Section 19 Flood Investigation

Flooding 14/15 November 2019

Various locations

Warwickshire County Council as Lead Local Flood Authority

Version	Date	Issued to
Version 1: Draft	April 2020	FRM
Version 2: Draft	October 2021	FRM
Version 3: Final draft	November 2021	Partners
Final	October 2022	Public

CONTENTS

1 EXECUTIVE SUMMARY

Parts of Warwickshire experienced a period of heavy rainfall on the 14 November 2019 which fell onto ground already saturated from previous wet weather. This resulted in internal property flooding to 34 properties, 28 emergency school closures, more than 150 reports of highway flooding resulting in a number of closures, and numerous reports of flooding to gardens, outbuildings and other land.

The impacts of the flooding were spread across a number of communities, most of which were within Stratford-on-Avon District Council area. There were also reports of flooding in parts of Warwick District and Rugby Borough areas.

As required by Section 19 of the Flood & Water Management Act 2010, Warwickshire County Council (WCC) as Lead Local Flood Authority (LLFA) has a duty to investigate flooding where the appropriate thresholds have been met. Our thresholds for investigation are outlined in our Local Flood Risk Management Strategy and have triggered the requirement for this report at 1 location (Clifford Chambers). However, to provide a more wide-ranging report on the flooding experienced on 14/15 November 2019, all 20 locations where internal property flooding was confirmed has been included.

In the recovery phase that followed, WCC worked with the National Flood Forum, Environment Agency, Severn Trent Water and District & Borough Councils to identify affected residents, provide advice and guidance and identify further actions.

Considerable work has taken place in the time since the event, with the recovery phase and follow-on actions now largely complete.

2 INTRODUCTION

2.1 The requirement to undertake this report

Section 19 of the Flood & Water Management Act 2010 (FWMA) requires that the Lead Local Flood Authority (LLFA) undertake an investigation (to the extent that it considers it necessary or appropriate) upon becoming aware of flooding in its area.

The role of the LLFA in Warwickshire is carried out by the Flood Risk Management team at Warwickshire County Council (WCC).

The flood investigation must also determine the risk management authorities (RMAs) that have relevant flood risk management functions and whether each of those authorities have exercised or is proposing to exercise those functions in response to the flood. See Appendix I for the responsibilities of the various RMAs involved in this flood event.

Warwickshire County Council's Surface Water Management Plan (SWMP) identifies the thresholds that will apply when determining whether an investigation under Section 19 of the FWMA is required. These thresholds are as follows:

1. Flooding that poses a threat to the safety of the public or may directly result in serious injury or death
2. Five or more residential properties internally flooded
3. Two or more commercial properties internally flooded
4. One or more piece of critical infrastructure affected that impact on the wider area
5. Flooding that places vulnerable individuals or vulnerable communities at risk e.g. hospitals, care and nursing homes, schools, etc.
6. Where one or more residential properties have flooded internally from the same source on five or more occasions within the last five years

2.2 Scope of this report

This report summarises the completed and ongoing investigations carried out by risk management authorities into the flooding which occurred across Warwickshire on the 14/15 November 2019.

As the impacts of flooding were widespread across Warwickshire, this report encompasses all 20 locations where internal property flooding was confirmed. Whilst not all these locations individually reach the investigation thresholds stated in the Local Flood Risk Management Strategy, it was agreed that by including all known locations, a fuller picture of the event could be provided.

This report does not obligate the LLFA or other risk management authorities into resolving the flooding issues investigated herein, nor is it possible for the LLFA to impose others to undertake any of the recommended actions.

2.3 Disclaimer

This report has been prepared as part of WCC's responsibilities under the FWMA. 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 WCC when preparing this report including reliance on information provided by others.

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3 WEATHER AND FLOOD INFORMATION

3.1 Antecedent conditions

In the two months preceding the 14/15 November flood event, Warwickshire experienced above-average rainfall[1] for the time of year. This rainfall had a notable impact on the condition of the ground causing soils to become wetter than average[2]. Heavy rainfall is known to runoff rapidly when clayey soils, such as those generally found across Warwickshire, are in such condition.

The rainfall in the months leading up to the flood event also meant that many rivers were responsive to further rainfall. During the week preceding the flood event, some of Warwickshire's rivers were considered to be notably or exceptionally high by the Environment Agency[3].

This event followed significant flooding earlier in the month across northern England and north-east Midlands.

3.2 Weather and flood warnings

A Met Office yellow warning for heavy rain was in force across Warwickshire for the 14th and 15th November 2019. There was also a yellow Flood Guidance Statement in force forecasting significant flooding impacts from rivers and surface water.

A number of Environment Agency Flood Alerts and Flood Warnings were also in force for river flooding across parts of Warwickshire.

3.3 Rainfall

From the early hours of the 14 November, a weather front brought a band of rain across Warwickshire which persisted for most of the day. The rain was generally heavier across southern parts of the county where the largest rainfall totals occurred. As shown in Figure 1 below, parts of the county received 39 mm of rain during this event, which is 60% of the average rainfall expected for the entire month[4].

[1] Met Office, 2020 < https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps> [accessed 06/02/2020]
[2] Environment Agency, 2019, *Monthly Water Situation Report for England, November 2019*
[3] Environment Agency, 2019, *Weekly rainfall and river flow summary: 6-12 November 2019*
[4] Environment Agency, 2019, *Weekly rainfall and river flow summary: 13-19 November 2019* (where the long-term average rainfall for November is 65 mm for central England)

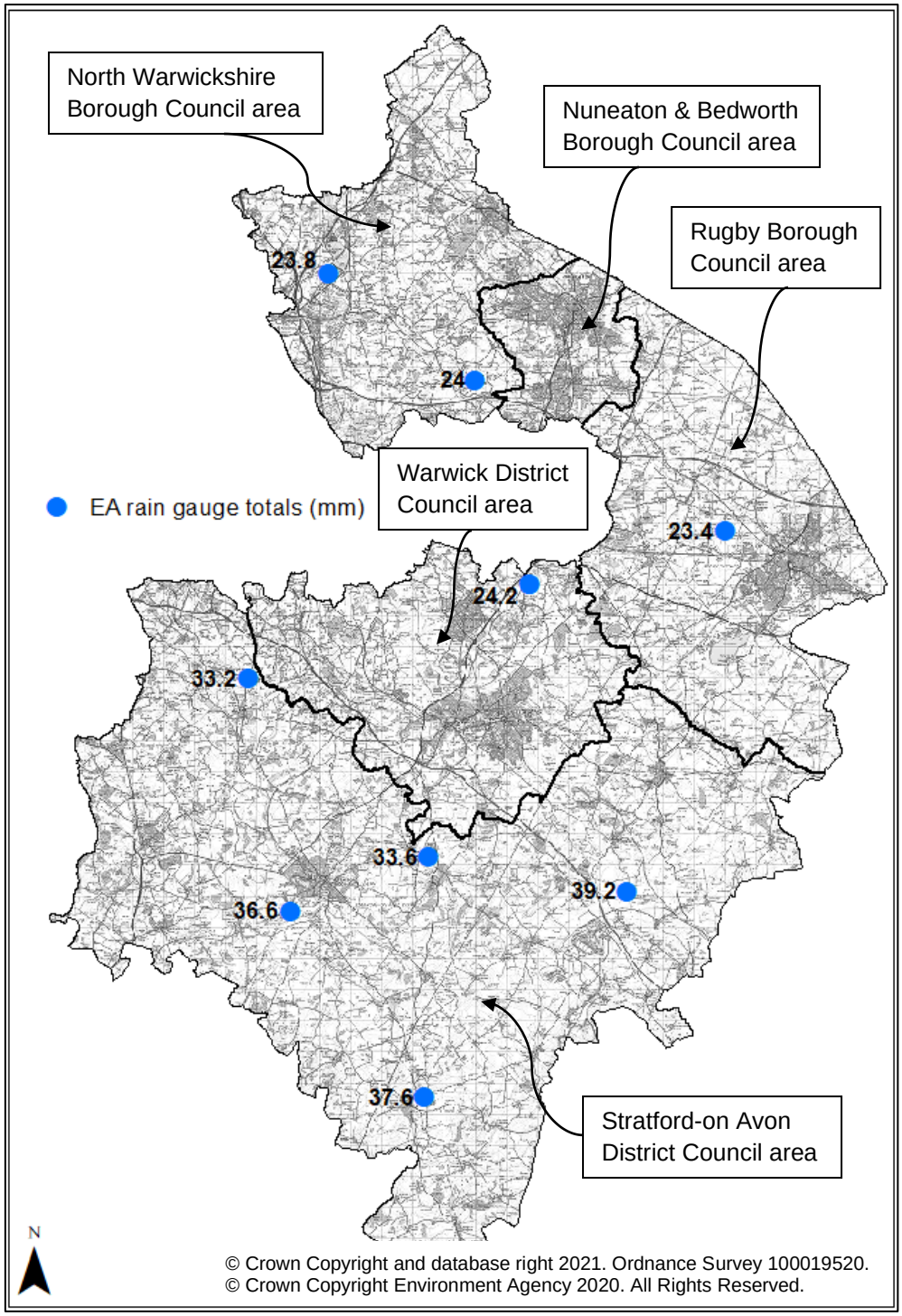


Figure 1: Map of Warwickshire and District/borough boundaries showing 48 hr rainfall accumulations in Environment Agency rain gauges on the 14/15 November 2019.

3.4 River response

Data from Environment Agency river gauges show that there was a notable rise in river levels across Warwickshire following heavy rainfall on 14 November. Rivers generally peaked later on the 14 November, or into the 15 November on some larger rivers. Anecdotal evidence suggests some smaller ordinary watercourses, such as those in steep or urban areas, responded to rainfall more quickly.

4 INVESTIGATION SUMMARY

4.1 Locations included in the investigation

There was a total of 34 properties that suffered from internal flooding across 20 locations, most of which were within Stratford-on-Avon District Council administrative area. Three of these properties were business premises and the remainder residential.

These locations form the basis of this investigation and are listed below and shown spatially in Figure 2.

Appendix A	Alderminster
Appendix B	Clifford Chambers
Appendix C	Loxley
Appendix D	Snitterfield
Appendix E	Stourton
Appendix F	Welford-on-Avon
Appendix G	Alcester, Arlescote, Bidford, Burmington, Eathorpe, Leamington Spa, Lower Brailes, Luddington, Marlcliff, Marton, Newbold-on-Stour, Sambourne, Southam, Upper Brailes

The summary of our investigations into flooding at these locations are contained within the appendices. Based on the complexity of the investigation, each location is either formed of a two-page summary or an entry in the table in Appendix G.

