# 2020 Flood Events:

# Flood and Water Management Act

# Section 19 - Investigation

# Mead Crescent & Manor Crescent, Stapenhill, Burton-Upon-Trent

Figure 1: Flooding at Mead Crescent in February 2020 (Image provided by the Housing Association)

Staffordshire
County Council

This report has been prepared by Staffordshire County Council as Lead Local Flood Authority for Staffordshire County, under Section 19 of the Flood and Water Management Act 2010, with the assistance of Severn Trent Water and the Housing Association.

This report is based on the information available at the time of preparation. Consequently, there is potential for further information to become available, which may lead to future alterations to the conclusions drawn in this report for which Staffordshire County Council cannot be held responsible.

| **Document Ref:** | | | **2020 Flooding: Section 19 Flood Investigation for Mead Crescent / Manor Crescent, Stapenhill, Burton** | | |
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# Executive Summary

When made aware of flooding, Staffordshire County Council, in its role as Lead Local Flood Authority, has a duty to investigate a flood to determine the causes of the flooding and identify appropriate actions that may be undertaken by the relevant Risk Management Authority (RMA).

Several storms occurred in 2020 across the Midlands region which impacted many areas. Storm Dennis, in February, was a long duration, low-to-moderate intensity event, causing widespread flooding nationwide. The event led to a severe weather warning over much of Wales and the Midlands. As a result of these storms, a significant number of flooding incidents were reported to Staffordshire County Council, including Mead Crescent and Manor Crescent located in Stapenhill, Burton-Upon-Trent.

Following the storm events, Staffordshire County Council worked closely with the various Risk Management Authorities (RMAs) and local residents to gather information and determine the impact of the flooding.

Staffordshire County Council, in partnership with Severn Trent Water and the Housing Association, has undertaken an investigation into each of the areas where internal property flooding was reported, to determine the most likely cause of flooding (surface water flooding, flooding from rivers, flooding from sewer infrastructure and flooding from highway drainage).

This report focuses on Mead Crescent and Manor Crescent located in Stapenhill, Burton. The investigation undertaken has been summarised, outlining the extent of flooding reported, the most likely cause of the flooding and the actions that have been completed, or are proposed to be completed in the future.

# Introduction

Several storms occurred in the Midlands in 2020 resulting in flooding at several locations in Staffordshire. Storm Dennis hit Burton-Upon-Trent on the 16th February 2020.

This storm caused widespread flooding to highways and properties across Staffordshire and as a result, Staffordshire County Council has undertaken investigations in the areas where flooding occurred.

This report will aim at providing a broad overview of the causes of the flooding at Mead Crescent and Manor Crescent located in Stapenhill, resulting from the event in February 2020 and identifies the next steps, if any, that need to be taken by the relevant Risk Management Authorities (RMAs).

Although this report specifically focuses on Mead Crescent and Manor Crescent, Stapenhill, flooding associated with Storm Dennis resulted in more than 130 applications for grant support from residential and business properties across East Staffordshire. Many areas also experienced incidents in which five or more properties were internally flooded, reaching the criteria for a Section 19 investigation.

## Lead Local Flood Authority

Following Royal Assent of the Flood and Water Management Act in 2010 (FWMA), Staffordshire County Council (SCC) became the Lead Local Flood Authority (LLFA) for Staffordshire. As such, SCC is responsible for the management of surface water food risk, groundwater flood risk and the flood risk from ordinary watercourses[1].

As LLFA, SCC is required to work in partnership with other agencies and authorities to manage flood risk. These agencies and authorities include, but not exclusively:

- Environment Agency, who hold responsibility for Main Rivers.
- Severn Trent Water, who hold responsibility for the public sewer network.
- Emergency service providers; and,
- Other public agencies and bodies.

## Section 19 Requirements

The FWMA also places a duty on Lead Local Flood Authorities to investigate incidents of flooding. This is set out in Section 19 of the act and the investigations are therefore typically termed '*Section 19 Reports*.' The Act states:

1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate

a) Which risk management authorities have relevant flood risk management functions, and

b) Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

[1]An ordinary watercourse is defined as any watercourse not designated as 'Main River,' i.e. watercourse that are not managed by the Environment Agency.

2) Where an authority carries out an investigation under subsection 1) it must
    a) Publish the results of its investigation, and
    b) Notify any relevant risk management authorities.

It should be noted that not all flooding will require a formal investigation and report.
SCC has set out in its *Local Flood Risk Management Strategy*[2]*, in Appendix D the* process which will be used to determine to what extent it considers is 'necessary or appropriate' to investigate and what constitutes a significant flood event.

Stage 1 is an initial assessment, sufficient to ascertain with some confidence the extent of the flooding consequences. The second stage is to carry out a detailed investigation of the sites where it has been deemed necessary and appropriate. Reporting and publishing is the third, and final, stage. These stages may be described as: -

- Stage 1: Initial assessment
- Stage 2: S19 Investigation
- Stage 3: S19 Report and publish

It follows that there will be requirements for coordination and cooperation between Risk Management Authorities at each stage and, where required, following the outcome of a S19 Investigation. This will be undertaken via day to day officer communication, and through the LLFA's governance process for flood risk management.

## Flood Investigation Methodology

SCC will undertake/coordinate a Flood Investigation in accordance with Section 19 of the Flood and Water Management Act (2010) when one or more of the following thresholds are exceeded.

<u>Consequence Staffordshire Flood Investigation Thresholds</u>:

- Five or more residential properties are reported to have been internally flooded during a single flood event in one location;
- Two or more business properties are reported to have been internally flooded during a single flood event in one location, or;
- One or more items of critical infrastructure are reported to have been adversely affected during a single flood event in one location

SCC may investigate flooding outside these categories, but only when all outstanding issues with a higher priority have been considered. These guidelines set numerical thresholds, however, in recognition of the fact that all floods will be different; a certain amount of discretion will be required in order to implement this policy effectively.

This policy only relates to how flood investigations will be prioritised and does not guarantee that any flood risk mitigation works will be installed at the locations where investigations are undertaken.

*This report has been based on the number of reported incidents of flooding; however, it is likely that the actual number of incidents of flooding was higher than that reported.*

*This data is the best currently available and is being verified and quality checked for accuracy.*

[2] https://www.staffordshire.gov.uk/environment/Flood-Risk-Management/Local-Flood-Risk-Management-Strategy.aspx

Investigation into Flooded areas

*Step 1: During the Flood Event*

SCC received a high number of calls during the event, which reported flooding of properties, gardens, and highways

During the flood event, the LLFA coordinated with multiple Risk Management Authorities (RMAs) to ensure that flooding was managed effectively and the risk to people and properties was mitigated as far as reasonably practicable.

*Step 2: Initial Investigations*

Using call records, flooding investigation questionnaires and site visits, the LLFA identified the locations where flooding occurred.

Responses were received, providing personal accounts of the flood event including the estimated time, duration, extent, and depth with any other information which was felt pertinent.

Following receipt of the Flood Survey responses, the LLFA identified areas where at least one property experienced internal flooding.

*Step 3: Detailed Investigation and Analysis*

The LLFA conducted detailed investigation and individual location analysis of each of the areas where a minimum of one property experienced internal flooding. It should be noted that SCC have defined internal property flooding as:

*'Flooding that occurs in a habitable room within a single property, excluding garages, porches and underfloor ingress of water.'*

These investigations typically included a review of existing infrastructure and topography, identification of predominant flow paths, site visits and local knowledge gathering.

Through a detailed analysis, the LLFA have identified the types of flooding that occurred at each location during the events of February 2020.

The LLFA does not undertake detailed investigation of external flooding to garages, gardens, and highways due to limited resources and funding. Indeed, gardens often act as flood storage areas and highways can be designed to convey flood waters reducing the extent/level of internal property flooding.

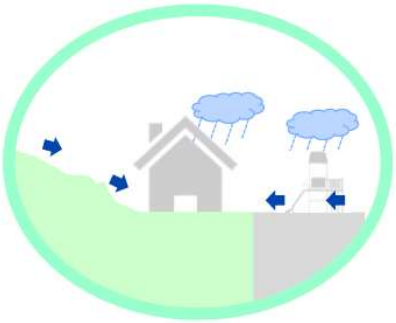
*Step 4: Recommended Actions*

Following the analysis of the affected area, the LLFA have worked in collaboration with other RMAs to identify opportunities and options to mitigate the potential that a similar rainfall event will result in similar outcomes. These have been summarised as 'Recommended Actions' and a lead RMA has been identified to undertake these actions.

# Types of Flooding

## Surface Water Flooding

Surface water is rainwater which is on the surface of the ground and has not soaked into the ground or entered a watercourse, drainage system or sewer. During a storm event, rainfall will land on the ground and depending on the characteristics of the ground it will behave in different ways.



**Soft surfaces**, known as *permeable surfaces*, allow water to soak (infiltrate) into the ground. These are typically in the form of gardens, parks, fields, and green spaces,

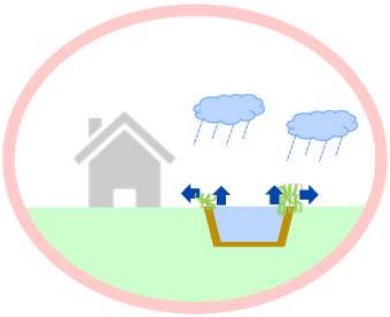
**Hard surfaces,** known as *impermeable surfaces*, do not allow any rainfall to soak into the ground and this rainfall will become (surface water) runoff. Runoff is usually very quick too. These are typically in the form of highways and roads, roofs, car parks and public squares.

Surface water flooding occurs under several circumstances, most commonly occurring when:

- There has been a prolonged period of rainfall and the permeable surface becomes saturated therefore no more water can infiltrate into the ground.
- The rainfall intensity is very high, and the rain is falling faster than it can infiltrate into the ground.
- There has been a prolonged warm dry period, the permeable surface may be baked hard and effectively turn the permeable surface into hard impermeable surface.
- It rains on impermeable surfaces, and there is no formal means of managing the rainfall.
- There is heavy rainfall on impermeable surfaces and surface water cannot enter the drainage system provided to manage rainfall as the system is at capacity.

