WARRINGTON
Borough Council

Environment & Transport

S19 Flood Investigation Report

Storm Babet
19th – 20th October 2023

Engineering & Flood Risk Management Team
Warrington Borough Council – Lead Local Flood Authority
Date: Thursday 19 October 2023 – Friday 20 October 2023
Location: Croft, Warrington
Flood Investigation Reference Number: 2023/016/001
Version: Final 02

Disclaimer

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

This report has been prepared as part of Council's responsibilities under the Flood and Water Management Act (2010) as Lead Local Flood Authority (LLFA).

The findings of this report are based on a subjective assessment of the information available to those undertaking the investigation and therefore may not include all relevant information. Therefore, it shouldn't 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 our assumptions when preparing this report, including, but not limited to those key assumptions noted in the reports, including reliance on information provided by third parties.

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This document will be reviewed following any new information being received in relation to the flood event and its causes/effects.

Revision Schedule & Approvals

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Supporting Documents List

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1 Introduction

This document has been prepared by Warrington Borough Council, as the Lead Local Flood Authority (LLFA), for the specific purpose of meeting the requirements of Section 19 (1) and (2) of the Flood and Water Management Act 2010 (FWMA 2010) which states:

> *(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate:*
>
> *(a) which risk management authorities have relevant flood risk management functions, and*
>
> *(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.*
>
> *(2) Where an authority carries out an investigation under subsection (1) it must—*
>
> *(a) publish the results of its investigation, and*
>
> *(b) notify any relevant risk management authorities.*

This report aims to meet the requirements of Section 19 of the FWMA 2010 as well as provide a reference for the effective future management of flooding in the administrative area of Warrington Borough Council by:

- Providing details of the flooding incident,
- Undertaking analysis of the flood history of the area,
- Identifying the responsibilities of Risk Management Authorities (RMAs) and the actions which were carried out,
- Identifying successful response measures and lessons learned, and
- Recommending the next steps.

The supporting data has been collated from a variety of sources. Whilst every effort has been made to identify the cause, and consequence of flooding, this document does not include every flooding occurrence, only where flooding has been reported and is indicative only.

2 Incident Summary

Table 2.1: Incident Summary

Incident Reference	2023/016/001
Location	Croft, Warrington
Date(s) of Incident(s)	Thursday 19th October 2023 – Friday 20th October 2023
Reason for Investigation	Internal flooding to property
Identified Cause	Combination of: • A significant storm event (Babet). • Prolonged heavy rainfall and saturated catchment due to persistent rainfall in 2023 (40% increase in rainfall compared to 2022) • Lack of capacity of the drainage system to cope with overland flow from a very large catchment area. • Significant tree roots in the drainage system. • Failure of the liner in sections (installed circa 2016). • Failure of the pipe adjacent to the chamber near No1 Mustard Lane creating a significant void. • Flooding to the school as a result of water flowing through the underground service ducting, not overland flow.

2.1 Affected Areas

Mustard Lane, Croft is a residential area located in Culcheth, Glazebury and Croft Ward within the administrative area of Warrington Borough Council. It is approximately 4.1 miles to the north east of Warrington town centre.

Warrington Borough Council is aware that flooding occurred between Thursday 19th October 2023 and Friday 20th October 2023 to Mustard Lane, Croft.

It is understood that internal flooding occurred to 2 properties on Mustard Lane as follows:

- Croft Memorial Hall
- Croft Primary School

It is understood that external flooding occurred to 2 further properties on Mustard Lane, Croft in the vicinity of the Memorial Hall and the Primary School.

Figure 1: Photograph of Flooding to Croft Memorial Hall

Source: Facebook

3 Flood Incident Weather Details

This section of the report details the meteorological conditions, rainfall and weather warnings where appropriate during the period 18th to 21st October 2023.

The following information has been used to help provide an overall picture of the conditions that led to the flooding event in Warrington during October 2023:

- Environment Agency Water Situation Reports - The Environment Agency issues monthly water situation reports for England at both national and regional scale, which provide an overview of various hydrological information including rainfall, soil moisture and river flows for the month.

- CEH Hydrological Summary reports – The Centre for Ecology and Hydrology (CEH) issues reports for the United Kingdom, which, similar to the Environment Agency Water Situation Reports, provide analysis of various hydrological records for the month.

