2009, and should recognise and make allowances for the significant debris load of the Pix Brook system.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Stotfold
	Any maintenance regimes for these structures must also take into account the debris loading in the Pix Brook. Any improvement works planned should be advised by a wider catchment study of the Pix Brook to ensure wider objectives and flood risk benefits are achieved.
	To review the Risk Assessment and Method Statement for the undertaking of maintenance to the culverts at Brook Street and Hitchin Road during flood conditions.
	Advise CBC Highway Authority of compromises in asset performance of the culverts during flood events.
	To work with stakeholders to support measures at Stotfold which would empower the local community to increase their resilience against flooding (subject to available funding and prioritisation).
	Continue to liaise with the Environment Agency regarding the representation within the Flood Map for Planning by sharing their hydraulic modelling to support the challenge.
Community Action Group	To liaise with riparian owners and raise awareness to their responsibilities to maintain the beds and banks of the ditches, watercourses and culverts adjacent to or within their property, and to keep them clear of obstructions such as vegetation and any other debris. This may include cutting back vegetation, removing blockages, ensuring that rubbish and garden waste is not stored along the banks of the watercourse where it can fall in were the water level to rise.
	To take an active role in the production of the Emergency Action Plan and delivery of its activities when activated.
	To monitor and report water levels, blockage or any other situation that may cause flooding from the Pix Brook, taking health and safety issues into account.

Authority/ Stakeholder	Recommended actions to manage the risk of flooding in the future for Stotfold
Land owners	Anyone affected by flooding should try to document as much information about the incident as possible. As the Pix Brook is classed an IDB watercourse, residents are advised to report incidents to the IDB on 01234 767995. CBC should also be contacted and will make a record of the details provided. In a flood emergency where there is a possible risk to life, residents are advised to contact the Fire and Rescue Service.

9 Jargon Buster

Term	Definition
Annual Probability	This is how often something is likely to occur in any given year. Floods are often defined according to their likelihood of occurring in any given year. For example, if you lived for 70 years in a location that had a 1% chance of flooding in any one year, then there would actually be a 50% chance, or one in two odds, of you experiencing at least one flood during that 70 year period.
Aquasacs	A 'sandless' alternative to sandbags promoted by CBC. An aquasac is a sturdy sack containing a superabsorbent polymer (SAP). After soaking in water for 5 – 8 minutes the bag self-inflates to over 30 times its original size. After inflation, the aquasac can be used in the construction of flood defenses in a similar way to using traditional sandbags.
Category 1 and 2 responders	These are organisations defined in the Civil Contingencies Act 2004 as having responsibilities for carrying out the legislation. These are typically "blue light" services, local authorities, the Environment Agency, National Health bodies, transport and utility providers.
Environment Agency Surface Water Map	Available online, it observes how rain water is likely to flow and pond. There are four levels of flood risk shown: • High - each year, the area has a chance of flooding of greater than 1 in 30 (3.3%) • Medium - each year, the area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%) • Low - each year, the area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%) • Very low - each year, the area has a chance of flooding of less than 1 in 1000 (0.1%)
Environment Agency Flood Map for Planning	Available online the map shows the probability of river and sea flooding using 'flood zones', defined as follows: • Flood Zone 1 – low probability • Flood Zone 2 – medium probability • Flood Zone 3a – high probability • Flood Zone 3b – the functional floodplain (i.e. land where water has to flow or be stored in times of flood)
Local Flood Risk Management	The Flood and Water Management Act requires a Lead Local Flood Authority to develop, maintain, apply and monitor a strategy for local flood risk management in its

Strategy	area. CBCs Strategy is available online and identifies objectives to manage local flood risk to local communities.
Main River	Watercourses designated as 'main rivers' as shown on the maps held by the Environment Agency, they generally the larger arterial watercourses, however they can include smaller watercourses of local significance.
Ordinary watercourse	Any river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a main river network.
Property Resilience Measure	Property Resilience Measures (PRM) are a process undertaken by individual property owners to protect their homes and business from flooding. PRM includes resistance measures (the fitting of manufactured products, such as barrier and airbrick covers, aimed at preventing flood water from entering the property) and resilience measures (actions taken to minimise damage caused by flooding). To find out more about PRM and the types of measures that are available please click here to download a short information leaflet entitled 'What is Property level Protection?'
Risk Management Authorities	Bodies recognized by the Flood and water management Act 2010 as having relevant powers and duties to manage flood risk. These are: • The Environment Agency • A lead local flood authority • A district council for an area for which there is no unitary authority • An internal drainage board • A water company • A highway authority
Yellow Warning of Rain	Is a warning provided by the MET office and means "severe weather is possible over the next few days and could affect you".

10 Disclaimer

Although every effort has been taken to ensure the accuracy of the information contained within the pages of the report, we cannot guarantee that the contents will always be current, accurate, or complete.

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

The findings of the report are based on a subjective assessment of the information available by those undertaking the investigation and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by Central Bedfordshire Council when preparing this report, including, but not limited to those key assumptions noted in the Report, including reliance on information provided by third parties.

Central Bedfordshire Council expressly disclaims responsibility for any error in, or omission from, this report arising from or in connection with any of the assumptions being incorrect.

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

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