During most storm events, the rainfall rate is low enough to allow surface water to soak into the ground or drain into formal drainage systems (e.g. gully pots). However, during an extreme event, where the intensity of the rainfall is high or there is an excessive volume of water, it is unable to soak into the ground or enter formal drainage systems and as such it will flow across a surface in an uncontrolled manner.

# River Flooding



River flooding occurs when the amount of water in a river channel exceeds its capacity. This causes the water level in the river channel to rise above the riverbanks, where water flows from the channel into the surrounding area.
In terms of flood risk management there are two classifications of rivers/watercourses:

**Main River** and **Ordinary Watercourse**.

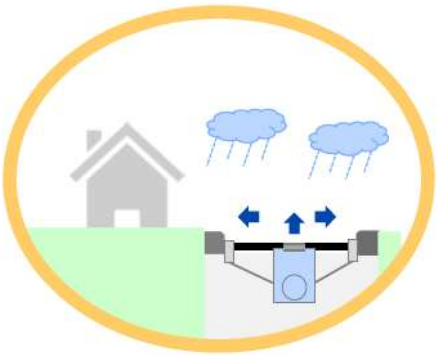
The Environment Agency holds responsibility for the management of flood risk on Main Rivers. All other watercourses, which are not specified as Main Rivers are termed Ordinary Watercourses. Flood risk management of these watercourses is the responsibility of the LLFA. However, in both cases, the riparian owner, that is anyone who owns land or property next to, or over, a watercourse, is responsible for maintenance of watercourse through their land.

River flooding occurs under several circumstances, most commonly occurring when:

- There has been a prolonged period of rainfall and the river levels have risen due to surface water runoff and inflow from sewer infrastructure.
- There has been a prolonged period of rainfall whereby permeable surfaces become saturated and the rate of surface water runoff increases thereby reaching the river faster.
- There is heavy rainfall on impermeable surfaces and the provided drainage system conveys water to the river quickly.
- There are high flows within the river which become restricted by structures (e.g. bridges and culverts) which results in water levels upstream rising and spilling from the banks.
- Sediment and debris builds up in the river channel and reduces the capacity of the river channel causing flows to spill from the banks.

During most storm events, rivers are capable of conveying flows within their channels however, during an extreme event where the volume of water may be significant, flows may exceed the channel capacity and spill from the river in an uncontrolled manner.

# Flooding from Sewer Infrastructure



Where rainfall falls on an impermeable surface, it will typically be served by a formal drainage system, most commonly this is a sewer.

There are different types of sewer, including:

***Surface Water Sewers*** carry rainfall and surface water away from properties to watercourses.

***Foul Water Sewer***, carries wastewater away from properties to be treated; and,

***Combined Sewer*** drain both wastewater from properties along with runoff from highways, roofs, car parks and other sources. These systems were typically constructed up to the 1950s and hence are still found in historic areas of cities.

Flooding from sewer infrastructure occurs under several circumstances, most commonly occurring when:

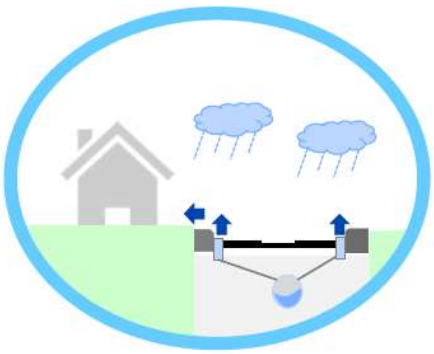
- There is a blockage, or the sewer itself collapses, which restricts or prevents flow within the sewer network. This causes water to back-up through the network and find its way to the surface, typically through a manhole or associated drainage structure.
- There is a period of heavy and/or prolonged rainfall, which results in significant flows that exceed the capacity of the sewer network. This prevents water from entering the sewer network and may result in surface flooding.

Severn Trent Water, as the sewerage company, is responsible for the operation and maintenance of the public sewers within the Staffordshire area.

Surface water and foul water sewers are currently designed in accordance with Sewers for Adoption (8th Edition, published 2018). This guidance states that sewers should have the capacity to deal with all runoff from a storm with a 3.33% or greater probability of occurring in any given year and not cause any above ground flooding. This guidance is relatively recent having been brought into effect in the last 10 to 15 years. In addition, improvements in computer aided design and calculations also ensure designs agree with the existing standards.

Therefore, at the time of construction of much of the sewer network across Staffordshire, the design standards may have been to accommodate a smaller storm event. The designs will likely have been done by hand and may have used “rules of thumb” to determine the required sizes. As a result, the drainage network is complex with some sewers able to accommodate storms well above current design standards and other sewers much lower. Thus, when a large storm event occurs, the existing drainage network (combined or surface water sewers) may be significantly overwhelmed.

# Flooding from Highway Drainage



Highway drainage consists of gullies, drainage channels and other features which collect and drain rainfall away from the highway. These features are typically located on one, or both, side(s) of the highway where they connect to an underground highway drainage system which ultimately connects to the public sewer infrastructure.

Where rainfall falls onto the highway, this will enter the highway drainage system or flow within the highway channel until a point where it enters the system or ponds on the surface.
In new development, it is common practice to use highways to contain and convey heavy rainfall events away from properties, however historically this practice has not happened.

Across Staffordshire, properties can be seen at or below the level of the adjacent road. This means that should a carriageway not be able to contain the water flowing within it, flow will overtop the kerbs on the highway and spill over adjacent land into properties.

Flooding from highway infrastructure occurs under several circumstances, most commonly occurring when:

- There is a blockage or build-up of surface debris in the vicinity of a gully, typically trash, leaves and twigs, which prevents, or restricts, the highway runoff from entering the gullies and subsequent highway infrastructure.
- There is a period of heavy and/or prolonged rainfall, whereby the volume of rainfall falling onto the highway overwhelms the highway drainage features and is unable to be captured. The resulting flows are then conveyed or contained within the highway, until such times as the water level overtops the kerbs and flows overland into properties.
- The sewer, culvert, or watercourse to which the highway drainage is connected is at full capacity and therefore the highway run-off has no-where to drain to.

Staffordshire County Council, in their role as the local highway authority, is responsible for the highway drainage and gullies across East Staffordshire Borough Council. This work includes maintenance of the highway drainage including roadside gully pots.

# Flood Risk Mapping

Flooding is traditionally very difficult to predict, and there are many local factors that influence flooding. There are a number of publicly available national information tools which can enhance our understanding of the potential flood risks within a local area, more specifically risk of flooding from surface water and from rivers.

## Surface Water Flood risk

In 2013, the Environment Agency, working with LLFAs, produced the Risk of Flooding from Surface Water map. This is the third national surface water map produced by the Environment Agency under their Strategic Overview role and is the first publicly available surface water flood risk map.

Storms are usually given with an annual probability or the chance of occurring in any given year. Typically, smaller storms have a higher probability of occurring in any given year and larger storms have a lower probability of occurring. However, the probability only describes the chance a storm will occur and not when. This means that if a large, low probability storm occurs, it can happen again soon after or can happen a long time after.

This mapping assesses surface water flood risk as a result of the chance of rainfall occurring in any given year, and is categorised into the following three scenarios:

***High Risk***: Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year or 3.3% chance that the storm will occur in a single year

***Medium Risk:*** Flooding occurring as a result of rainfall between 1 in 100 and 1 in 30 chance in any given year or between 1% and 3.3% chance that the storm will occur in a single year

***Low Risk:*** Flooding occurring as a result of rainfall between 1 in 1000 and 1 in 100 chance in any given year or between 0.1% and 1% chance that the storm will occur in a single year

***Very Low Risk***: Flooding occurring as a result of rainfall with less than 1 in 1000 chance in any given year or less than 0.1% chance that the storm will occur in a single year.

It should be noted that this mapping has been produced at national scale with a number of assumptions and therefore there are some limitations at a local scale and is not appropriate for identifying individual property level flood risk. This mapping is publicly available for use: https://flood-warning-information.service.gov.uk/long-term-flood-risk/postcode


**Figure 2:** Example of Environment Agency updated Flood Map for Surface Water Flooding

# River flood risk

With regards to river flooding the Environment Agency publish the Flood Risk from Rivers or the Sea map. This shows the flood risk from Environment Agency Main Rivers and from the sea, considering any flood defences that may be present.

Storms are usually given with an annual probability or the chance of occurring in any given year. Typically, smaller storms have a higher probability of occurring in any given year and larger storms have a lower probability of occurring. However, the probability only describes the chance a storm will occur and not when. This means that if a large, low probability storm occurs, it can happen again soon after or can happen a long time after.
This mapping assesses flood risk from rivers or the sea as a result of the chance of rainfall occurring in any given year, and is categorised into the following four scenarios:

***High Risk***: Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year or 3.3% chance that the storm will occur in a single year

***Medium Risk:*** Flooding occurring as a result of rainfall between 1 in 100 and 1 in 30 chance in any given year or between 1% and 3.3% chance that the storm will occur in a single year

***Low Risk:*** Flooding occurring as a result of rainfall between 1 in 1000 and 1 in 100 chance in any given year or between 0.1% and 1% chance that the storm will occur in a single year

***Very Low Risk***: Flooding occurring as a result of rainfall with less than 1 in 1000 chance in any given year or less than 0.1% chance that the storm will occur in a single year.