- Information supplied from Environment Agency (on request) for the area of interest within an authority area. This information includes data obtained from monitors recording rainfall, ground water level and watercourse levels, as well as any flood alerts issued to the general public.

3.1 National context of Storm Babet

Storm Babet brought exceptional rainfall to parts of eastern Scotland with 150 to 200mm falling in the wettest areas and the Met Office issuing two red warnings for rain. For the county of Angus - coinciding with this red warning area - 19 October 2023 was, by a wide margin, the wettest day on record in a series from 1891.

Heavy, persistent and widespread rain also affected much of England, Wales and Northern Ireland from 18th to 20th, with 100mm falling fairly widely. This was the third-wettest independent 3-day period for England and Wales in a series from 1891, while the Midlands provisionally recorded its wettest 3-day period on record. This rain came on top of very wet weather earlier in October with some central and eastern parts of England and Scotland recording more than twice the October whole-month average rainfall in the first three weeks of the month.

Babet also brought some very strong winds, gusting at over 50Kt (58mph) across northeast England and much of Scotland. A blocking area of high pressure over Scandinavia prevented Babet clearing the UK eastwards into the North Sea and as a result these wind speeds were sustained for a prolonged period. The persistent heavy rain and strong wind resulted in atrocious weather conditions for a sustained period, with a gust of 67Kt (77mph) at Inverbervie (Kincardineshire) and winds gusting at over 100Kt (115mph) across Scotland's mountain summits.

3.1.1 National Impacts

Storm Babet resulted in the most severe and widespread disruptive weather impacts of 2023. Multiple severe flood warnings were issued by the Environment Agency (EA) and the Scottish Environment Protection Agency (SEPA). At least seven people were reported to have died as a result of the storm.

In Scotland, hundreds of homes and businesses were flooded with the town of Brechin severely affected after defences were overtopped by the river South Esk. The main A90 trunk road was closed between Forfar and Brechin after storm Babet damaged a bridge, and schools across Angus were closed. Scottish farmers were reported to have lost crops, with

some sheep also washed away by floodwater, and around 30,000 homes in northern Scotland lost power during the storm.