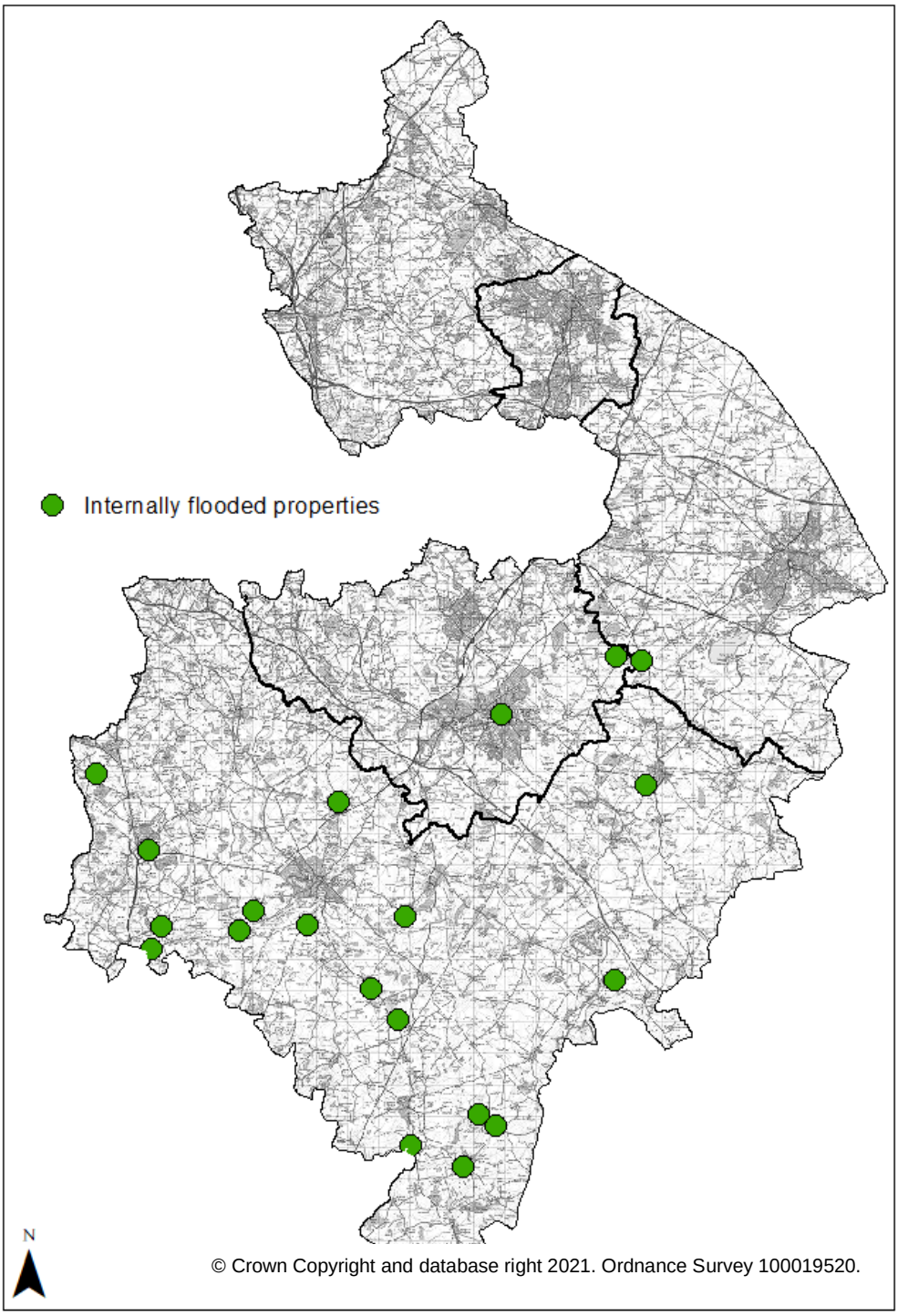


Figure 2: Map of Warwickshire and District/borough boundaries showing locations of confirmed internally flooded properties on the 14/15 November 2019.

4.2 Wider impact summary

This section summaries other flooding impacts reported across the county. This is to gain a wider appreciation of the extent of flooding on the 14/15 November 2019.

4.2.1 Highway flooding

There were more than 150 reports of highway flooding during the 14/15 November. Figure 3 below shows the location of these reports which were fairly widespread across the county. WCC County Highways team responded to these reports by closing roads, placing flood signage and deploying sandbags where properties were significantly affected by flooding from the highway and resources allowed.

Figure 3 shows the 40 locations where Warwickshire Fire and Rescue Service attended a water rescue call-out, such as a vehicle stranded in flood water on the highway. These were mostly in the south of the county.

Also shown on Figure 3 is the highway resilient network. This network shows the stretches of WCC highway which are given priority during extreme weather to maintain economic activity and access to key services. A total of 43 of all highway or fire and rescue reports occurred on the resilient network.

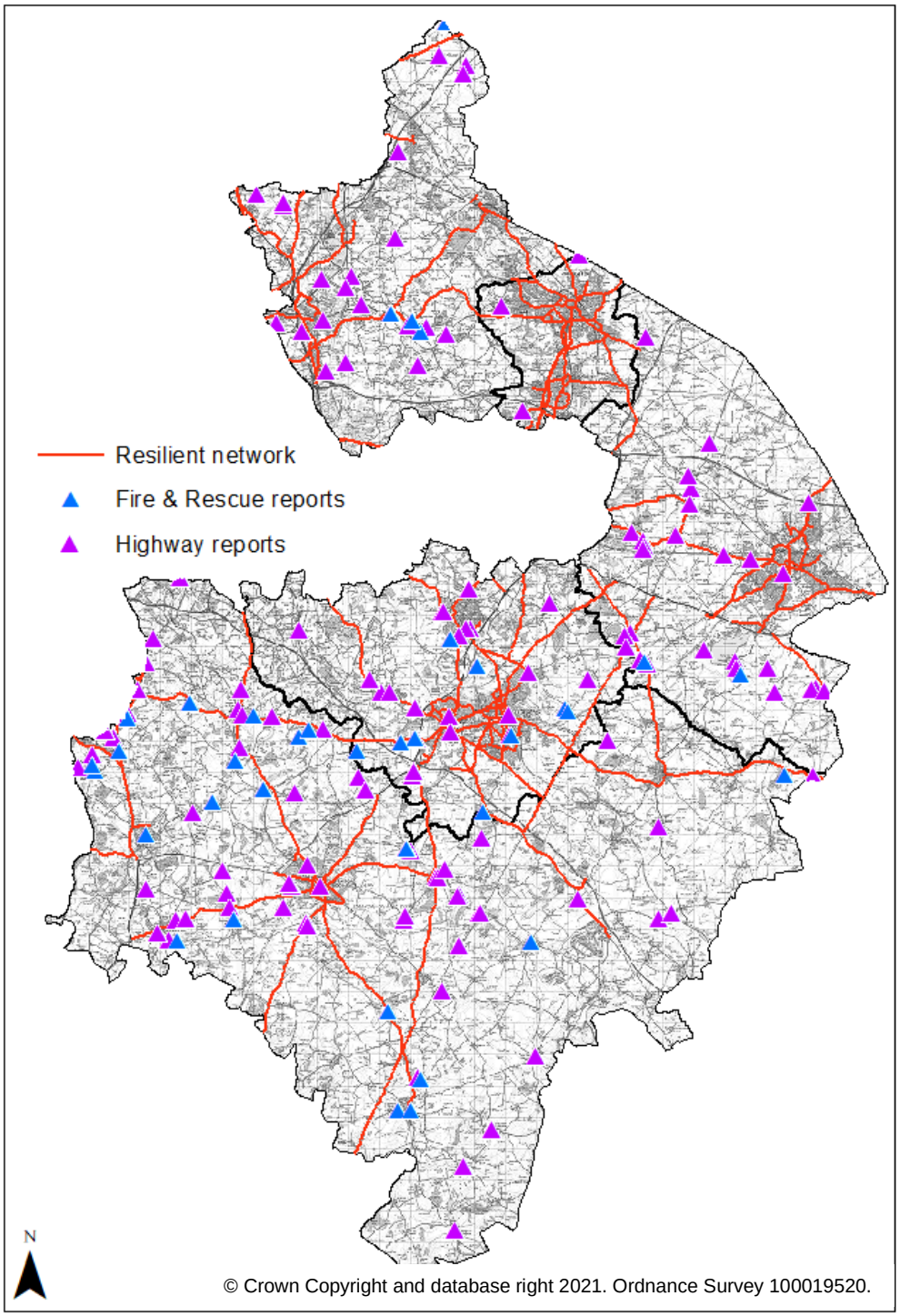


Figure 3: Map of Warwickshire and District/borough boundaries showing locations of the WCC highway resilient network, WCC highway flood reports and Warwickshire Fire & Rescue service water rescues on the 14/15 November 2019.

4.2.2 Other reports of flooding

In addition to the reports detailed above, there were a large number of other reports of flooding across the county. These reports mostly consisted of reports of flooding to gardens, garages or outbuildings, driveways and footpaths.

Some of these reports were of property flooding that remained unconfirmed despite efforts to confirm this. WCC and other partners made a number of attempts to confirm any reports of internal property flooding, such as visiting the property and sending written correspondence. As we were unable to make contact with relevant residents these were recorded as unconfirmed for the purpose of this report.

There were 28 emergency school closures across the county as staff and students were unable to safely access the schools due to flooding to the highway or external areas of the school grounds. The distribution of these schools is shown in Figure 4.

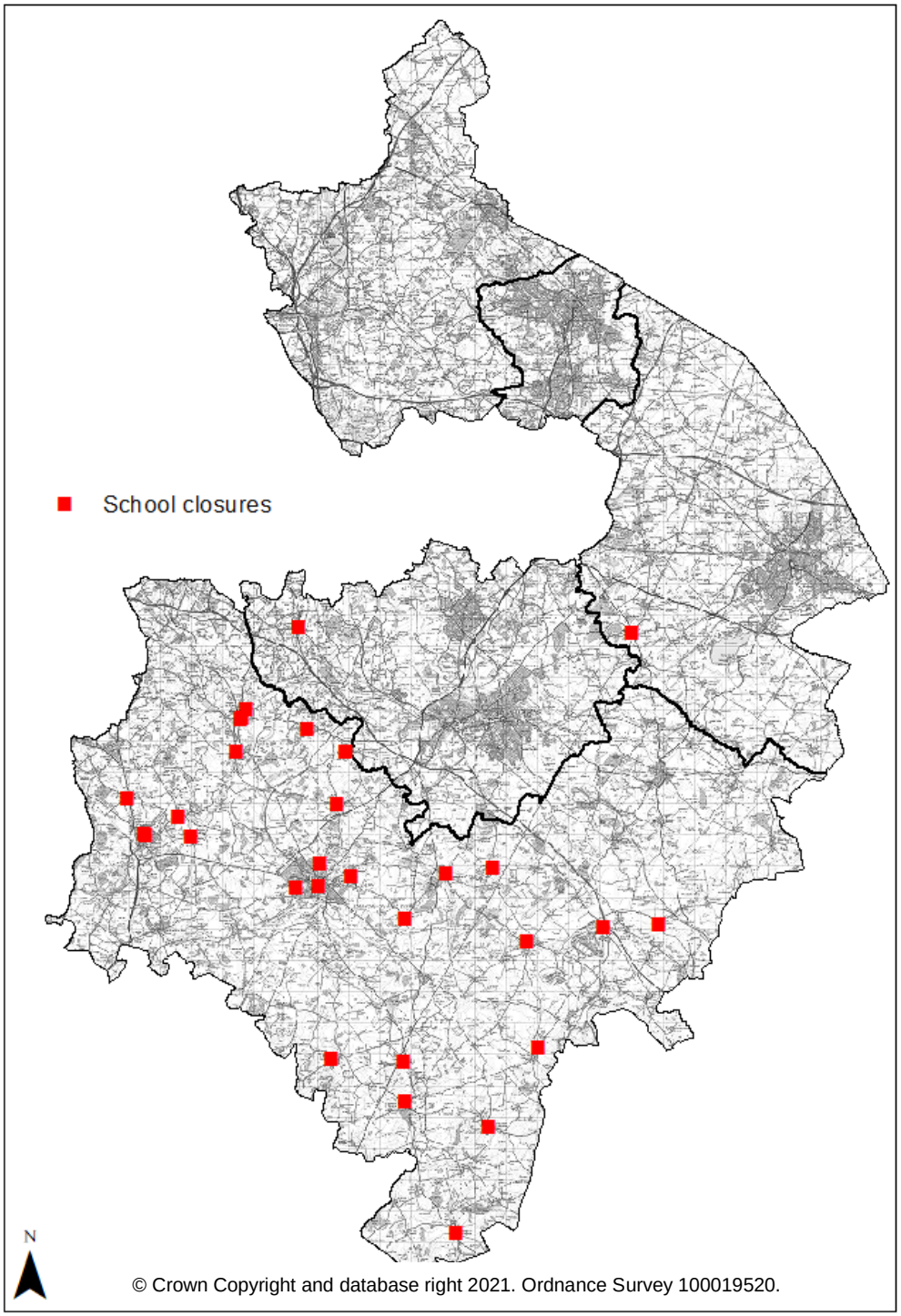


Figure 4: Map of Warwickshire and District/borough boundaries showing locations of closed schools due to flooded access on the 14/15 November 2019.