This modelling is publicly available as the Environment Agency's Flood Risk from Rivers or the Sea map and is available online: [https://flood-warning-information.service.gov.uk/long-term-flood-risk/postcode](https://flood-warning-information.service.gov.uk/long-term-flood-risk/postcode)

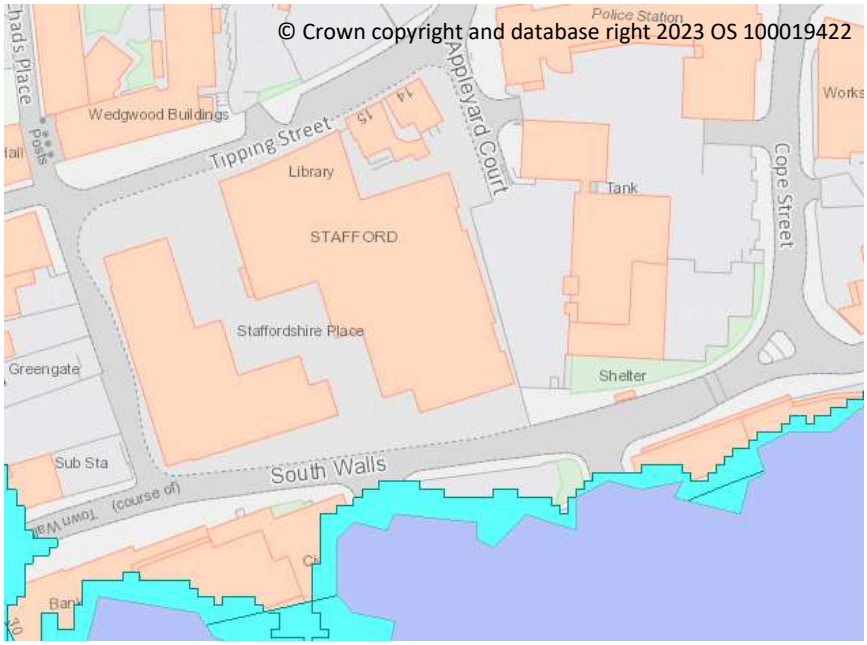



**Figure 3:** Example of Environment Agency River Flood Zones mapping

# Analysis of Flooding Location

## Mead Crescent & Manor Crescent, Stapenhill, Burton-Upon-Trent

The following sections of this report describe the flood event that occurred at Mead Crescent and Manor Crescent, Stapenhill on 16th February 2020. The event has been assessed through the review of anecdotal evidence from local residents and through consultation with the various Risk Management Authorities (RMAs).

### Event Background

Several storms occurred in winter 2019-2020 across the UK and Midlands. The combined impacts of Storms Ciara, Dennis and Jorge led to exceptionally high rainfall totals across the UK, causing flooding in several areas.

Storm Dennis (15-16 February 2020) was the fourth named storm in the 2019/20 season, which arrived one week after Storm Ciara and brought with it heavy and persistent rainfall[3]. In the twelve months prior to Storm Dennis, Staffordshire had exceptionally high rainfall compared to the average (**Figure 4**). Rainfall in December and January was unremarkable. However, rainfall totals in February were exceptionally high, with February the wettest month in a series from 1862; the England figure was 258% of the long-term average (1981-2010). Crucially, soil moisture deficit from December 2019 through to February 2020 was generally practically zero/remained close to zero in Central England[3] (**Figure 5**). This means in the time running up to Storm Dennis there was generally little to no capacity within soils to drain or infiltrate rainfall. River flows in large rivers were also exceptionally high through February.

[3] Met Office – Winter 2019/2020 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/uk_monthly_climate_summary_winter_2020.pdf

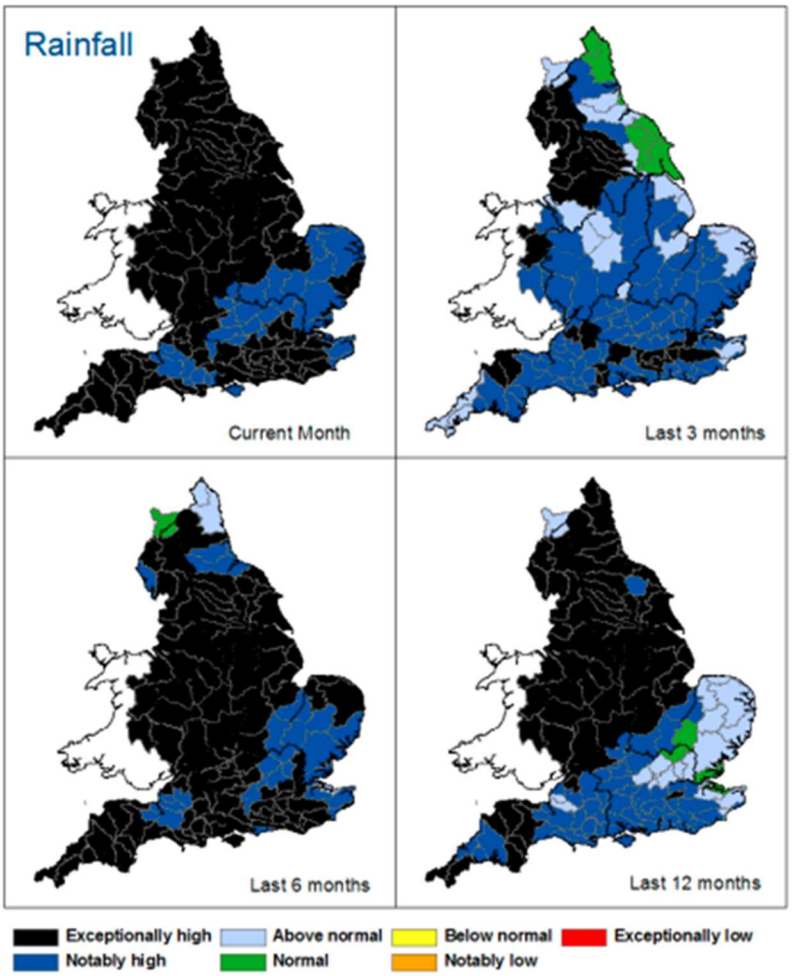



**Figure 4:** Total Rainfall Across England up to February 29 2020 (Source: Environment Agency[4])

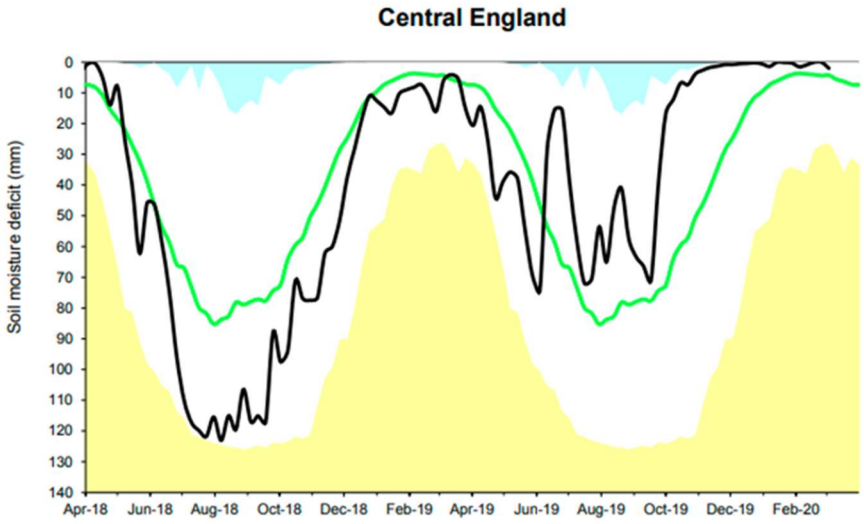



**Figure 5:** Central England Soil Moisture Deficit (Source: Environment Agency[4])

[4] Environment Agency – Monthly water situation report: England
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/871949/Water_situation_February_2020.pdf

On 14 February, Storm Dennis developed off the west coast of Ireland moving east and arriving in England by early afternoon. By mid-afternoon the front swept into Staffordshire and by late Friday night/early hours of Saturday morning this front had passed east out of Staffordshire. On Saturday 15 February a large front of rainfall developed in the morning and approached Staffordshire quickly, sustaining through to mid-day and continuing to remain over Staffordshire until early afternoon on Sunday 16 February. **Figure 6** shows radar-images of the rainfall across the UK. Through the rest of Sunday, the sustained/persistent rainfall moved over the rest of Europe, leaving scattered rainfall showers over Staffordshire through to Monday. For a more detailed account of Storm Dennis please refer to The Met Office[5] and Centre for Ecology and Hydrology[6].

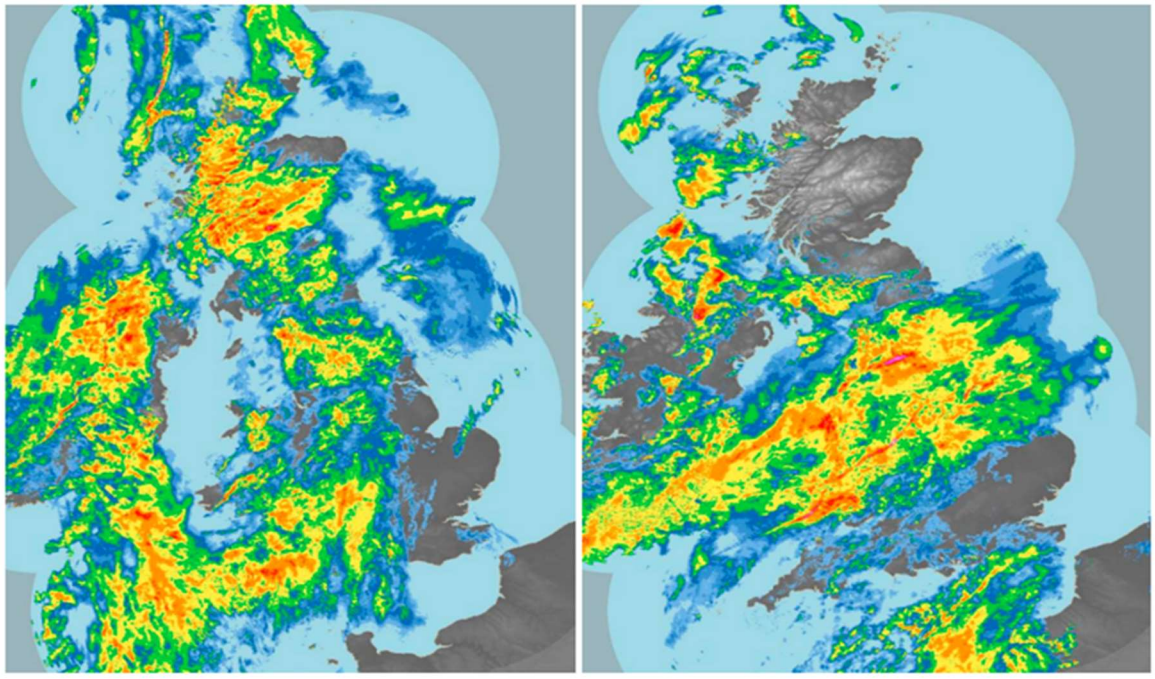


**Figure 6:** Rain-radar images at 12 UTC 15th and 00 UTC 16th February 2020 show the heavy and persistent rainfall from storm Dennis with the fronts sweeping across the UK (Source: The Met Office[5])

[5] Met Office – Storm Dennis https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2020/2020_03_storm_dennis.pdf

[6] Centre for Ecology and Hydrology – Briefing note: Severity of the February 2020 floods – preliminary analysis https://nrfa.ceh.ac.uk/sites/default/files/Briefing_Note_V6.pdf

# Location Background

Mead Crescent and Manor Crescent are located in Stapenhill, a suburban village and civil parish in Burton-upon-Trent (Figure 7). Stapenhill is situated on the edge of the Staffordshire border with the neighbouring county of Derbyshire. The area affected by the flooding comprises a development of residential properties owned and managed by the Housing Association. The A444 is located along the southern boundary of the site. To the west there is a school and more residential properties. There are further residential properties to the east and south east, with the land use then changing to become more rural. To the north there is an open field which is used primarily for agricultural purposes and falls within the County of Derbyshire.