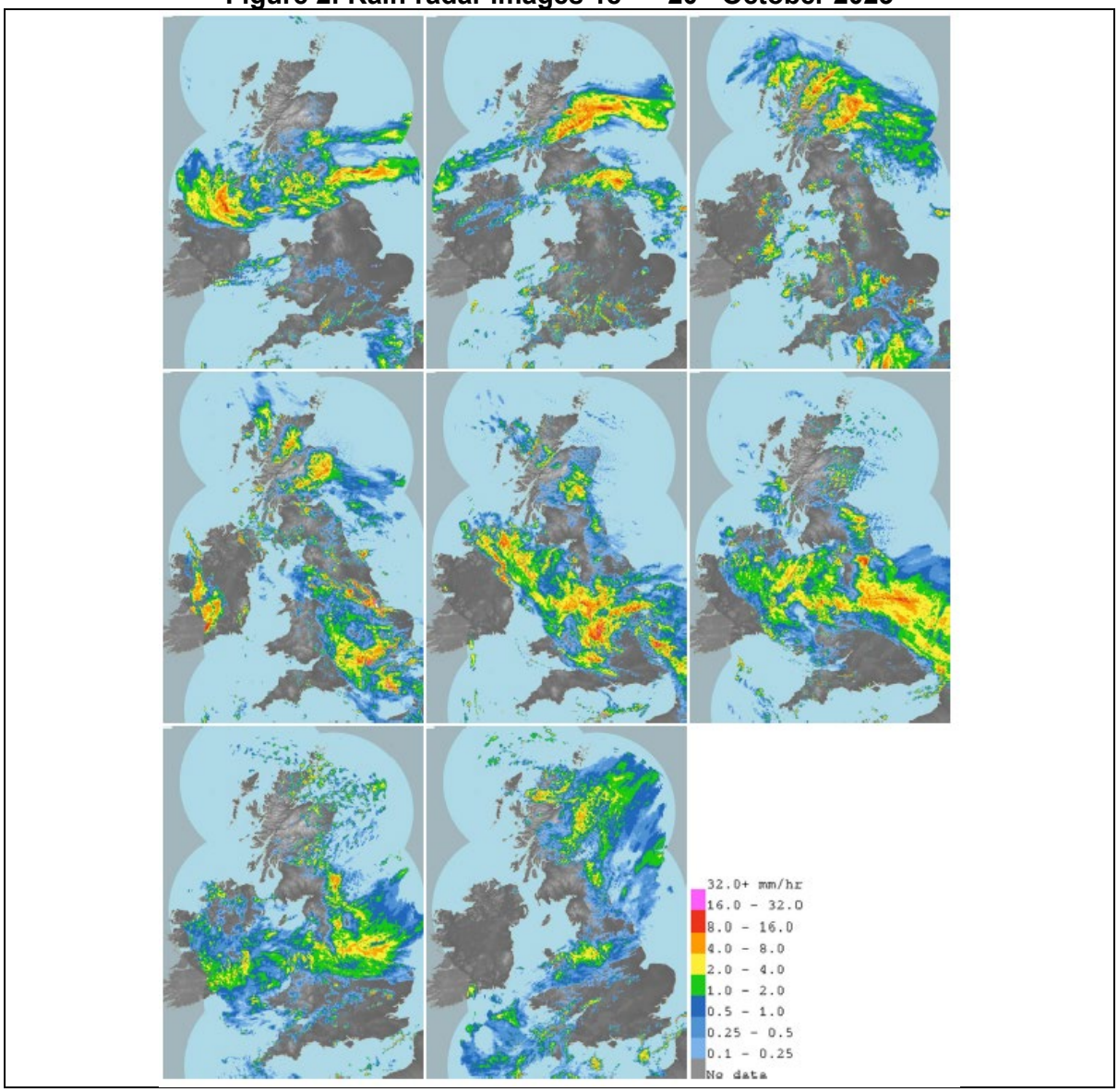
Over 1000 homes in England were also affected by flooding across Yorkshire, the East Midlands and the Humber area. In Chesterfield (Derbyshire), around 400 homes were flooded while 500 homes were evacuated in Retford (Nottinghamshire) and widespread flooding affected other areas such as the Stafford and Wrexham areas, while Derby's Museum of Making was flooded. In Suffolk, a major incident was declared due to flooding. Rail services on the East Coast were severely affected due to flooded lines and Kings Cross station in London was temporarily closed due to concerns with overcrowding. Other rail services in Scotland and northern England were cancelled or severely disrupted. Leeds Bradford airport closed after an aircraft skidded off the runway during the storm. 45 workers were airlifted off a North Sea drilling platform after it lost anchors during the storm. Sections of railings were destroyed at Sunderland's pier by large waves.

3.1.2 National Weather Data

Atlantic storm systems affecting the UK in the autumn and winter months normally track west to east, driven by the jet stream, clearing eastwards fairly quickly. In contrast, storm Babet was on an unusual track from south to north, enabling it to pick up additional moisture as it crossed the Bay of Biscay. Babet was also unable to clear eastward into the North Sea due to a blocking area of high pressure across Scandinavia. The rain-bearing fronts therefore remained stationary across eastern Scotland for a prolonged period before moving back across England and Wales.

The following sequence of rain-radar images at 6-hour intervals from 6:00am on 19 October 2023 to midnight on 21 October 2023 show the heavy rainfall across northern England and Northern Ireland moving north to affect eastern Scotland through this period, with further widespread heavy rain then spreading back to affect much of England and Wales through the 20th.