5 KEY CONCLUSIONS OF THE INVESTIGATION

5.1 Source of flooding

The flood impacts from the rain which fell across Warwickshire on 14/15 November 2019 was exacerbated by the wet conditions in the months preceding the event. Rivers reacted quickly to the rainfall causing river flooding in some areas. In other areas rainfall quickly ran as overland flow across already saturated ground leading to surface water flooding. The source of flooding in some areas was complex, usually where a combination of sources brought about flooding impacts.

5.2 Gathering data for the investigation

In the immediate aftermath of the flood event, officers from WCC attended many of the locations included in this report to gather information on the extent of flooding and offer support and guidance to those affected.

Subsequent to this WCC worked with partners to confirm those properties affected by flooding through further site visits and/or postal questionnaires. SDC also supported us on this by attending site visits and sending correspondence.

5.3 Summary of investigations

Due to the fact that the flooding occurred in a large number of communities, there was no clear single cause of the flooding. It is noted however that reports of excess surface water runoff from fields or the highway were common in a number of locations.

Approximately 70% of the locations included in this investigation experienced flooding from surface water runoff, which by far makes it the most common source of flooding during this event.

Almost half of all locations were affected by a combination of flooding sources. This shows the complex interactions that take place in some areas resulting in flooding where no simple solution can be applied. It also shows the importance of a multi-agency approach whereby residents and landowners must work alongside one or more risk management authorities to address the issue.

The table below shows how prevalent each source of flooding was across the 20 locations included in this report. As discussed above, surface water clearly stands out but there are a number of other sources of flooding which contributed to the flooding observed across the event. The appendices detail the site-specific conclusions.

Source of flooding	Percentage of locations affected by this source*
Surface water	70%
Ordinary watercourse	25%
Main river	30%
Sewer	10%
Other (such as groundwater)	10%

*Note that this column does not add up to 100% as some locations were affected by more than one source

Each location has identified recommendations for one or more relevant risk management authorities to carry out their role in investigating the cause of flooding further and/or help reduce the risk in the future. Whilst we have given recommended actions, there may be a number of reasons why such recommendations are not taken forward (for example funding availability, landowner agreement).

Many of the properties flooded are within areas modelled at risk of flooding from rivers, surface water or both on Environment Agency mapping. However some properties had not previously experienced flooding to the extent of 14/15 November 2019 to the knowledge of the residents.

5.4 Government flood recovery grants

Soon after the flooding on 14/15 November, the government announced activation of the MHCLG Flood Recovery Framework and the Defra Property Flood Resilience (PFR) Recovery Support Scheme 2019 due to the widescale flooding across England at the time.

Where there were a minimum of 25 properties that had suffered internal flooding within a single district/borough administrative area during this flood event, the district/borough council became eligible to award the recovery grants to affected and eligible properties.

Within Warwickshire, only Stratford-on-Avon District Council (SDC) met the governments criteria for these schemes. We, as LLFA, supported SDC in administering the schemes and recommended those properties eligible for the scheme install property flood resilience. This is reflected in the recommended actions listed in the following appendices.

Thirty properties were eligible for the Defra PFR grant scheme within SDC administrative area. However only eight properties made a successful application despite best efforts by SDC and WCC to encourage uptake and provide support and advice through the process. SDC and WCC have shared feedback on the process with Defra/EA with a view to improving the process and maximising uptake should the scheme/s be activated again in the future.

6 APPENDICES A-G: LOCATION REPORTS

Appendix A: Shipston Road, Alderminster

Appendix B: The Nashes, Clifford Chambers

Appendix C: Goldicote Road, Loxley

Appendix D: School Road, Snitterfield

Appendix E: Village Road, Stourton

Appendix F: Pool Close, Welford-on-Avon

Appendix G: Alcester, Arlescote, Bidford, Burmington, Eathorpe, Leamington Spa, Lower Brailes, Luddington, Marlcliff, Marton, Newbold-on-Stour, Sambourne, Southam, Upper Brailes

WCC Section 19 Flood Investigation

SHIPSTON ROAD, ALDERMINSTER

Appendix A

What was affected?

Residential properties internally flooded	2
Commercial properties internally flooded	0
Properties externally flooded	1

Source of flooding

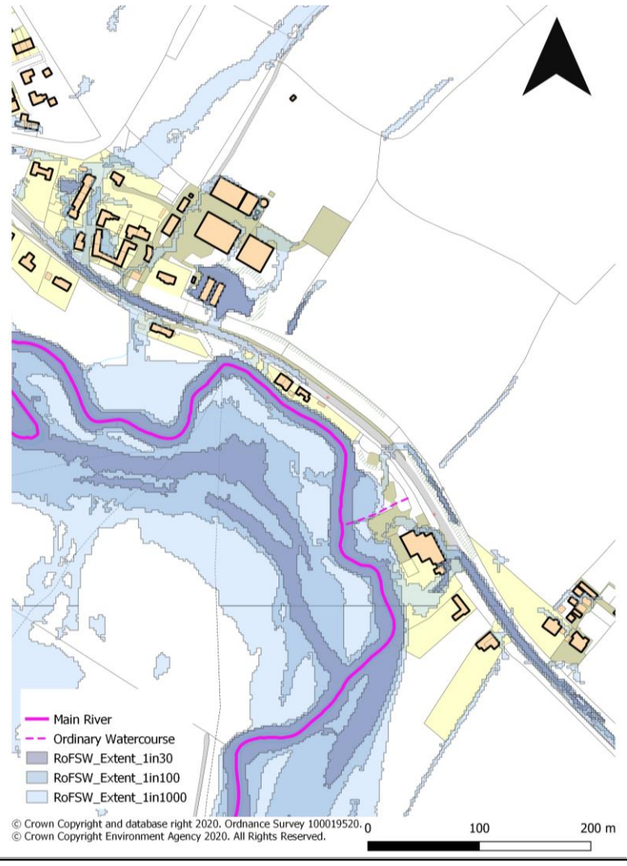
Surface water	✓
Sewers	✗
Main river	✗
Ordinary watercourse	✗
Other	✗

How does the existing system operate?

The village of Alderminster is located about 4 miles south of Stratford-upon-Avon.

The River Stour flows to the south of the settlement generally flowing in a north eastern direction. The Stour, which is classified as a main river, is joined by several unnamed Ordinary Watercourses in Alderminster, including land drainage ditches. The land to the north of Alderminster rises steeply and is generally set aside as arable land. The land also rises to the east along the route of Shipston Road.

In the vicinity of Shipston Road (A3400), surface water is captured either through the highways drainage network or through a number of private riparian culverts which drain to the Stour. The ability of these systems to discharge is likely restricted when the Stour is high and submerges the outlets.



Note that the Risk of Flooding from Surface Water (RoFSW) mapping shown above is a national-scale model indicating long-term risk. It does not include the effect of formal drainage systems nor does it identify the areas that flooded on the 14/15 November 2019.

What happened here on 14/15 November 2019?

Significant flows were reported to have entered the carriageway from the higher agricultural land north of Shipston Road. These flows exceeded the capacity of the WCC Highways network which is not designed to carry runoff from adjacent land.

Surface water flows in the carriageway followed the contours of the highway toward Alderminster (see indicative flow arrows on map) and were able to flow between two residential dwellings utilising an area of dropped kerb used for car parking.

The remaining flows continued north-westwards before entering the Stour by means of a similar area of dropped kerb associated with a car parking area. During the event water had welled up from beneath the floor flooding the properties to several centimetres. There are anecdotal reports that an old and damaged land drain may flow beneath the properties, however no records exist to confirm the existence of such a feature.

It is notable that significant ditching works have been undertaken in the land above the affected properties which may have channelled flows towards the highway. It should be noted that the works undertaken appear to have been undertaken as maintenance works and are not newly constructed features.

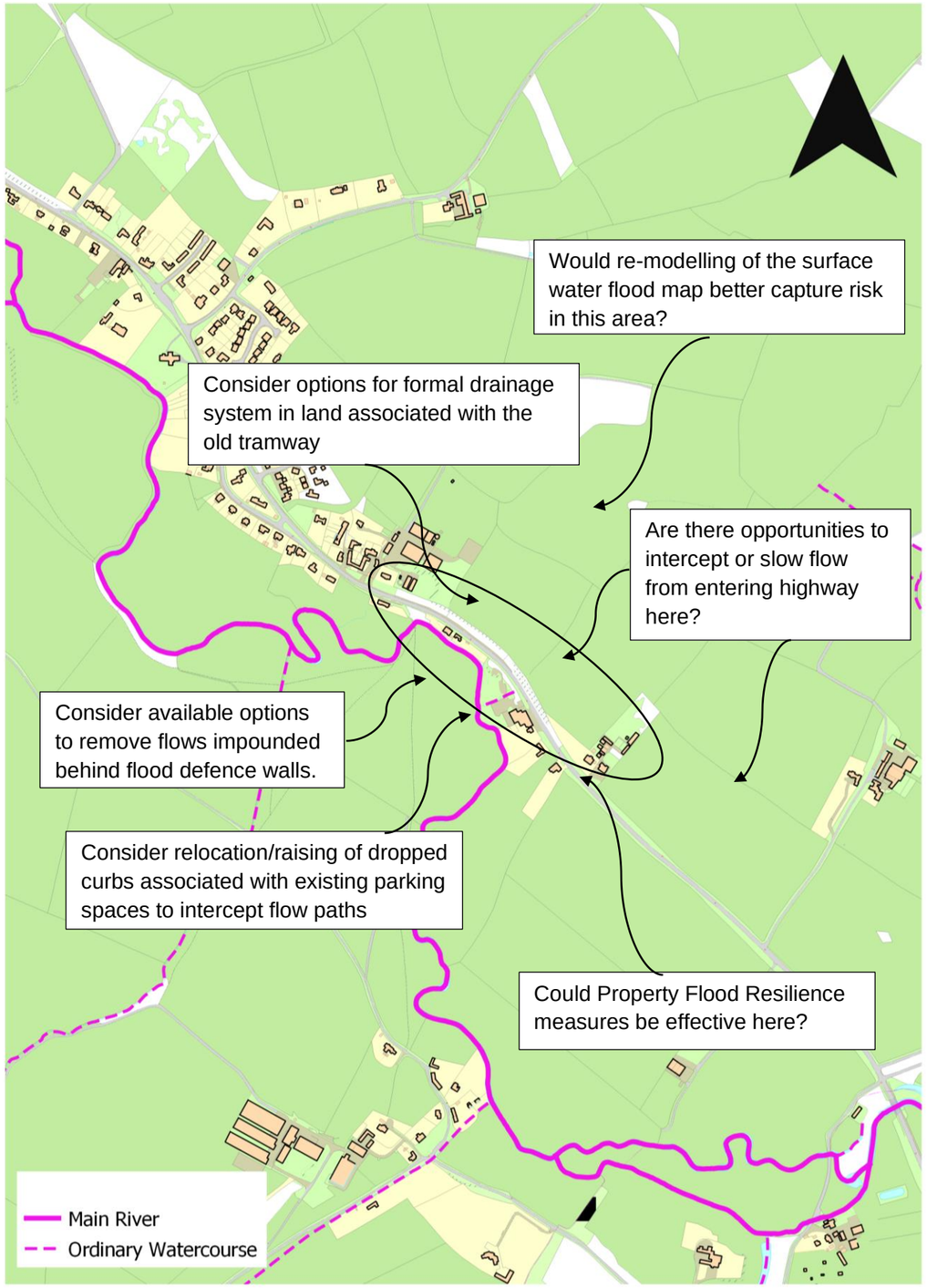
Is there a history of flooding in this location?