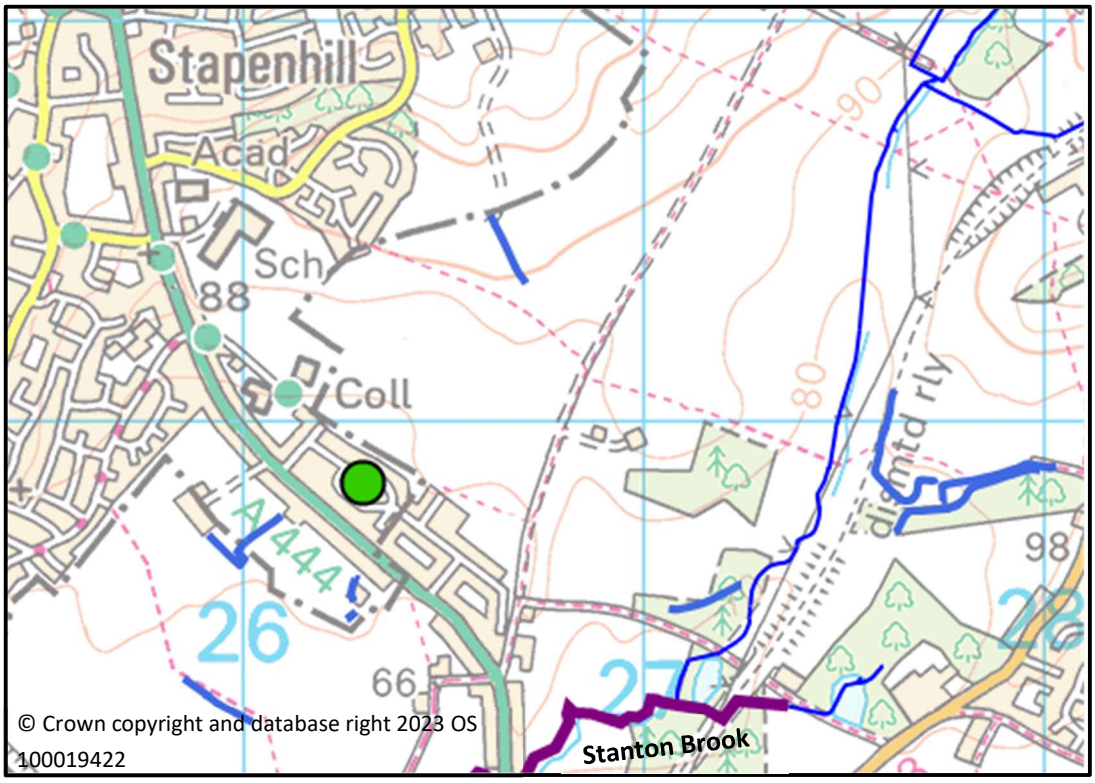



**Figure 7**: Location Plan of Mead Crescent and Manor Crescent (Flood location shown by green dot, Main Rivers shown by purple line, Ordinary Watercourses shown by blue lines)

**Local Watercourses and Drainage Systems**

There are no watercourses located within the immediate vicinity of Mead Crescent and Manor Crescent. The nearest watercourse is located approximately 750m to the southeast and is referred to as Stanton Brook.

Review of OS mapping identifies a drain to the north which runs parallel to an unnamed track. This drains into a pond at NGR SK26712129, approximately 540m north of Mead Crescent and Manor Crescent.

A drainage ditch and bund run along the northern edge of the gardens between Mead Crescent and Mead Walk and the agricultural land to the north (Figure 8). The ditch intercepts surface water runoff from the field to the north which flows towards a culvert inlet situated at a low spot approximately halfway along the field boundary (Culvert Inlet A). Review of OS Mapping and contour data indicates that approximately 0.2km$^2$ of the field to the north of the flood location drains into the drainage ditch (Figure 9). The outlet pipe from the field conveys surface water runoff through a 150mm diameter pipe in a southerly direction. A grille with approximate spacing of 90mm is situated above the pipe inlet. Site investigations have confirmed that Pipe A discharges into the Severn Trent Water surface water sewer situated in Mead Crescent, approximately 38m to the south.

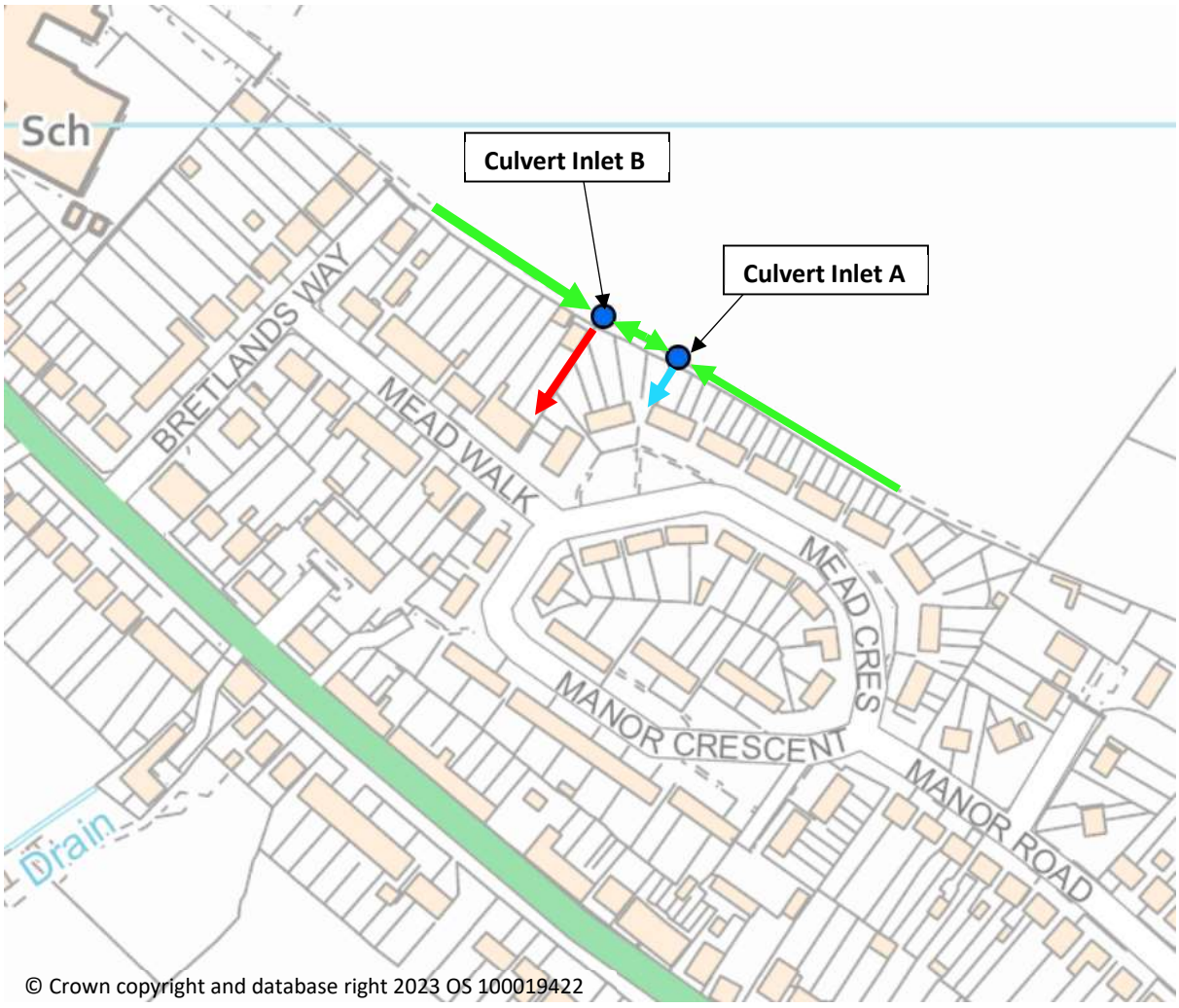



**Figure 8:** Location of drainage ditch and bund (green line), culvert inlet A and outlet pipe (blue line) and culvert inlet B and outlet pipe (red line).