Figure 2: Rain-radar images 18th – 20th October 2023



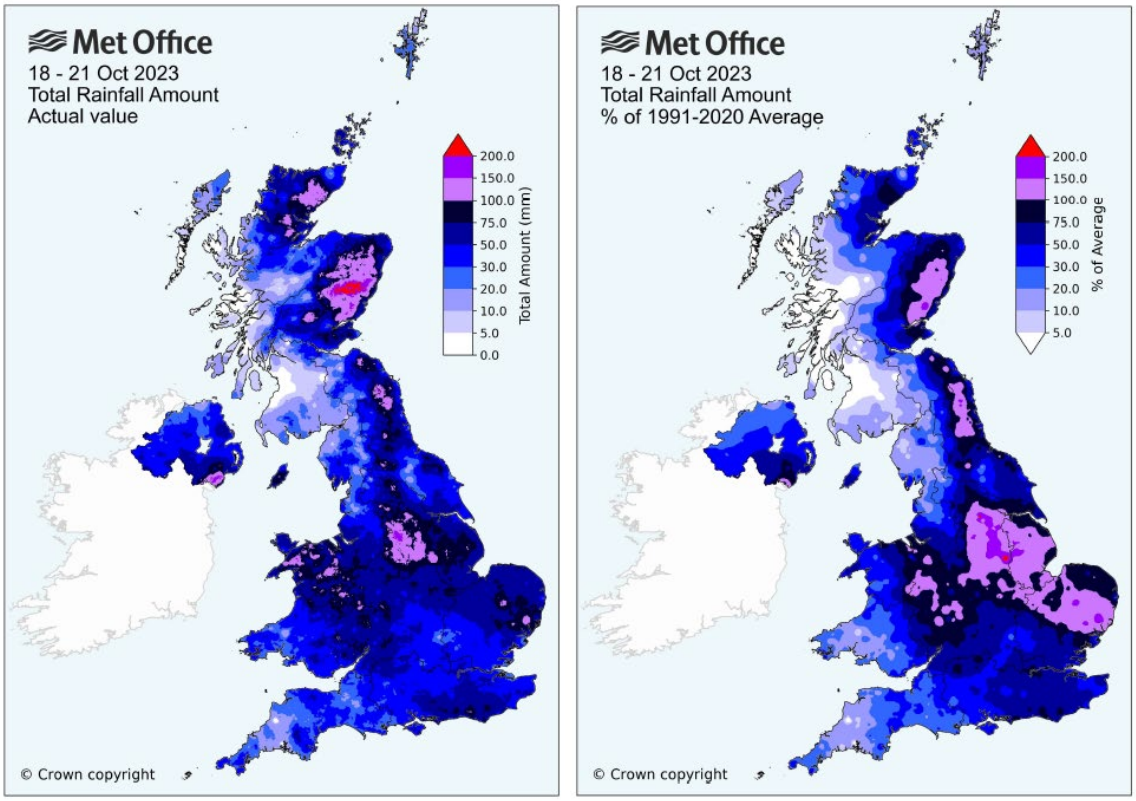
Source: Met Office

The maps below show the accumulated daily rainfall for the 4-day period 18 to 21 October 2023 from storm Babet as actual totals in mm (left) and percentage of the October whole-month average (right).

Large swathes of the UK received over 50mm of rain, with 75 to 100mm widely across eastern Scotland, the Pennines, North Wales, the Mourne Mountains of Northern Ireland and parts of the West Midlands, East Anglia and south-east England, and over 100mm in the wetter locations (in some places over 150mm).

The process used to generate the maps attempts to take topographical influences into account, and this shows a significant area of eastern Scotland receiving over 200mm (shaded in red). Much of the Midlands, East Anglia, south Pennines, Northumberland and eastern Scotland received over the whole-month average rainfall, with significantly more than this in some areas.