- Historic reports of water ingress to one property resulting from a damaged highway drain. This line has now been abandoned and outfalls elsewhere away from the property.
- A second flood event was subsequently reported (9th January 2020) by one of the same properties affected in November and a business property flooded by a similar mechanism. It was reported that significant volumes of water were impounded behind a flood defence wall within the garden of the property eventually exceeding the threshold level of the property, causing internal property flooding and resulting in the failure of the flood wall.

What actions are being taken?

No.	Action	Responsible authority	Progress
1	Establish condition/connectivity of culvert under carriageway that takes field drainage.	WCC LLFA	Complete
2	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval on Shipston Road.	WCC Highways	Complete – embedded as business as usual
3	Advise resident to consider investigating the presence of a private land drain and undertaking repairs as appropriate.	WCC LLFA	Complete
4	Undertake appropriate checks to ensure culverted system under the public highway and private land on the south eastern edge of the village is suitably maintained following recent ditching activities.	WCC Highways WCC LLFA	Ongoing
5	Offer advice to residents that have been internally flooded from this event	WCC LLFA	Complete
6	Reprofiling of highway verge/accesses adjacent to affected properties to redirect flows / additional drainage	WCC Highways	Complete
7	Offer eligible residents access to the Defra Property Flood Resilience grant	SDC	Complete – 2 properties took up offer of PFR grant

What are the future opportunities that may reduce flood risk here?



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WCC Section 19 Flood Investigation

THE NASHES, CLIFFORD CHAMBERS

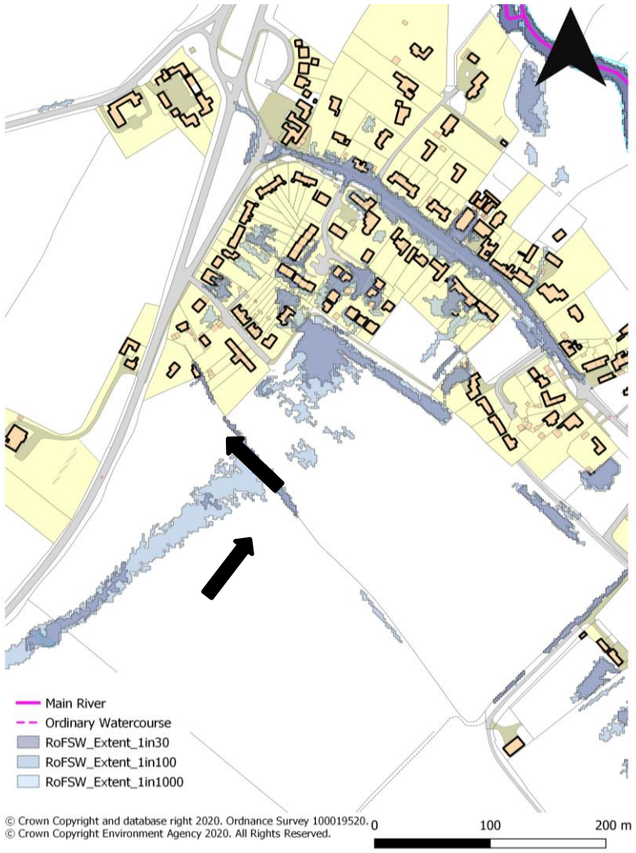
Appendix B

What was affected?

Residential properties internally flooded	5
Commercial properties internally flooded	0
Properties externally flooded	3

Source of flooding

Surface water	✓
Sewers	✗
Main river	✗
Ordinary watercourse	✗
Other	✗



Note that the Risk of Flooding from Surface Water (RoFSW) mapping shown above is a national-scale model indicating long-term risk. It does not include the effect of formal drainage systems nor does it identify the areas that flooded on the 14/15 November 2019.

How does the existing system operate?

The village of Clifford Chambers is located about 3 miles south of Stratford-upon-Avon.

There is a ditch elevated above the rear of several properties along The Nashes at Clifford Chambers. This ditch conveys surface water runoff from a large area of land to the south of Clifford Chambers, primarily used for agriculture, known as Martins Hill (see indicative flow arrows on map). The ditch then becomes culverted and flows discharged into the highway drainage system which is located on Campden Road.

This water is then discharged in a northerly direction via a combination of ditches and piped systems into the River Stour.

Some properties along The Nashes have taken measures to protect their properties from flooding, such as the installation of property flood resilience measures and approaches to intercept flood flows within rear gardens.

What happened here on 14/15 November 2019?

Due to saturated ground conditions, heavy rainfall generated overland flows across Martins Hill which is situated to the south of The Nashes. The volume of water entering the ditch from Martins Hill exceeded the capacity of the ditch and overtopped. Water entered the gardens of numerous properties and eventually led to internal flooding to properties.

To the East of The Nashes is an allotments site that like Martins Hill to the south, was already saturated due to the volume of rainfall. Surface water flows again made their way off the allotments and entered The Nashes flooding the road as well as numerous other properties internally.

In total, four properties along The Nashes and one property further into Clifford Chambers near Barn Close internally flooded.

Is there a history of flooding in this location?

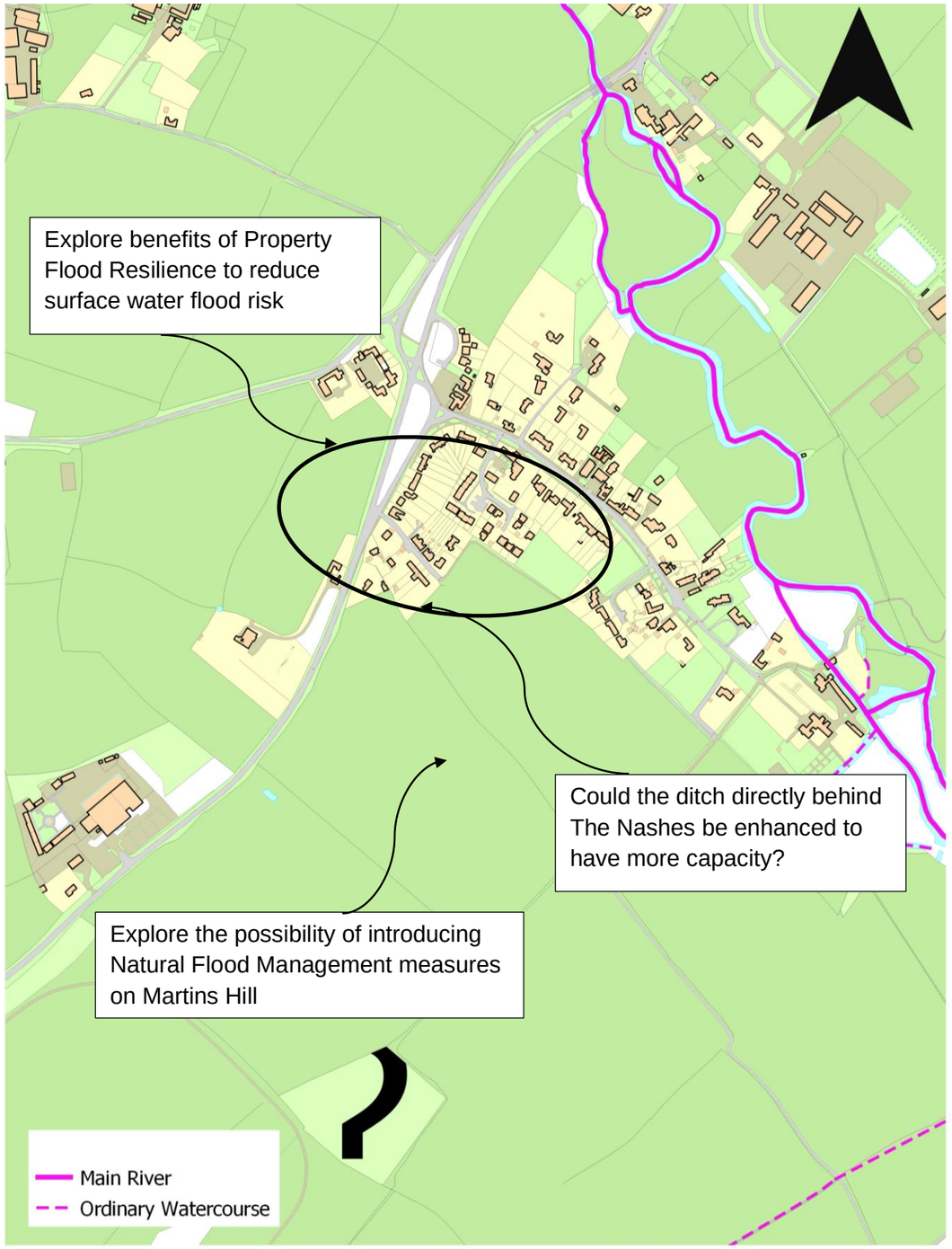
- Reports of internal property flooding in Clifford Chambers in 1998 (18 properties), 2007 (10 properties), 2012.
- As part of our visit to Clifford Chambers in November we were made aware of other occasions where internal property flooding had occurred however no specific dates were provided, including some near misses nearby in Clifford Chambers.
- In February 2020 we received reports from residents on The Nashes that runoff from Martins Hill had once again caused flooding however no properties were reported to have been affected internally. More recently, flooding has occurred in the vicinity of The Close.

THE NASHES, CLIFFORD CHAMBERS

What actions are being taken?

No.	Action	Responsible authority	Progress
1	Continue to progress with works to deliver a Property Flood Resilience scheme in Clifford Chambers in 2022-2023	WCC LLFA	Ongoing – Outline Business Case approved by EA
2	Offer advice to residents that have been internally flooded from this event	WCC LLFA	Complete
3	Remind local landowners of their riparian duties to maintain watercourses	WCC LLFA	Complete
4	WCC to explore wider drainage issues within Clifford Chambers to see if there are opportunities to reduce the flood risk	WCC LLFA	Ongoing
5	Offer eligible residents access to the Defra Property Flood Resilience grant	SDC	Complete – 1 property took up offer of PFR grant

What are the future opportunities that may reduce flood risk here?



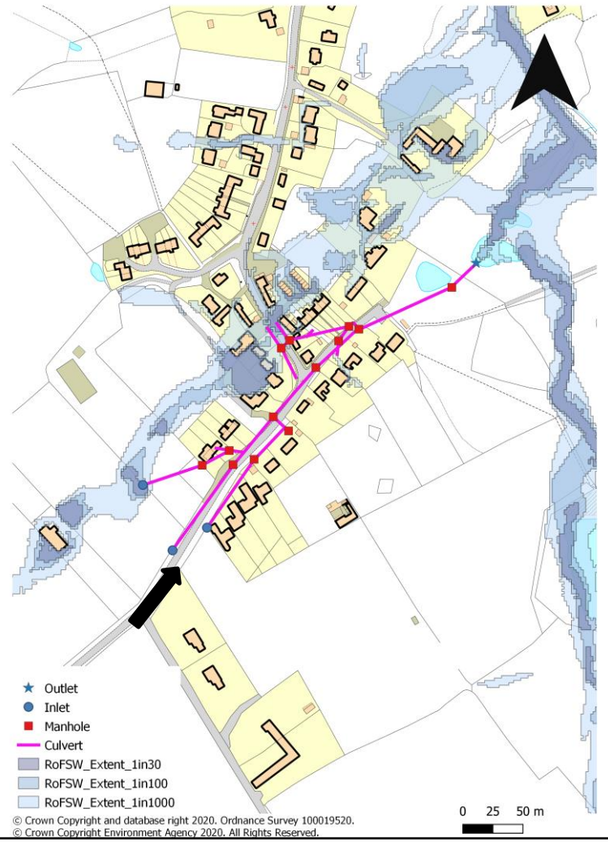
GOLDICOTE ROAD, LOXLEY

What was affected?

Residential properties internally flooded	1
Commercial properties internally flooded	0
Properties externally flooded	4

Source of flooding

Surface water	✓
Sewers	✗
Main river	✗
Ordinary watercourse	✗
Other	✗



Note that the Risk of Flooding from Surface Water (RoFSW) mapping shown above is a national-scale model indicating long-term risk. It does not include the effect of formal drainage systems nor does it identify the areas that flooded on the 14/15 November 2019.