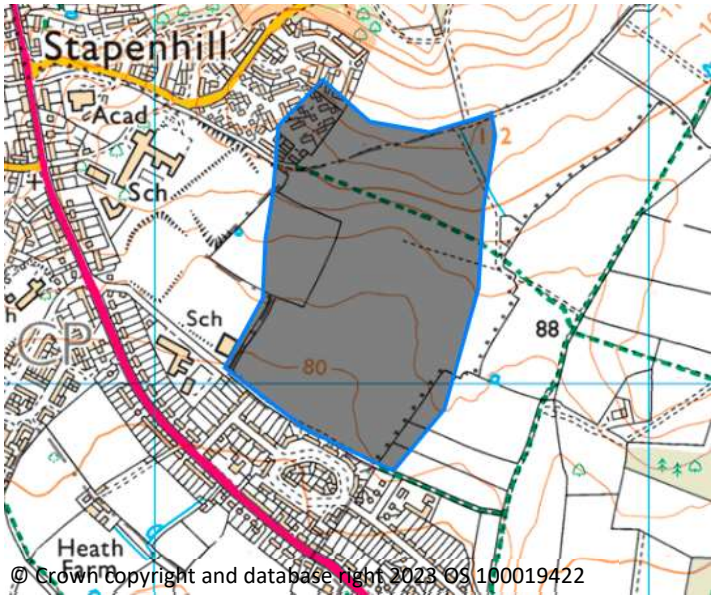



**Figure 9:** Estimate of catchment area draining to drainage ditch and culvert outlet pipe.

Approximately 30m to the west of Pipe A an additional culvert inlet has been observed within the ditch (Culvert B, Figure 8). This pipe also conveys surface water runoff from the field ditch, however, it is not clear whether this pipe acts as an overflow pipe from Pipe A or whether it conveys a proportion of the surface water runoff from the western part of the field. Two pipes from the western and eastern sides of the drainage ditch connect into Pipe B, both of which have a grille on the upstream end. Site investigations have confirmed that Pipe B flows in a southerly direction for approximately 70m through a private garden, before connecting into a 300mm diameter Severn Trent Water Surface Water sewer that runs in an easterly direction along Mead Walk.

It is understood from consultation with the Housing Association that a bund was constructed between the drainage ditch and properties to prevent water from flowing towards the properties at Mead Crescent, however no further details of the bund were available.

# Historical Flooding at Mead Crescent & Manor Crescent, Stapenhill

Staffordshire County Council hold a flood incident database relating to flood incidents from various sources across the County. This information is limited prior to the establishment of the Council as the Lead Local Flood Authority in 2009. As such, prior to the event on 16th February 2020, the Council has no confirmed records of internal flooding at Mead Crescent and Manor Crescent.

It is understood the area has experienced flooding in the past and is considered a flooding hotspot. Discussions with the Housing Association have also indicated that Mead Crescent and Manor Crescent have experienced significant flooding on at least three previous occasions. Whilst no further details were available to confirm dates or extents of flooding experienced, subsequent web searches have indicated that flooding was experienced in February 2019, with photographs from the Derby Telegraph website showing external flooding to the highway (Dramatic pictures show extent of flooding in Burton and South Derbyshire - Derbyshire Live (derbytelegraph.co.uk). It is not known whether any internal flooding was experienced during this event or the cause of the flooding.

**Environment Agency Flood Mapping:**

From a flooding perspective, there are no watercourses located immediately adjacent to Mead Crescent and Manor Crescent and the Environment Agency's Flood Zone map places both Mead Crescent and Manor Crescent in Flood Zone 1.

The Environment Agency's Risk of Flooding from Surface Water (RoFSW) map shows a small area of ponding along Manor Crescent, with several properties shown to be located within the 1 in 1000 year RoFSW map (Figure 10). This means that flooding occurring as a result of rainfall with less than 1 in 1000 (or 0.1%) chance in any given year.

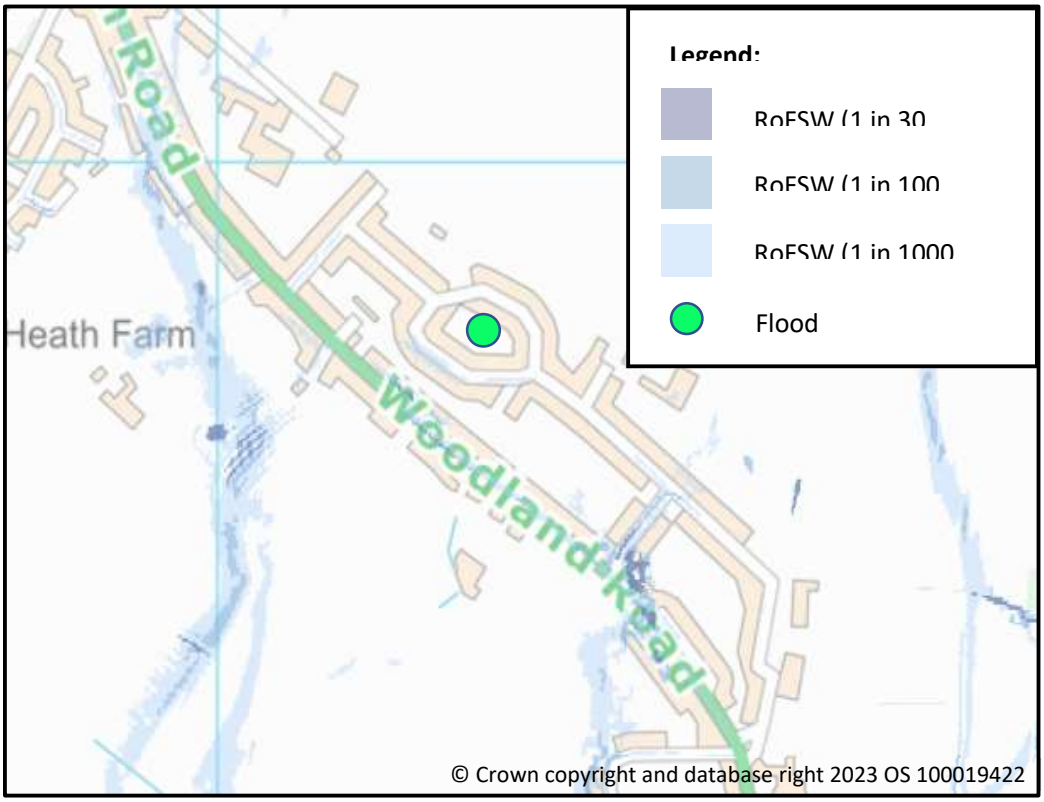
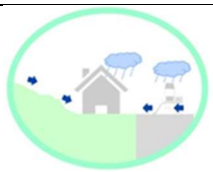



**Figure 10:** Environment Agency Risk of Flooding from Surface Water (RoFSW)

# February 2020 - Flood Event

| Identified Flooding Type(s) |
| --- |
| Surface Water |
|  |

On 16th February 2020, multiple properties along Mead Crescent and Manor Crescent reported that they had experienced flooding. Records passed to us by East Staffordshire Borough Council (ESBC) and the Housing Association indicate that 16 residential properties experienced flooding internally. This information came via properties that claimed for damages as a result of the flooding. It is therefore possible that some properties did flood internally but did not claim.

Accounts from residents describe how surface water was observed flowing from nearby fields to the rear of the properties along Mead Crescent, before entering homes from both the front and rear of the properties. Several residents described how furniture was damaged and carpets and flooring ruined throughout the downstairs of their properties. In addition, flooding was also experienced to gardens, driveways and the highway. Figure 11 below presents two photographs taken by residents on the evening of the flood event and shows flood water up to the front doors of properties and along the highway of Mead Crescent.

**Figure 11:** Photographs taken along Mead Crescent on the evening of 16th February 2020 (Images provided by the Housing Association).

Representatives from the Housing Association have described how there was some concern from residents that the water may have been contaminated, possibly with agricultural pollutants, however this has not been verified. The extent of damage to the properties resulted in the Housing Association evacuating residents from their properties.

**Flood Incident Response:**

Mead Crescent and Manor Crescent are not covered by the Environment Agency's flood warning or flood alert areas.

On Sunday 16th February 2020, Staffordshire County Council and East Staffordshire Borough Council received a significant number of calls through their emergency telephone lines informing the Council of localised flooding throughout the Borough, including the Burton-on-Trent area. Officers immediately put the Town Hall on standby in case it needed to be mobilised as a rest centre.

Over the course of Monday 17th February, East Staffordshire Borough Council was advised that flooding was potentially becoming more widespread within the Borough and at 5pm on Monday, officers chaired a multiagency conference call which resulted in formal Strategic and Tactical Co-ordinating groups being set up. This included Staffordshire County Council, Police, Fire, West Midlands Ambulance Service and the Civil Contingencies Unit (CCU) as part of the local resilience forum response.

As part of the response, it was highlighted that a number of properties may need to be evacuated and the Town Hall was mobilised as a rest centre, to accommodate any residents displaced due to flooding. However, emergency services indicated that this would not be required, and rest centre facilities were closed shortly after. On the morning of 18th February, the Strategic Coordinating Group stood down the response phase and moved into the recovery phase.

Subsequent consultation with the Housing Association as part of this section 19 investigation has indicated that several property owners at Mead Crescent and Manor Crescent had to vacate their properties and were required to move into temporary accommodation until repairs had been completed. This is understood to have taken approximately three to four months.

East Staffordshire Borough Council (ESBC) received more than 130 applications for grant support from residential and business properties across East Staffordshire. By the end of the scheme, the DEFRA Property Flood Resilience grant scheme and ESBC will have provided grants to approximately 86 properties that equals an approximate value of £370,840 across the Borough.

# Investigation

Flooding to both property and the highway at Mead Crescent and Manor Crescent has occurred on several occasions. Prior to 2020, SCC Lead Local Flood Authority (LLFA) had limited knowledge of the issues and flooding mechanisms at this location. Following the flood event, SCC LLFA have worked in conjunction with the relevant Risk Management Agencies (RMAs) and other relevant organisations, including the Housing association, to obtain data to help understand what happened on 16th February 2020.

**Rainfall Analysis:**

Rainfall data has been obtained from various sources to obtain a better understating of the February 2020 event. On the 15th and 16th of February, Storm Dennis generated a severe weather warning over much of the Midlands. The Storm Dennis event has been characterised as a long duration, low to moderate intensity rainfall event that spread over large catchments, which is typical with winter rainfall storm events.

Figure 12 shows the recorded 5-minute HydroMaster rainfall data for Mead Crescent and Manor Crescent. A total of 32.9mm of rainfall was recorded over the 24 hour time period 15th February 2020 to 16th February 2020. Of this total, 29.8mm was recorded during a 17-hour period between 20:40 on February 15th and 13:40 on 16th February 2020 demonstrating that the storm was intense with rainfall falling continuously throughout the duration of the storm.