Figure 3: Rainfall totals for period 18th – 21st October 2023



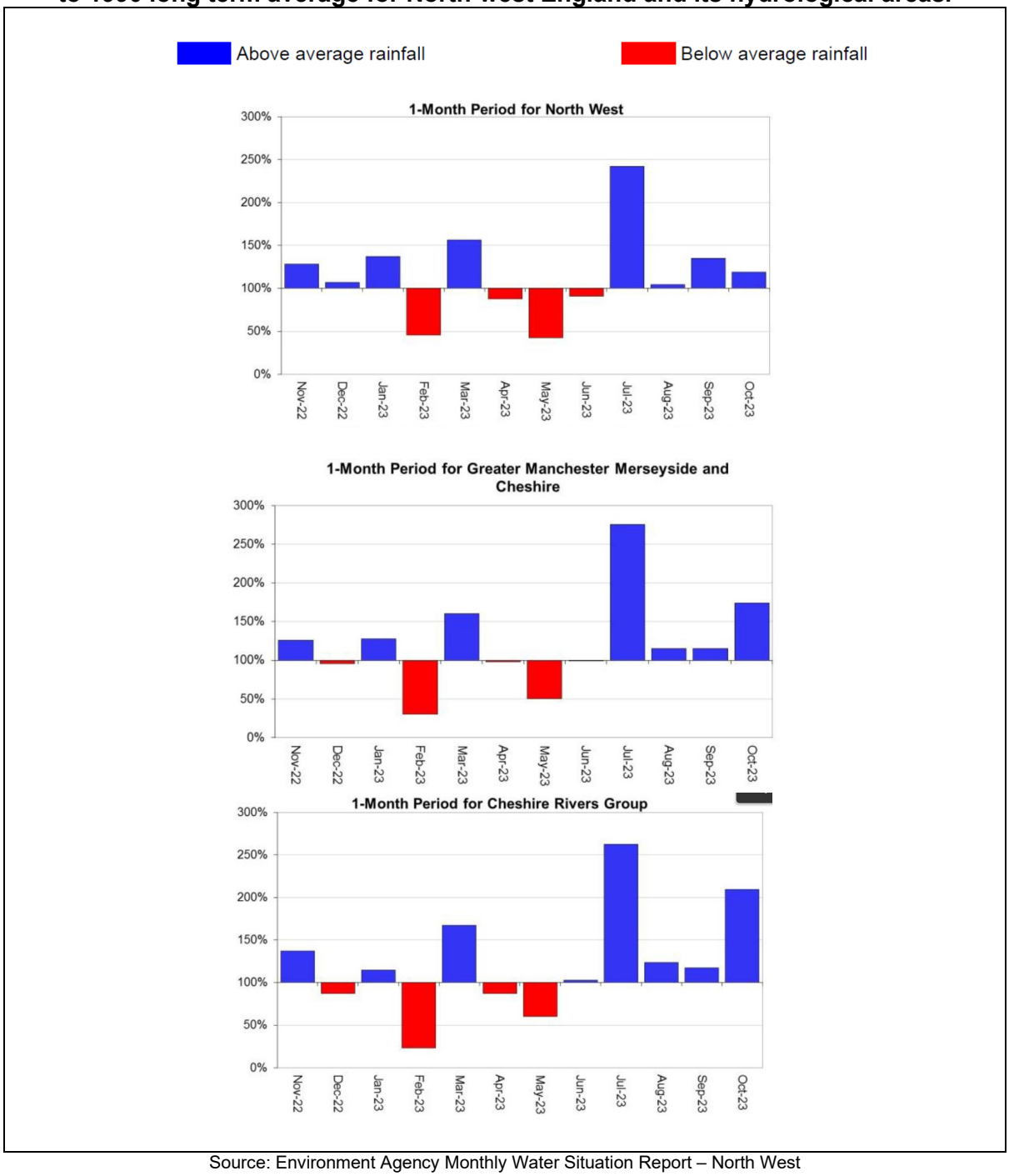
Source: Met Office

3.2 Antecedent Conditions

Rainfall in North West England was overall classed as Normal for October, having received 119% of the long-term average (LTA). Rainfall varied spatially across the areas; significantly Greater Manchester, Merseyside and Cheshire received 174% of the LTA, classifying the area as having received Notably high rainfall, whereas Cumbria and Lancashire was classed as Normal with 105% of the LTA.

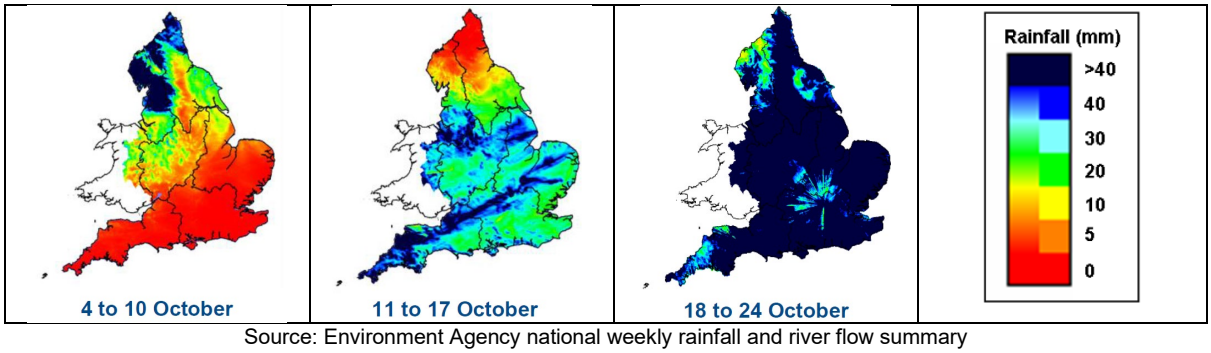
As a result of Storm Babet, heavy rainfall was observed across Greater Manchester, Merseyside and Cheshire, as well as southern parts of Lancashire. Exceptionally high rainfall was observed in the Cheshire Rivers Group hydrological area (209% of the LTA), and the Mersey and Irwell hydrological area received 150% of the LTA, classed as Notably high.