How does the existing system operate?

The village of Loxley is located about 3 miles south-east of Stratford-upon-Avon.

The village drains from the surrounding higher land, notably to the south and drains broadly in a northerly direction before entering the River Dene at Charlcote. The village drainage is served by several open ditches and culverted systems, a large proportion of which are the responsibility of private landowners to maintain.

Detailed survey works and extensive root cutting were undertaken on the drainage systems on Goldicote Road and Manor Drive in late 2018. The downstream sections of the system appear susceptible to root ingress and several sections within the village were noted to have been historically repaired by private landowners with a range of pipework sizes. The culverted drainage infrastructure of Loxley is in part be maintainable by WCC as a Highways Authority, however large sections are the riparian responsibility of a large number of private landowners and dwellings.

What happened here on 14/15 November 2019?

Following heavy rainfall it is reported that surface water flows entered the highway (Goldicote Road) from land south-west of the village (see indicative flow arrow on map). The resulting flows overwhelmed the highway drainage, flowing northward and down Manor Drive. It was reported that flows surcharged from a chamber on Goldicote Road. This chamber was inspected post-flood event and noted to be holding water, suggesting a blockage or similar issue in the downstream system. This flow path is not shown on the EA RoFSW map (left).

Internal flooding occurred to one property located in the resulting surface water flow path. It is reported that whilst water did not breach the threshold of the property, it appeared to have risen through the floor.

Is there a history of flooding in this location?

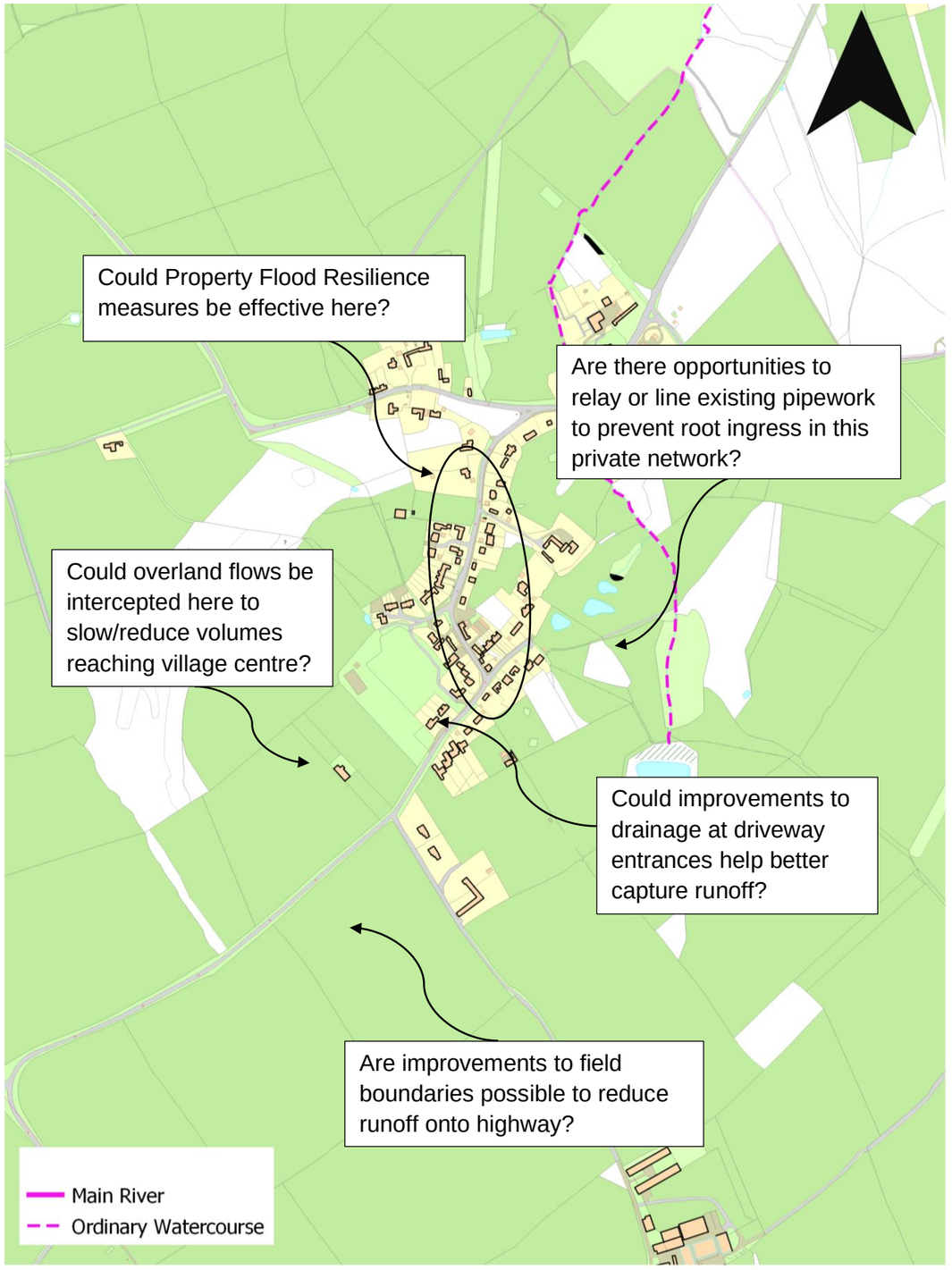
- Repeated garden, driveway and garage flooding at this location.
- External flooding occurred through similar mechanisms on 9 January 2020.

GOLDICOTE ROAD, LOXLEY

What actions are being taken?

No.	Action	Responsible authority	Progress
1	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval on Goldicote Road.	WCC Highways	Complete – embedded as business as usual
2	Investigate why system on Goldicote Road is not flowing effectively.	WCC Highways	Complete
3	Offer advice to residents and business owners that have been internally flooded from this event	WCC LLFA	Complete
4	Offer eligible residents access to the Defra Property Flood Resilience grant	SDC	Complete – 0 properties took up offer of PFR grant

What are the future opportunities that may reduce flood risk here?



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WCC Section 19 Flood Investigation

SCHOOL LANE, SNITTERFIELD

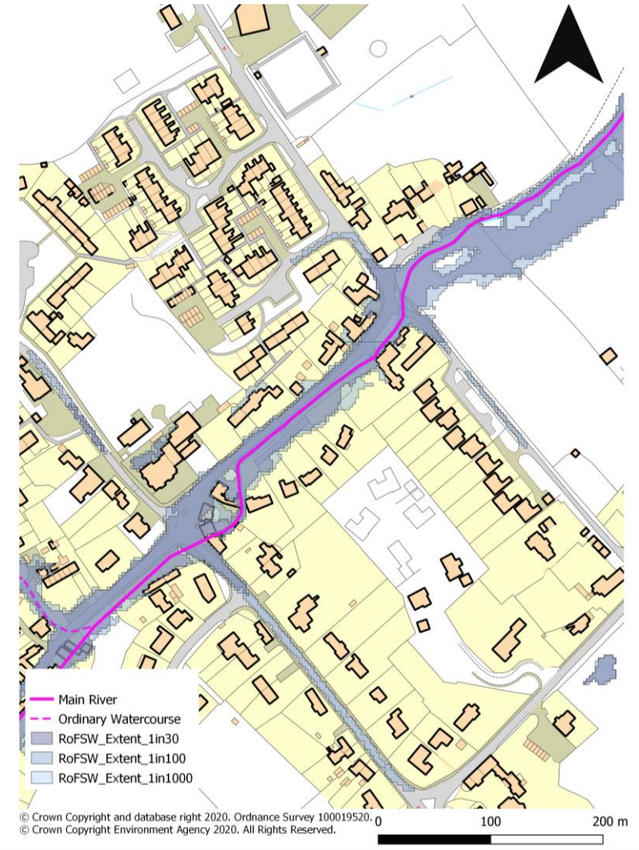
Appendix D

What was affected?

Residential properties internally flooded	4
Commercial properties internally flooded	0
Properties externally flooded	4

Source of flooding

Surface water	✓
Sewers	✓
Main river	✓
Ordinary watercourse	✗
Other	✗



Note that the Risk of Flooding from Surface Water (RoFSW) mapping shown above is a national-scale model indicating long-term risk. It does not include the effect of formal drainage systems nor does it identify the areas that flooded on the 14/15 November 2019.

How does the existing system operate?

The village of Snitterfield is located about 3 miles north of Stratford-upon-Avon.

All the gullies sited at the junction of School Road, Wolverton Road and Bell Lane discharge into an access chamber positioned outside of Brook Barn. From here, there is a 300 mm diameter pipe which connects to an access chamber adjacent to the Bell Brook. There is an outlet from this access chamber to the Bell Brook which has a gate flap arrangement to prevent water flowing from the Bell Brook back up the system.

A bypass culvert was constructed upstream of this location along the Bell Brook to route flows away from properties.

What happened here on 14/15 November 2019?

Following a period of heavy rainfall, the river level in the Bell Brook rose significantly. This prevented the highway drainage surface water system from discharging into the Bell Brook as it would during normal conditions. The Bell Brook then burst its bank leading to further highway flooding and overwhelmed the foul sewer system causing this to back up leading to internal property flooding.

In close proximity to School Lane are a number of steep roads including Bell Lane, Wolverton Road, Smiths Lane and Bearley Road. Any water that fell on these stretches of highway ran down towards the low point of the village (School Lane) and began to collect around the already full Bell Brook.

In total 5 properties were flooded internally, some to depths in excess of 15 centimetres.

Is there a history of flooding in this location?

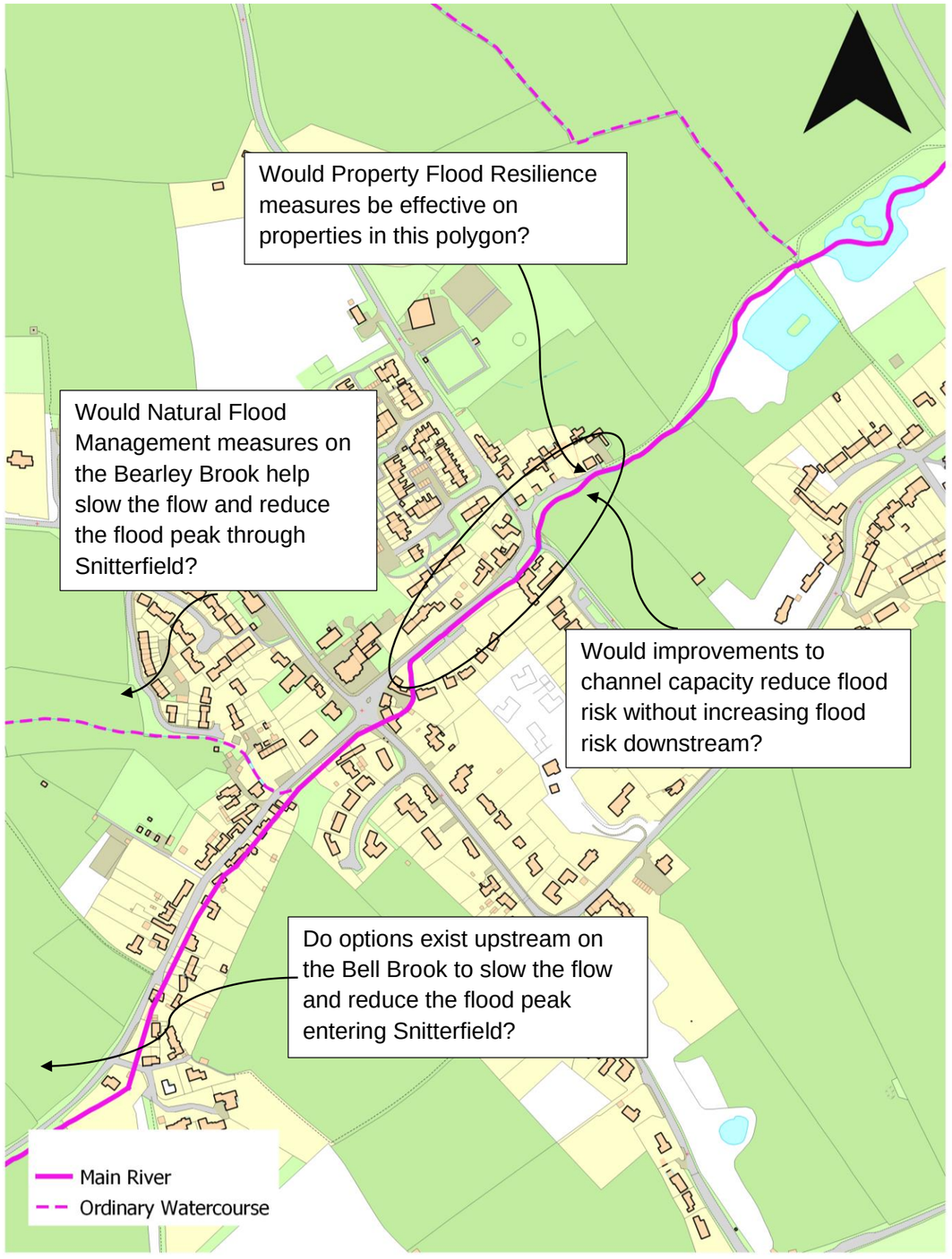
- WCC as the LLFA hold historic records of flooding occurring in Snitterfield in September 2019, March and February 2016, 2012, 2007 and 1998.
- Further flooding occurred in Snitterfield in August 2020, including internal flooding to properties.