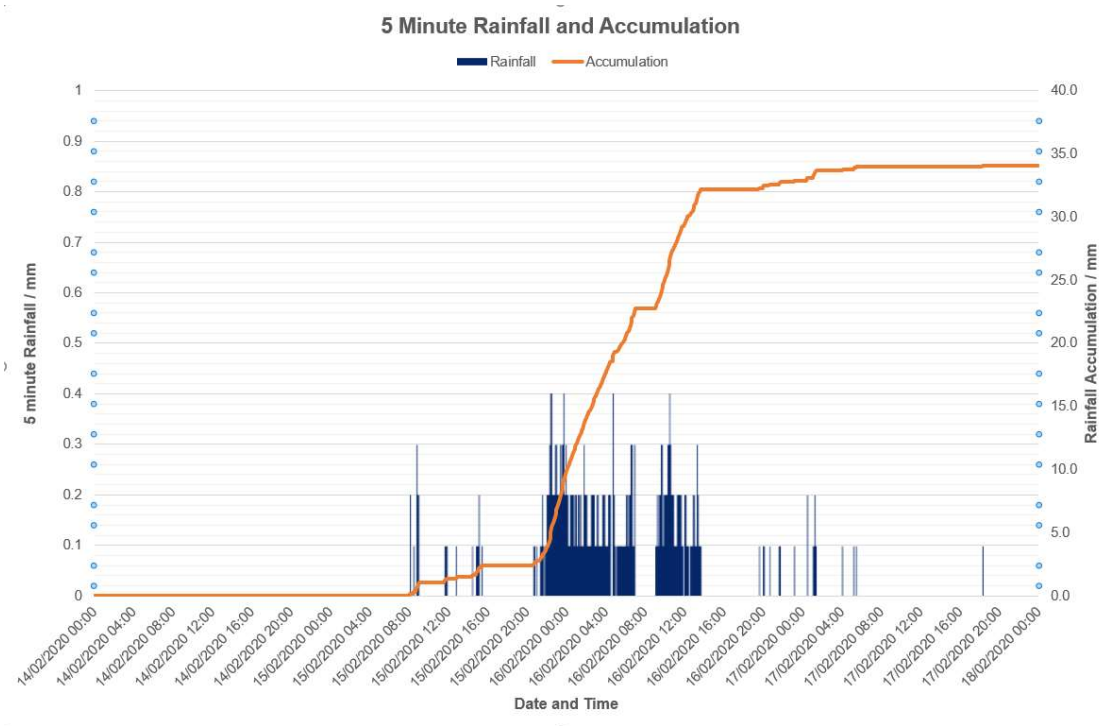



**Figure 12**: 5-minute Rainfall data for Mead Crescent and Manor Crescent, Stapenhill, from Hydromaster data for February 14th to February 18th 2020 (Source: Hydromaster)

This intense periods of rainfall prior to the flooding incidents that occurred across the County resulted in significant volumes of surface water flowing over what was already saturated ground.

The rainfall return period of the February 2020 event has been estimated as between a 1-year and 2-year event (Table 1). Whilst the magnitude of the rainfall event alone was not exceptional, when combined with the preceding conditions and extremely saturated ground it resulted in a more extreme, lower probability flooding event.

**Table 1**: Rainfall event return periods for Storm Dennis on February 16th and 17th 2020

| Event duration | Event occurrence (date / time) | Total rainfall (mm) | Rainfall Intensity (mm/hr) | Event return period |
|---|---|---|---|---|
| 6-hour | 15/02/2020 21:55 – 16/02/2020 03:55 | 12.7 | 2.1 | < 1 year |
| 12-hour | 15/02/2020 22:40 – 16/02/2020 10:40 | 22.0 | 1.8 | > 1 year & < 2 year |
| 24-hour | 15/02/2020 13:45 – 16/02/2020 13:45 | 31.2 | 1.3 | > 1 year & < 2 year |
| 48-hour | 15/02/2020 05:25 – 17/02/2020 05:25 | 35.2 | 0.7 | < 1 year |

Similar rainfall totals for the same time-period were recorded by DEFRA Environment Agency rain gauges within the area. The closest gauge to Mead Crescent and Manor Crescent, Clay Mills, recorded daily (24 hour) rainfall totals as 10.6mm on 15th February and 33.2mm on 16th February, with a total recorded rainfall of 43.8mm over the two days. Comparable rainfall values were also recorded at Byrkely Park (40.6mm) and Overseal rain gauge (42.4mm) which are equal distances from the flood location. This demonstrates that in excess of 40mm of rainfall fell over the wider area prior to the flood event on February 16th, whilst soils were already saturated throughout the catchment from Storm Ciara the previous week.

Historic average annual rainfall data from the MET Office shows that for the nearest rain gauge to Mead Crescent (Sutton Bonington), the average annual rainfall for the month of February is 38.85mm (based on the baseline climate period 1981 to 2010). Therefore, it can be concluded that almost one month's rainfall fell in the 24 hour time period between 15th February 2020 to 16th February 2020.

Assessment of the rainfall data gathered following the event and based on evidence gathered after the flooding, including discussions with the Housing association, it is clear that other factors may have exacerbated the flooding at Mead Crescent, resulting in a greater impact than would be expected from a storm of this magnitude. The following sections summarise the investigation into factors that may have contributed to the flood event.

**Site Investigation & Discussions with Housing Association:**

A site visit was conducted between SCC's LLFA Flood Risk Officer and a representative from the Housing Association on 7th March 2022. During the site visit, the Housing Association representative provided an overview of the flooding that occurred. Figure 13 below demonstrates the main flow routes observed during the February 2020 event as described to SCC LLFA by the Housing Association.

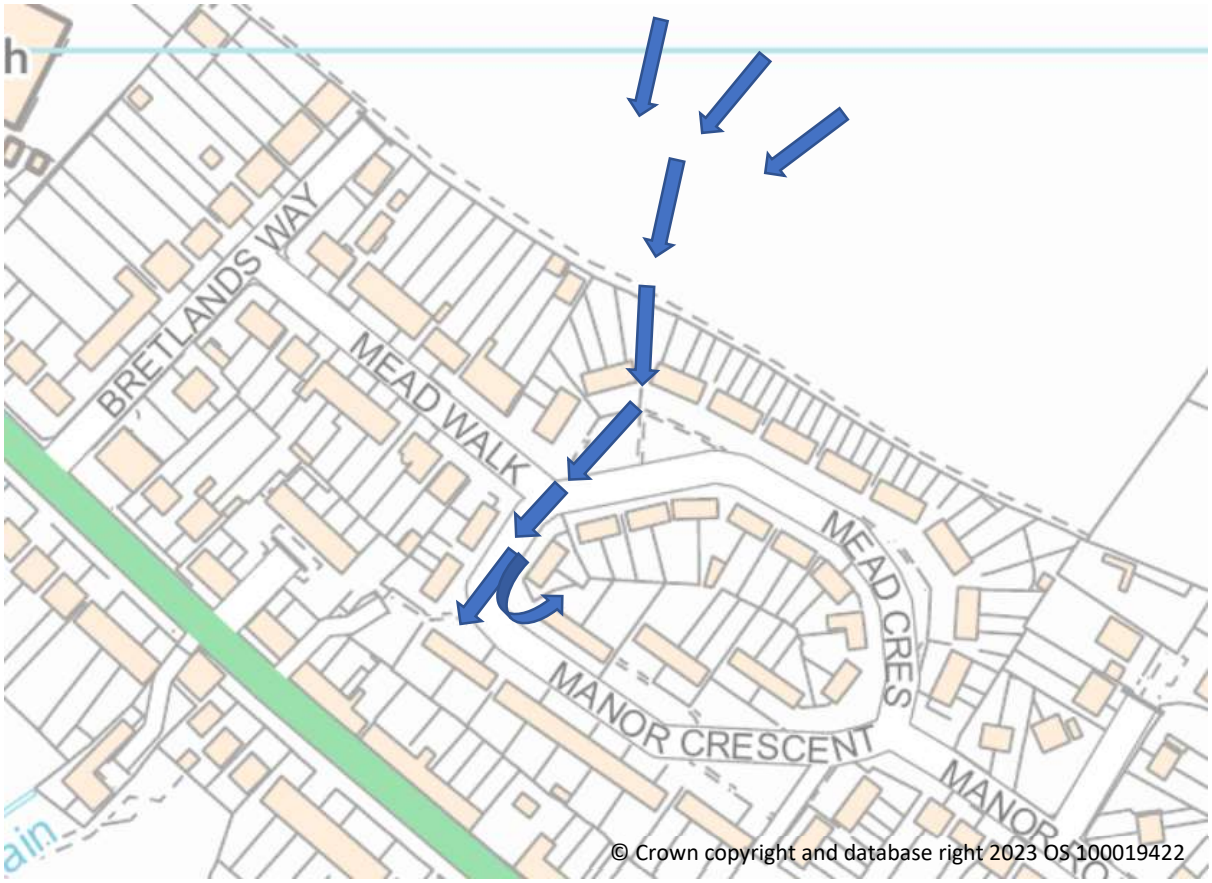



**Figure 13:** Blue arrows demonstrate the flow routes observed during the February 2020 event

Analysis of the rainfall data from the event has indicated that Storm Dennis was a medium intensity storm, with prolonged periods of heavy rainfall. The Housing Association representative described how water flowed from the field to the rear of Mead Crescent and filled the drainage ditch which became overwhelmed and part of the bund between the ditch and houses was washed away by the flood water. The flood water then followed the prevailing topography, between a gap in the properties along Mead Crescent and down towards Manor Crescent (Figure 13), resulting in internal flooding to several properties along Mead Crescent and Manor Crescent.

As previously stated, the antecedent conditions were such that the ground was saturated and therefore surface water runoff from the field to the north is likely to have been higher than would normally be expected. It is also possible that agricultural practices within the field may have

contributed to an increase in surface water flowing overland towards the ditch. Site observations following the event have shown the field to be well compacted (Figure 14) and it was reported that the field had been ploughed in a north to south direction, possibly creating drainage channels towards the ditch.