SCHOOL LANE, SNITTERFIELD

What actions are being taken?

No.	Action	Responsible authority	Progress
1	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval on School Lane	WCC Highways	Complete – embedded as business as usual
2	Carry out a CCTV Survey from manhole 3801 down towards manhole 4001 in the vicinity of the primary school and School Road to investigate foul drainage issues	STW	Complete
3	Progress with works to carry out a modelling exercise of the Bell Brook from Smith's Lane to downstream of the two ponds east of Snitterfield	EA	Ongoing
4	WCC LLFA to work with residents group to investigate options to reduce flood risk within the village, ensuring riparian duties are met.	WCC LLFA	Ongoing – frequent engagement with community
5	Severn Trent Water to consider whether options exist to reduce the risk of sewer flooding here in the future.	STW	Ongoing
6	Offer eligible residents access to the Defra Property Flood Resilience grant	SDC	Complete – 0 properties took up offer of PFR grant

What are the future opportunities that may reduce flood risk here?



WCC Section 19 Flood Investigation

VILLAGE ROAD, STOURTON

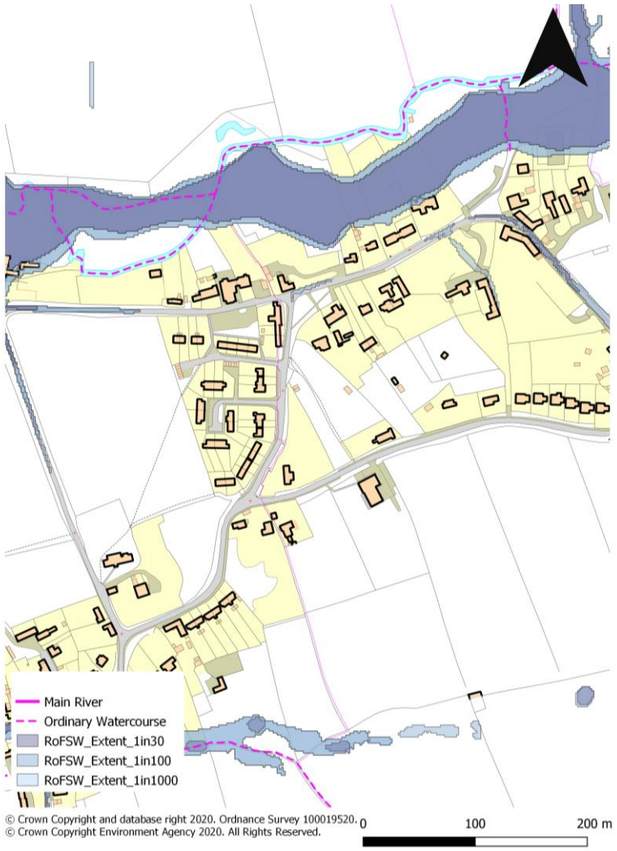
Appendix E

What was affected?

Residential properties internally flooded	4
Commercial properties internally flooded	0
Properties externally flooded	3

Source of flooding

Surface water	✓
Sewers	✗
Main river	✗
Ordinary watercourse	✓
Other	✓



Note that the Risk of Flooding from Surface Water (RoFSW) mapping shown above is a national-scale model indicating long-term risk. It does not include the effect of formal drainage systems nor does it identify the areas that flooded on the 14/15 November 2019.

How does the existing system operate?

The village of Stourton is located about 3 miles south-east of Shipston-on-Stour in Stratford-on-Avon district.

The Sutton Brook meets the River Stour a short distance upstream of Stourton and runs westwards across the northern parts of the village. The Environment Agency fluvial flood map and surface water flood map shows areas of flood risk to the rears of several properties along Village Road due to the River Stour.

The highway on Village Road is level with, or slightly elevated above, the property thresholds of some dwellings. As such any excess surface water flows on the highway have the potential to flow toward these properties where local levels allow for this, such as where dropped kerbs exist.

A highway drainage system exists in Village Road, with gullies evident along both sides of the carriageway.

What happened here on 14/15 November 2019?

Following a period of heavy rainfall, the River Stour rose significantly and spilled onto the floodplain. Flood water affected a number of properties, with depths of up to 1 m in gardens and fields adjacent to the river through Stourton.

WCC County Highways team received requests for sandbags from residents in Stourton.

Some properties used sandbags and/or had flood boards installed on door openings, although feedback from residents was varied as some questioned their effectiveness.

Despite the above measures, flood water managed to get inside four properties with depths up to 5 centimetres reported within habitable rooms.

It is likely that flood water managed to enter properties through openings (such as doors, air bricks and waste pipes), floors and walls.

Some properties reported flood water affecting their frontages which may have been due to a combination of high groundwater levels from the Stour in flood and also surface water runoff from the highway. The highway itself was reportedly flooded.

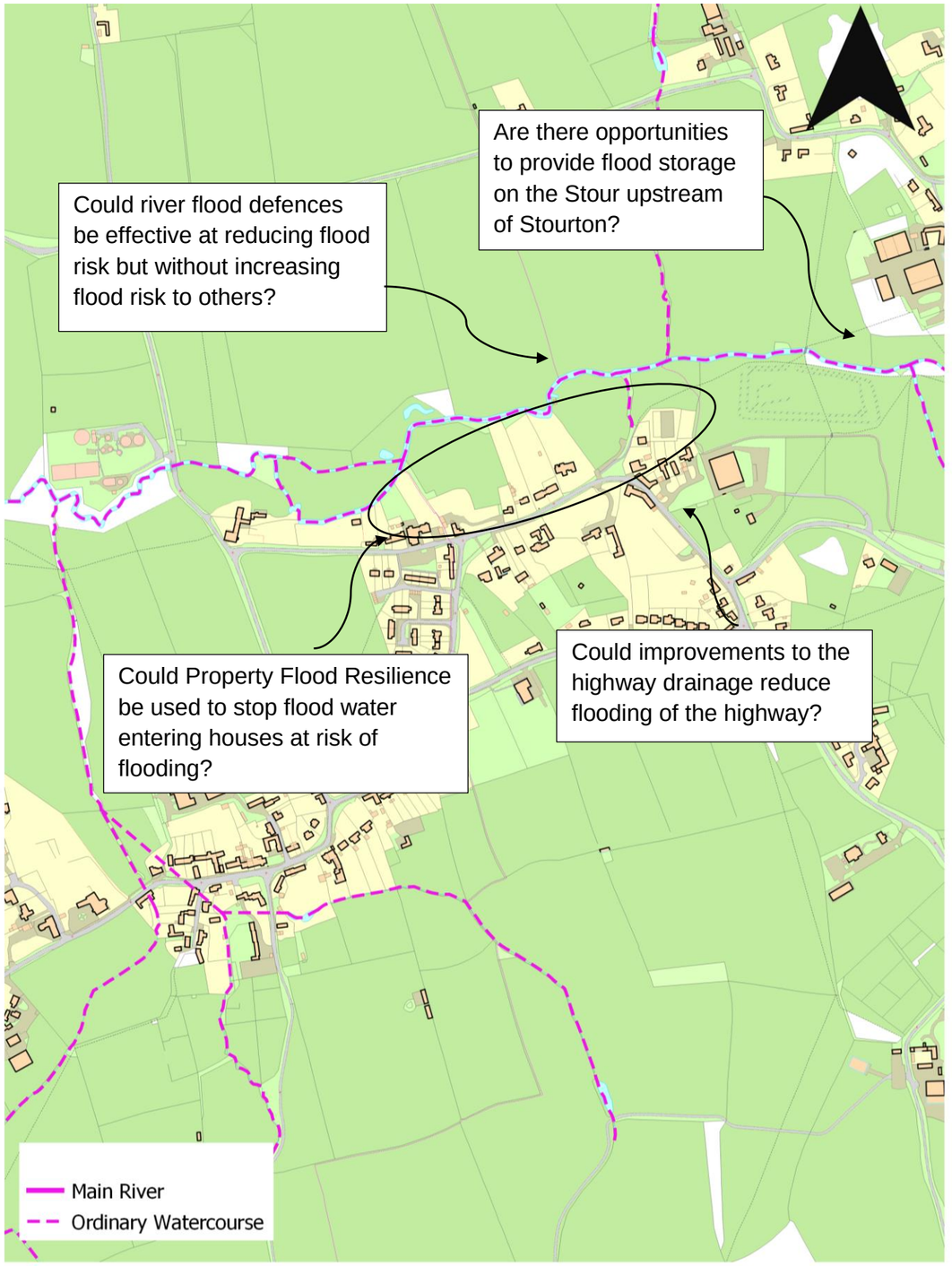
Is there a history of flooding in this location?

- Residents of Stourton report flooding occurs annually but the extent of this is unknown
- There are historic reports of property flooding in the nearby community of Cherington

What actions are being taken?

No.	Action	Responsible authority	Progress
1	Advise residents to review the effectiveness of existing Property Flood Resilience and explore any additional measures.	WCC LLFA	Complete
2	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval.	WCC Highways	Complete – embedded as business as usual
3	Offer eligible residents access to the Defra Property Flood Resilience grant	SDC	Complete – 0 properties took up offer of PFR grant

What are the future opportunities that may reduce flood risk here?



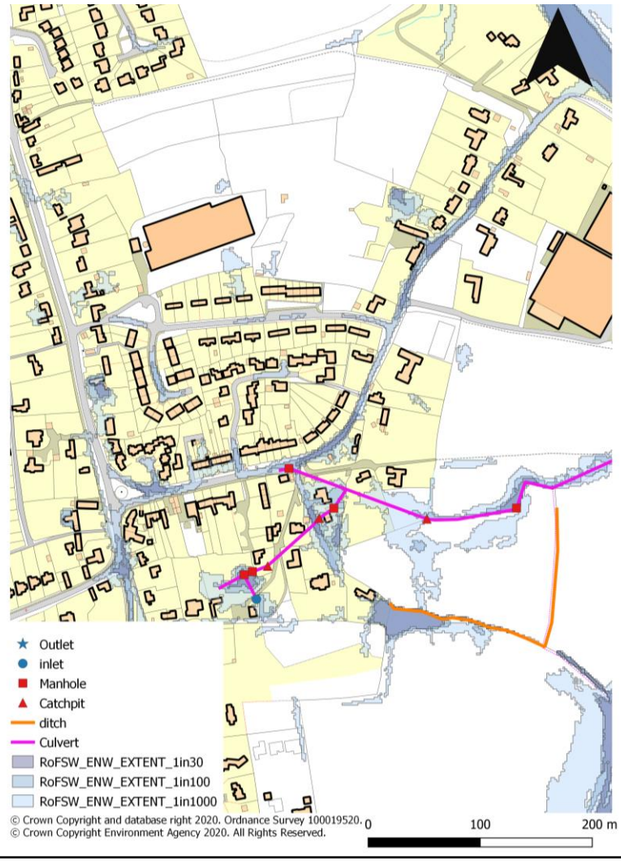
POOL CLOSE, WELFORD-ON-AVON

What was affected?