**Figure 14:** Looking in a northerly direction across the field from Culvert A

(Photograph taken in November 2020)

Site observation of culvert A indicates that the outlet pipe from the field comprises a 150mm diameter pipe (Figure 15) with trash screen (bar spacing approximately 90mm) situated above the inlet structure (Figure 17). Anecdotal evidence from the event has indicated that the pipe had

**Figure 15:** Culvert A outlet pipe from field following removal of blockage observed on site (photograph taken in November 2020)

**Figure 16:** Culvert A outlet pipe from field with blockage to pipe as observed on site in March 2022

insufficient capacity to convey the volume of flood water from the ditch into the downstream surface water sewer, becoming overwhelmed and quickly reaching its capacity.

**Figure 17:** Trash screen situated above culvert outlet pipe A

Calculations undertaken have estimated that the average runoff generated across the catchment over the course of the storm was approximately 100l/s. This is considered to be a conservative estimate which does not take into account other potential losses or other factors that may have contributed to the surface water runoff. Based on a pipe diameter of 150mm, it is therefore likely that the pipe was overwhelmed by the significant volume of water flowing from the fields and into the drainage ditch.

Whilst no reports of blockage to the culvert of inlet screen have been received as part of this investigation, during the site visit the trash screen at the culvert inlet appeared to be damaged and the outlet pipe was completely blocked with debris (Figure 15 and Figure 16).

A second site visit was held with the Housing Association on 13th April 2022 to investigate the connectivity of the two outlet pipes from the field and determine whether there are any significant structural issues or blockages within the drainage system. CCTV investigation of the surface water sewers connecting to culvert inlet pipes A and B was undertaken. This was commissioned by the Housing Association and undertaken by Draintech Services Ltd. Figure 18 overleaf presents the approximate location and extent of CCTV undertaken for each pipe.

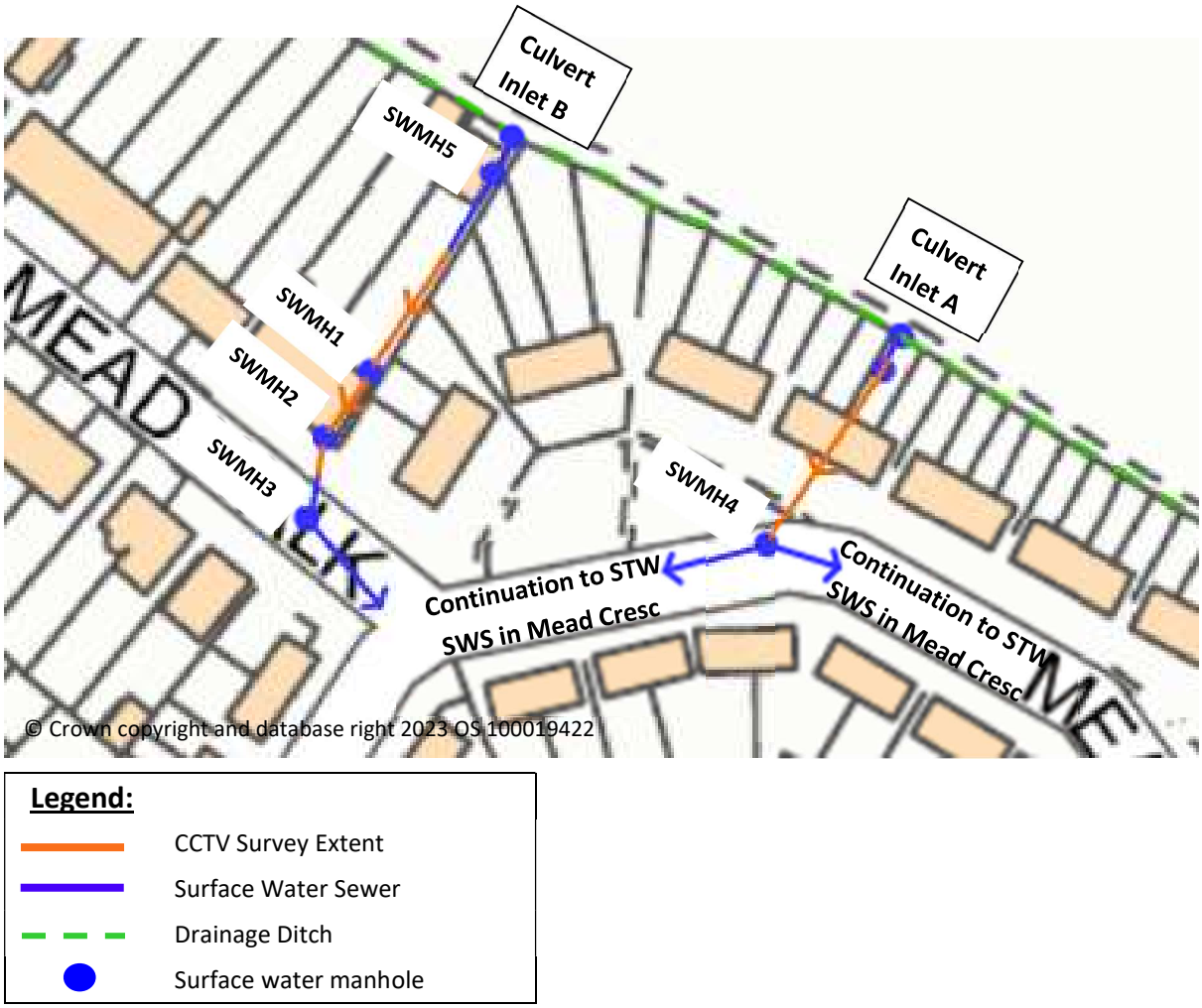



**Figure 18:** Approximate location of CCTV survey undertaken on 13th April 2022 showing extent of CCTV survey sections (orange line) and location of identified surface water sewer (SWS) manholes and continuation to Severn Trent Water (STW) Surface Water Sewers (SWS).

Section 1 surveyed in a northerly direction upstream from SWMH1 towards Culvert Inlet Pipe B. This showed the 300mm diameter vitrified clay pipe with no major defects. Several incoming pipes were identified along the route which are likely to be surface water connections from adjacent properties. At 22m, there was a build-up within the pipe and the camera was unable to progress. This is likely to be a build-up of sediment from the agricultural land to the north. The build-up did not present an obstruction to the water flow which was observed to continue to flow through downstream sections of the pipe.

Section 2 surveyed in a southerly direction from SWMH1. This showed a 300mm diameter vitrified clay pipe. Approximately 14m into the survey a large open joint was identified along with root ingress from a large tree immediately to the west of the sewer. At 17m, the survey was abandoned as the camera was unable to progress further. A further manhole was lifted as part of the survey (SWMH3), this showed the continuation of the surface water pipe into the Severn Trent surface water sewer within Mead Walk. During the survey a local resident consulted with the survey team and SCC Flood Risk Officers. It is understood that during periods of heavy rainfall, water can be heard flowing through the surface water sewer which connects to culvert inlet Pipe B and that prior to the

construction of the properties at Mead Walk, a watercourse flowed from the field in a southerly direction. Review of historical mapping indicates that the watercourse is likely to have connected to the drain which is situated to the south of Stanton Road.

CCTV survey of the surface water sewer connecting to culvert inlet Pipe A was also undertaken. A length of approximately 30m was surveyed from SWMH4 in a northerly direction towards the field ditch. Several incoming connections were identified during the survey. Whilst no major defects were observed, the surveyed was abandoned at approximately 26m. As with Pipe B, this is likely to be a build-up of sediment from the field.

In addition to the CCTV survey, an initial assessment of the drainage ditch was undertaken to determine approximate levels between the two culvert inlet pipes and the ditch bund. Figure 19 below presents an overview of the findings.

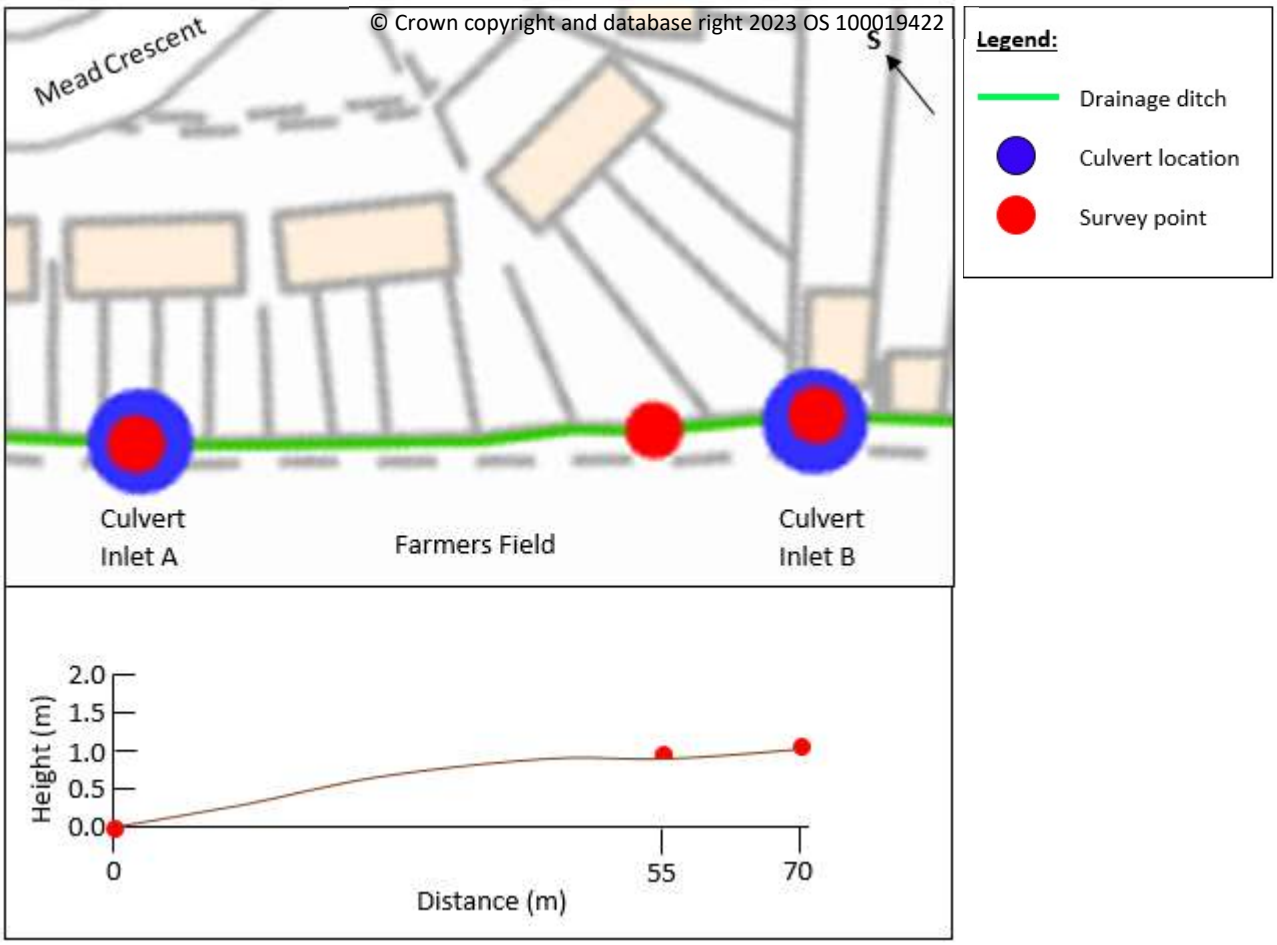



**Figure 19:** Sketch demonstrating locations of surveyed ditch bed levels and increase in ditch bed invert level between Pipe A and B.