Residential properties internally flooded	3
Commercial properties internally flooded	0
Properties externally flooded	4

Source of flooding

Surface water	✓
Sewers	✓
Main river	✗
Ordinary watercourse	✗
Other	✗



Note that the Risk of Flooding from Surface Water (RoFSW) mapping shown above is a national-scale model indicating long-term risk. It does not include the effect of formal drainage systems nor does it identify the areas that flooded on the 14/15 November 2019.

How does the existing system operate?

The village of Welford-on-Avon is located about 4 miles south-west of Stratford-upon-Avon.

The highway drainage system in Church Street connects onto a piped system at the junction with Pool Close where there is an access chamber. The piped system then changes direction and leaves the access chamber at an angle of approximately 45 degrees and flows south-east for approximately 150 m.

Surface water runoff from Pool Close and areas upstream of here then connect to the aforementioned system via a 150 mm diameter clay pipe. This connection is on private land and is also a blind connection meaning there is no way of accessing the connection apart from through excavation works.

The system discharges into another access chamber located on private land and flows eastwards for approximately 250 m before discharging into an open channel. The open channel flows for approximately 80 m at which point it reverts to a culverted pipe that flows for approximately 130 m before discharging into the River Avon. There is a gated valve at this point that prevents water from the River Avon flowing back up the pipe when river levels in the Avon are high.

What happened here on 14/15 November 2019?

Following a period of heavy rainfall, and wet weather subsequent to this, the land to the south-east of Pool Close quickly became saturated. These conditions subsequently began to flood the gardens of some of the properties in Pool Close and eventually overwhelmed the piped drainage system which carries flows eastwards away from the area.

There is also a pumped combined foul and surface water sewer system in Pool Close which reached capacity resulting in sewer flooding affecting several properties.

Capacity on the piped system was severely reduced due to blockage occurring from tree root ingress just downstream from Pool Close. This meant it was not able to discharge the surface water flows, causing flows to back up.

The above situation resulted in internal flooding to 3 properties from a combination of foul and surface water flows.

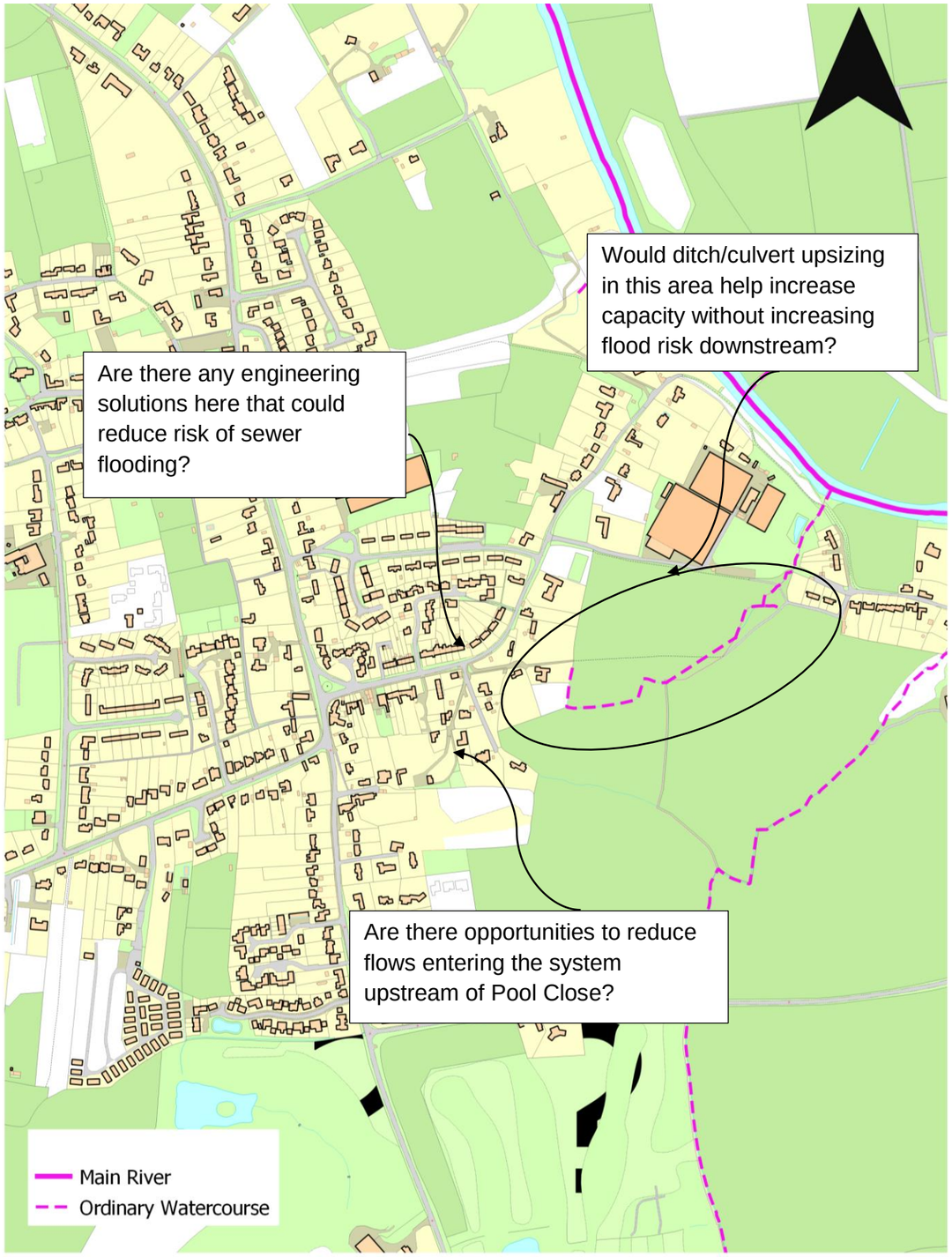
Is there a history of flooding in this location?

- Welford on Avon has suffered from flooding on many occasions most notably in 1998 and 2007 when there was extensive internal flooding. The source of the flooding on both occasions was the River Avon.
- Previous flooding issues reported in 2016 in the vicinity of Pool Close

What actions are being taken?

No.	Action	Responsible authority	Progress
1	Use of WCC contractors to undertake emergency blockage clearance works on piped system to relieve flooding	WCC LLFA	Complete
2	Work with local landowners to develop options to mitigate flood risk associated with the connectivity of downstream drainage features.	WCC LLFA Local landowners	Complete
3	Continue to work with local residents, Welford Flood Action Group (FLAG) and Environment Agency to develop proposals for a flood mitigation scheme in Welford	WCC LLFA EA	Ongoing
4	Continue to liaise and communicate with local landowners to mitigate flooding in Welford and remind them of their riparian responsibilities.	WCC LLFA	Complete
5	Offer advice to residents that have been internally flooded from this event (surface water)	WCC LLFA	Complete
6	Severn Trent Water to consider whether options exist to reduce the risk of sewer flooding here in the future.	STW	Ongoing
7	Offer eligible residents access to the Defra Property Flood Resilience grant	SDC	Complete – 0 properties took up offer of PFR grant

What are the future opportunities that may reduce flood risk here?



Town / locality	Street name	Source/s of flooding	No. of properties internally flooded	Description of flooding	Is there a history of flooding?	Recommendations	RMA responsible for taking recommendations forward	Status
Alcester	Mill Lane	Surface Water	1	Mill Lane is in the village of Oversley Green, Alcester. Heavy rain lead to surface water runoff from the field located to the rear of properties along Mill Lane resulting in internal flooding to one property and extensive garden flooding to 2 properties	No LLFA records on Mill Lane or from surface water. Parts of Oversley Green were previously affected by main river flooding.	Advise resident to contact the adjacent landowner to discuss relocated field access.	WCC LLFA	Complete
						Offer advice to the resident that has been internally flooded from this event	WCC LLFA	Complete
Arlescote	Arlescote Road	Surface Water	1	Arlescote is situated at the base of some very steep land. A number of properties suffered as a result of surface water runoff from the steep land behind the village resulting in one property to internally flood and one property to externally flood. The flow of water is then believed to carry on past the properties and exit the village along the main road where several gullies are located.	Residents informed us that flooding occurred in the village a few years ago but no specific dates were provided.	Write to landowners to ensure they understand importance of routine riparian maintenance of the ditch course that runs parallel to Arlescote Road in the centre of the village	WCC LLFA	Complete
						Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval.	WCC Highways	Complete – embedded as business as usual
Bidford-on-Avon	Stratford Road	Surface Water	1	Whilst areas of Bidford-on-Avon are situated in the floodplain of the River Avon, the internal flooding on this occasion was believed to have been caused by surface water seeping along an electricity cable which has been drilled through a chamber of the drainage system, but not sealed.	No LLFA records on Stratford Road. Other parts of Bidford-on-Avon have been affected by flooding from multiple sources. The LLFA has records of flooding from 1998, 2007, 2012.	Advise resident to carry out works to seal the ducting on an electricity cable. This should mitigate water seeping along the cable.	WCC LLFA	Complete
Burmington	London Road A3400	Main river	1	Very high river levels on the River Stour caused water to rise through the floor and walls of the property to a depth of ”several inches”. The access to the property was also flooded.	The property has a long history of flooding. In 2007 flood water rose to the ceiling of some ground floor rooms.	Offer advice to residents and business owners that have been internally flooded from this event	WCC LLFA	Complete
						Advise residents and business owners to contact EA regarding flood warnings and any other services they can offer, as the Stour is main river.	WCC LLFA	Complete
Eathorpe	Main	Main River	1	The River Leam at this location rose	5 properties had	Replace the defective sump pump.	WCC LLFA	Complete

Town / locality	Street name	Source/s of flooding	No. of properties internally flooded	Description of flooding	Is there a history of flooding?	Recommendations	RMA responsible for taking recommendations forward	Status
	Street	Ordinary Watercourse		notably and flooded onto surrounding land, which included one property. The property had (amongst other measures) three float actuated sump pumps fitted in 2016 as part of a WCC flood mitigation scheme. One of these pumps had a damaged and corroded housing which tripped the RCD circuit leaving the pump without power. This was the first time the pump had been required since its installation. As a result flooding occurred to the property damaging a number of white goods and the property boiler.	property flood resilience measures installed in 2016, as part of a WCC flood mitigation scheme. Previous flooding reports from 1998 and 2007.			
						Recommend resident checks all water ingress points have been appropriately sealed in the coal bunker.	WCC LLFA	Complete
						To encourage homeowner to inspect pumps on a routine basis to ensure they function appropriately.	WCC LLFA	Complete
Leamington Spa	The Parade	Main River	1	Following heavy rainfall, the River Leam through Leamington Spa exceeded levels where minor flooding is possible and spilled onto its floodplain within the public gardens. This led to internal flooding of one commercial property.	Leamington Spa has flooded previously in 1998 & 2007 from the main river Leam.	To advise property owner on property level resilience and flood action plans, which should be updated using the latest guidance and flood warnings available.	WCC LLFA	Complete
Lower Brailes	High Street	Surface Water Ordinary Watercourse	1	High river levels on the Sutton Brook caused water to spill out onto the High Street and affect nearby properties. Surface runoff from the highway also proceeded to make its way to the low point of the highway and combined with the water from the Sutton Brook which caused one property to internally flood in Lower Brailes.	We hold records of flooding at this location in April 1998, July 2007, November 2012, December 2013 & March 2016	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval on the High Street	WCC Highways	Complete – embedded as business as usual
						Provide advice to residents internally flooded from the November 2019 Flood event	WCC LLFA	Complete
						Deliver a property flood resilience scheme to help reduce flood risk.	WCC LLFA	Ongoing
Luddington	Evesham Road	Groundwater Surface Water	1	We have limited information on the mechanism of flooding at this location. However we understand that following heavy rainfall one property was reportedly internally flooded by groundwater to several inches deep. It is possible that surface water runoff also played a contributing part.	No LLFA records of flooding exist in the vicinity of this report.	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval.	WCC Highways	Complete – embedded as business as usual
						Provide advice to residents internally flooded from the November 2019 Flood event	WCC LLFA	Complete