The surveyed levels indicated that the invert level of Pipe B was approximately 1.0m higher that the invert level of Pipe A (Figure 19). Observations showed a rise in the ditch bed level between the two pipe inverts. Review of OS contour data for the field and site observations indicate that the

prevailing topography is towards Pipe A. It is likely that during the February 2020 event, surface water runoff followed the prevailing topography towards Pipe A but was unable to discharge quickly enough through the outlet pipes from the field. Once the hydraulic capacity of the pipe was reached, the ditch then filled with water, eventually overtopping the far side of the ditch and flowing through the rear gardens of the properties along Mead Crescent.

The photographs in Figure 20 below the southern side of the drainage ditch where it backs onto the Mead Crescent properties. An informal soil bund has been built up along the wire mesh fence forming the boundary between the ditch and gardens. The height of the bund varied along the length of the ditch. Initial surveyed levels show the bund to be approximately 0.6m above the top level of the drainage ditch at a point 55m along the ditch between Pipe A and Pipe B. Whilst this will have provided some protection from the flood water, it is likely that the volume of water will have quickly infiltrated into the soil, breaking it up and washing parts of it away during the event. Any subsequent flood water will have then flowed into the gardens and followed the prevailing topography towards Mead Crescent and Manor Crescent.

**Figure 20:** Photographs demonstrating the informal bund between drainage ditch and gardens of properties along Mead Crescent

Further observation of the drainage ditch showed it to be heavily vegetated with a substantial debris within the length of the ditch, including garden waste, DIY waste and tyres. Therefore, it is possible that blockage of the outlet pipe contributed to the extent of flooding experienced in February 2020, leading to the drainage ditch becoming overwhelmed more quickly.

During the site visit it was observed that several of the properties along Mead Crescent had flood gates installed on the entrance to their properties. It is understood from discussion with the Housing Association that these were installed following a previous flood event but were ineffective during the February 2020 event.

**Conclusion:**

It can be concluded that the flooding event at Mead Crescent and Manor Crescent during Storm Dennis in February 2020 was the result of an exceedance event, with surface water flooding from the field behind Mead Crescent. Prior to the event, a prolonged period of rainfall resulted in the catchment becoming saturated. An intense period of heavy rainfall leading up to the event which fell onto an already saturated catchment was unable to infiltrate into the ground and a significant volume of surface water runoff from the field flowed into the ditch to the rear of the properties. The ditch became overwhelmed quickly before overtopping the bund and following the prevailing topography towards Mead Crescent and Manor Crescent. Given the size of the outlet pipe from the field, it is likely that it did not have sufficient capacity to convey the volume of surface water runoff. Whilst blockage of the culverts from the field cannot be ruled out, it is likely that the drainage ditch became overwhelmed quickly, reaching capacity and spilling over the bund between the field and the houses.

Several factors have been identified that may have exacerbated the flooding. These include farming practices within the adjacent field, damage to the existing bund, and possible blockage of the outlet pipe. However, there is insufficient evidence to determine whether this was the case.

The CCTV survey identified several incoming connections into both Culvert Inlet Pipe A and B. These sections of surface water sewer are therefore likely to be the responsibility of Severn Trent Water and further consultation is required to establish future roles and responsibilities for these two sections of pipe as well as the inlet pipes within the field ditch to the north.

# RECOMMENDED ACTIONS

As part of this flood investigation, it is vital to determine what contributed to the flood event but also to establish a set of recommended actions that may help to alleviate flooding in the future or at least reduce risk to properties.

Table 2 below sets out relevant Risk Management Authorities (RMAs) and other interested parties, actions that have been taken to date and those actions planned for the future, with the relevant RMA who will lead.

**Table 2:** Risk Management Authorities and recommended Actions

| Relevant RMA | Actions to date | Actions in future, Lead RMA and timescale |
|---|---|---|
| SCC as LLFA | Meeting with Housing Association and STW | Work with local residents and landowners to investigate what works might be possible, and impact of these on third party land and how these might be funded (SCC lead, timescale mid 2023). |
| SCC as LLFA | Site investigations with Housing Association to determine connectivity between drainage ditch and downstream STW surface Water sewer | Liaise with STW, Housing Association and appropriate landowners to confirm ownership of drainage outlet pipe and downstream surface water network and appropriate maintenance for the future (SCC / STW / Derbyshire District Council, timescale ongoing). |

Discussion with the Housing Association has indicated that following the flooding, regular maintenance of the drainage ditch and culverts is undertaken to ensure that they are free from debris and structurally sound. This includes CCTV survey of the surface water system from the field (undertaken twice a year). It is understood that the channel and culvert are also inspected and cleared prior to weather warnings of heavy rainfall.

In line with the Local Flood Risk Management Strategy for Staffordshire, information on flooding that has happened will also be used to inform, where appropriate:

- Our understanding of the level of flood risk around the County and how we take a risk-based approach to prioritising our resources,

- Our understanding of where watercourses and assets, such as culverts and trash screens have caused particular issues and future maintenance needs. We will work to achieve these with land and asset owners,

- Where we can support communities to understand flood risk and become more resilient to flooding,

- Responses to major planning applications to ensure new development does not exacerbate existing flood risk issues and where possible, carefully planned Sustainable Drainage Systems on new developments reduce flood risk elsewhere,

- Partnership working with other flood risk organisations to take a joined up approach to flood risk management,

- Work undertaken by the Staffordshire Local Resilience Forum to be more prepared for future flood events, and

- The future programme for flood alleviation schemes across the County

# RISK MANAGEMENT AUTHORITIES AND OTHER PARTIES

A summary of each of the RMAs and their role in flood risk management, is provided below:

*Staffordshire County Council (LLFA)*
LLFAs are county councils or unitary authorities which are required to prepare and maintain a strategy for local flood risk management in their areas, investigate significant local flooding incidents and publish the results of such investigations and play a lead role in emergency planning and recovery after a flood event.

*Severn Trent Water*
https://www.stwater.co.uk/my-supply/pipes-and-drains/help-with-pipes/sewer-flooding/
As a water and sewerage company, Severn Trent Water manage the risk of flooding to water supply and sewerage facilities and the risk to others from the failure of their infrastructure. They ensure their systems have the appropriate level of resilience to flooding, and maintain essential services during emergencies, maintain and manage their water supply and sewerage systems to manage the impact and reduce the risk of flooding and pollution to the environment.

*East Staffordshire Borough Council (ESBC)*
As the Local Planning Authority, ESBC are responsible for determining planning applications within the Stapenhill Catchment in accordance with local and national policies.

*Derbyshire County Council (LLFA)*

LLFAs are county councils or unitary authorities which are required to prepare and maintain a strategy for local flood risk management in their areas, investigate significant local flooding incidents and publish the results of such investigations and play a lead role in emergency planning and recovery after a flood event.

*Riparian Owners*
https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities

A riparian owner is any party or individual who has a watercourse within or adjacent to any boundary of their property. They are responsible for maintaining the riverbed and banks within their section of the watercourse to preventing obstruction to the water flow and mitigate flood risk.

*Other Parties:*

*Housing Association*
As owner and manager for the properties at Mead Crescent and Manor Crescent, the Housing association are responsible for the ongoing management and maintenance of the properties.

# Conclusions

Several storms occurred in 2020 across the Midlands region which impacted many areas. Storm Dennis, in February was a long duration, low-to-moderate intensity event, causing widespread flooding nationwide. Following the February 2020 storm event, incidents of flooding were reported to Staffordshire Council, including Mead Crescent and Manor Crescent, Stapenhill.

The flooding at Mead Crescent and Manor Crescent had a significant impact on the community, with records indicating that 16 residential properties experienced internal flooding, with some residents being evacuated from their properties. In addition to this, flooding to gardens, driveways and the highway was also reported.

The main type of flooding has been identified as surface water flooding. The dominant flooding mechanism has been identified as water flowing from the fields behind the properties along Mead Crescent, overland towards Manor Crescent. A prolonged period of rainfall prior to the event resulted in the catchment becoming saturated and an intense period of heavy rainfall leading up to the event, meant that water was unable to infiltrate into the ground. Surface water runoff quickly filled the drainage ditch between the field and properties and the pipe from the field did not have sufficient capacity to accommodate the volume of water. The flood water spilled from the ditch, over the bund and followed the prevailing topography, before inundating properties along Mead Crescent and Manor Crescent. Several factors have been identified that may have exacerbated the flooding. These include farming practices within the adjacent field, damage to the existing bund and possible blockage of the outlet pipe. However, there is insufficient evidence to determine whether this was the case.

Staffordshire County Council in its role as LLFA will continue to work with Severn Trent Water, the Housing Association and other identified RMAs to try and reduce the flood risk to properties, as well as assisting the local community to ensure that is resilient and prepared for flood events should they occur in the future.