Town / locality	Street name	Source/s of flooding	No. of properties internally flooded	Description of flooding	Is there a history of flooding?	Recommendations	RMA responsible for taking recommendations forward	Status
Marlcliff	The Bank	Surface water	1	Marlcliff is situated primarily in Flood Zone 2/3 and has a large surface water flow path passing through the village. Fluvial flood defences exist in Marlcliff to protect properties against flooding. Prior to May 2018 a surface water pump system operated to aid the removal of any flows impounded behind the defence structure and discharge it to the closest watercourse which ultimately will flow to the river Avon. During heavy rainfall surface water flows accumulated in the area known as "The Bank" and resulted in the internal flooding of one residential property and external flooding to around 10 other properties. Attempts were made at a community level to activate the pump, however it is unknown to what extent these pumping actions were successful.	We hold records of flooding at this location in 1998, 2007, 2012 and March 2016.	Ensure that highway cyclic gully cleansing is scheduled at an appropriate interval.	WCC Highways	Complete – embedded as business as usual
						Provide advice to residents internally flooded from the November 2019 Flood event	WCC LLFA	Complete
						The community have expressed a desire to have access to the decommissioned surface water pump in Marlcliff to operate during times of flood. EA to support the community's efforts in doing so.	Environment Agency	Ongoing
Marton	A423 Coventry Road	Surface Water	1	Excess surface water runoff is likely to have accumulated on the highway following heavy rainfall. Bow waves caused by vehicles driving through flood water may have exacerbated the flooding. This resulted in 1 property internally flooded. The nearby Rivers Leam and Itchen did not experience significant fluvial flooding events at this location but high river levels may have affected the ability for the highway to drain away.	10 properties are known to have flooded in 2017. Residents have also reported flooding in Easter 1998, 2007, 2012 and 2016.	Provide advice to residents internally flooded from the November 2019 Flood event	WCC LLFA	Complete
Newbold-on-Stour	Mill Lane	Main River Ordinary Watercourse	2	River levels on the River Stour and Mill Stream rose significantly following heavy rainfall and subsequently burst its banks leading to properties on Mill Lane to internally flood. Water entered through the floor and from the front of the properties. Water also affected access to one of the properties.	Residents informed us that these properties had previously flooded in 2007 and 2018.	Provide advice to residents internally flooded from the November 2019 Flood event	WCC LLFA	Complete
						Inform the EA of the flooding that occurred in Newbold-On-Stour due to the source of flooding being predominantly Main River	WCC LLFA Environment Agency	Complete

Town / locality	Street name	Source/s of flooding	No. of properties internally flooded	Description of flooding	Is there a history of flooding?	Recommendations	RMA responsible for taking recommendations forward	Status
Sambourne	Oak Tree Lane	Surface Water	1	Heavy rainfall caused overland surface water flows from the field to the rear of properties in Oak Tree Lane. These flows entered the rear garden and house of one residential property causing internal flooding.	No LLFA records of flooding to this specific property. However there are reports of flooding elsewhere in the village in 1993, 1998 & 2012.	WCC FRM Team to work with residents to investigate if any formal watercourse/drainage feature is present along the field boundary at a higher level that may need attention by a riparian landowner	WCC LLFA	Complete
Southam	Southfield Road	Surface Water	1	Heavy rainfall exceeded the capacity of the highway drainage gully, overtopped the dropped kerb and entered the business premises as the floor level is lower than the level of the highway.	It is understood to flood at least once a year through the same mechanism. Previous attempts have been made to hold water on the highway (by using a tarmac hump).	Measures should be considered to help reduce the likelihood of excess surface water leaving the highway	WCC Highways	Complete
						Advice given to business owner on possible works to reduce the likelihood and impact of any future flooding	WCC LLFA	Complete
Upper Brailes	B4035 Main Road	Surface Water	1	Runoff from fields to the rear of a property on Main Road combined with a blocked drain to cause internal property flooding.	No records of flooding to this specific property. However we hold a report of 1 property flooding elsewhere in Upper Brailes in 2007.	Provide advice to residents internally flooded from the November 2019 Flood event	WCC LLFA	Complete

7 APPENDIX H – GLOSSARY OF TERMS

Critical infrastructure	Infrastructure which is considered vital or indispensable to society, the economy, public health or the environment, and where the failure or destruction would have large impact. Examples include hospitals, communications, electricity sub-stations, water treatment works, transport infrastructure and reservoirs.
Department for Environment, Food and Rural Affairs (Defra)	The government department responsible for policy and regulations on environmental, food and rural issues. This includes all aspects of flood risk management.
Environment Agency (EA)	See Appendix I.
External flooding	Flooding of areas of property that are not under the definition of internal flooding. Examples include gardens, driveways, parking areas and outbuildings such as sheds and garages.
Flood Risk Management (FRM)	FRM aims to reduce the likelihood and/or the impact of floods. This typically includes the following elements: prevention, protection, preparedness, response and recovery. In the context of this report, FRM also refers to the team at WCC which undertakes the LLFA role.
Exceedance flows	Excess surface water flow that occurs when the capacity of the drainage system is exceeded.
Flood and Water Management Act 2010 (FWMA)	Legislation which came into effect in April 2010. The Act takes forward a number of recommendations from the Pitt Review into the 2007 floods and placed new responsibilities on the Environment Agency, local authorities and property developers (amongst others) to manage the risk of flooding.
Internal flooding	Flooding of habitable living or business areas of a property. This does not include gardens and outbuildings such as sheds, garages etc. and not normally basements and porches.
Lead Local Flood Authority (LLFA)	See Appendix I.
Main River	Watercourses designated as 'main' are generally the larger arterial watercourses, as shown on the Statutory Main Rivers Map. The Environment Agency has permissive powers, but not a duty, to carry out maintenance, improvement or construction work on designated main rivers.
Ministry of Housing, Communities and Local Government (MHCLG)	The government department which sets policy on local government, housing, urban regeneration, planning and fire and rescue. They provide funding to and agree expenditure plans for Local Authorities.
National Flood Forum (NFF)	A charity to help, support and represent people at risk of flooding.
Ordinary watercourse	A watercourse that is not a designated Main River. On ordinary watercourses the LLFA (or Internal Drainage Board if relevant) have permissive powers, but not a duty, to carry out maintenance, improvement or

	construction work.
Pluvial or surface water flooding	Caused by rainfall exceeding the capacity of the ground or drainage system and occurs due to water ponding on or flowing over the ground surface before it reaches a drain or watercourse.
Property Flood Resilience (PFR) measures	Measures that are designed to keep flood water out of properties and businesses, and could include flood barriers and doors, non-return valves and airbrick covers. Sometimes also known as Property Level Resilience (PLR).
Resilient network	Approximately 16% of the total WCC maintained highway network. The resilient network is given priority during severe weather to minimise any impact on economic activity and access to key services.
Riparian landowners	Someone who owns land or property adjacent to a watercourse. Under common law, a riparian owner has a duty to maintain the watercourse and allow flow to pass through freely.
Risk management authority (RMA)	An authority which is defined as such in the Flood & Water Management Act 2010. Such authorities have powers that they can use to carry out their flood and coastal erosion risk management responsibilities. See Appendix I for a summary of these responsibilities.
Risk of Flooding from Surface Water map (RoFSW)	National-scale long-term risk mapping on gov.uk website showing the areas of England at risk of flooding from surface water. Extent, velocity and depth information is available for a range of flood probabilities.
Section 19 Flood Investigation	An investigation of a flood event by the Lead Local Flood Authority under Section 19 of the Flood and Water Management Act 2010.
Severn Trent Water (ST)	See Appendix I.
Warwickshire County Council (WCC)	See Appendix I.

8 APPENDIX I – RISK MANAGEMENT AUTHORITIES

Risk Management Authorities (RMAs) have defined roles and responsibilities with regards to flood risk management, as defined within the Flood and Water Management Act 2010.

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

The section below outlines the key roles and responsibilities of the RMAs relevant to this Section 19 flood investigation.

8.1 Environment Agency

The Environment Agency (EA) is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion in England and Wales. They have prepared strategic plans which set out how to manage risk, provide evidence (for example, their online flood maps), and provide advice to the Government.

They provide support to the other RMAs through the development of risk management skills and provide a framework to support local delivery. The EA also has operational responsibility for managing the risk of coastal erosion and flooding from main rivers, reservoirs and the sea. Main Rivers are defined through an agreed map which is updated annually. These tend to be the larger rivers in the country.

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

8.2 Water and sewerage companies

Severn Trent Water (STW) holds responsibility for managing risks of flooding from water supply and sewerage within the majority of Warwickshire. Thames Water have a small area of responsibility in the south of the county.

Water and sewerage companies (WaSCs) as category 2 responders to national emergencies placing on them duties to share information with other responders in an appropriate manner. They are also responsible for managing risks associated with assets or processes that may cause or be affected by flooding.

Relevant actions include the inspection, maintenance, repair and any works to their water and sewerage assets which typically includes pipes, manholes, attenuation tanks or other infrastructure such as pumping stations.

8.3 Warwickshire County Council as Lead Local Flood Authority

Lead Local Flood Authorities (LLFA) have the lead operational role in managing the risk of flooding from surface water and groundwater.

Flood risk management functions include (but are not limited to); the provision of a Local Flood Risk Management Strategy (LFRMS) and Surface Water Management Plan, designation and maintenance of a register of structures or features that have a significant effect on flood risk, consenting and enforcement works on Ordinary Watercourses, undertaking works to mitigate surface water and groundwater flooding and undertaking Section 19 investigations.

The LLFA are a statutory consultee on major planning applications for surface water drainage. By working with developers and local planning authorities, the LLFA role is to ensure that runoff arising from major development sites is appropriately managed to avoid increasing flood risk.

8.4 Warwickshire County Council as Highway Authority

WCC also has responsibilities as a Highways Authority which may relate to flooding. Highway authorities are responsible for providing and managing highway drainage which may include provision of roadside drains/ditches and must ensure that road projects do not increase flood risk.

The Highways Authority has a duty under the Highways Act 1980 to maintain existing highways drainage. They also have powers to improve drainage systems but no duty to do so.

Highway drainage systems are designed to take highway surface water. Highway drainage systems are not designed as “storm drains”, and do not have the capacity for the level of rainfall from an extreme flash flood.

8.5 District and Borough Councils

District and Borough Councils can carry out flood risk management works on ordinary watercourses. Through the planning processes, they control development in their area, ensuring that flood risks are effectively managed. This includes the development of plans and strategies to limit or mitigate development in flood risk areas.

Within Warwickshire there are 5 district/borough councils: Stratford-on-Avon District Council, Warwick District Council, Rugby Borough Council, Nuneaton and Bedworth Borough Council, North Warwickshire Borough Council.

8.6 Landowners

Landowners have riparian responsibilities under the Flood and Water Management Act (2010) to maintain and undertake any necessary works on assets on their land (with consent from the relevant RMA) which may have an effect on flood risk including watercourses and drainage assets.

Further information on riparian responsibilities is available on www.gov.uk/guidance/owningawatercourse