Figure 4:
Monthly rainfall totals for the past 12 months expressed as a percentage of the 1961 to 1990 long term average for North-west England and its hydrological areas.



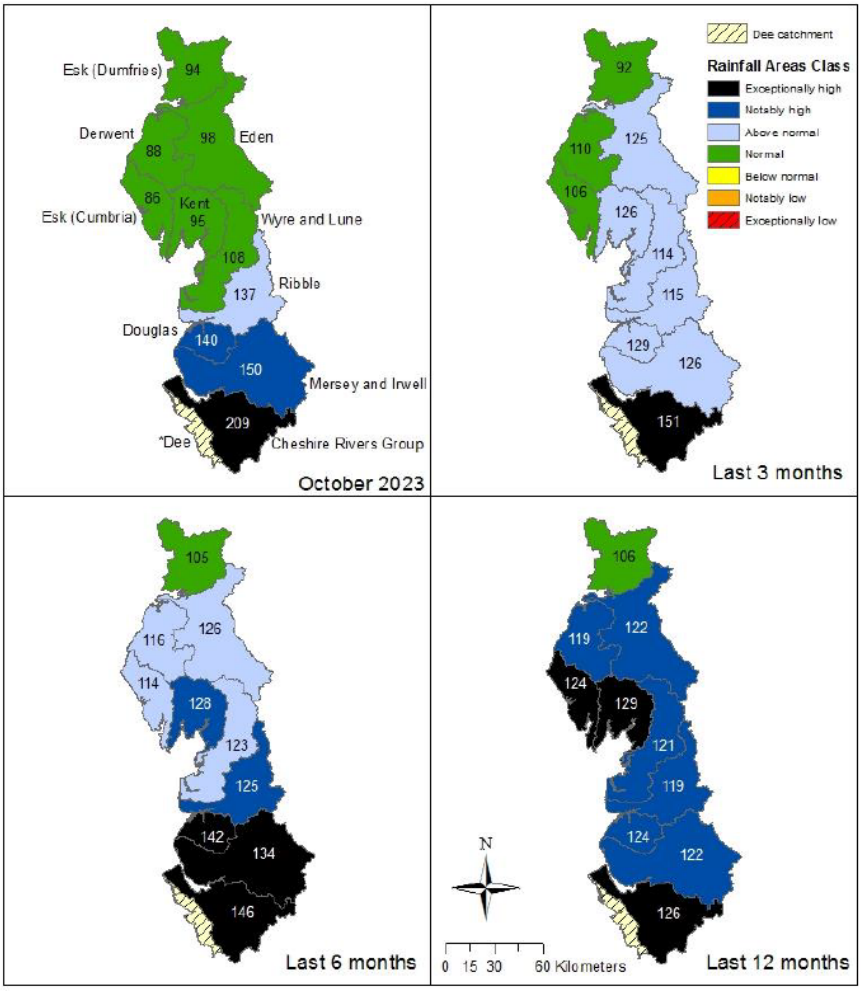
Source: Environment Agency Monthly Water Situation Report – North West

Figure 5: Weekly precipitation across England and Wales. UKPP radar data. EA Weekly rainfall and river flow summary 4th – 24th October 2023



Source: Environment Agency national weekly rainfall and river flow summary

Figure 6: Total rainfall (as a percentage) for hydrological areas across North West England for October 2023 and the 3 months, 6 months and 12 months leading up to October 2023



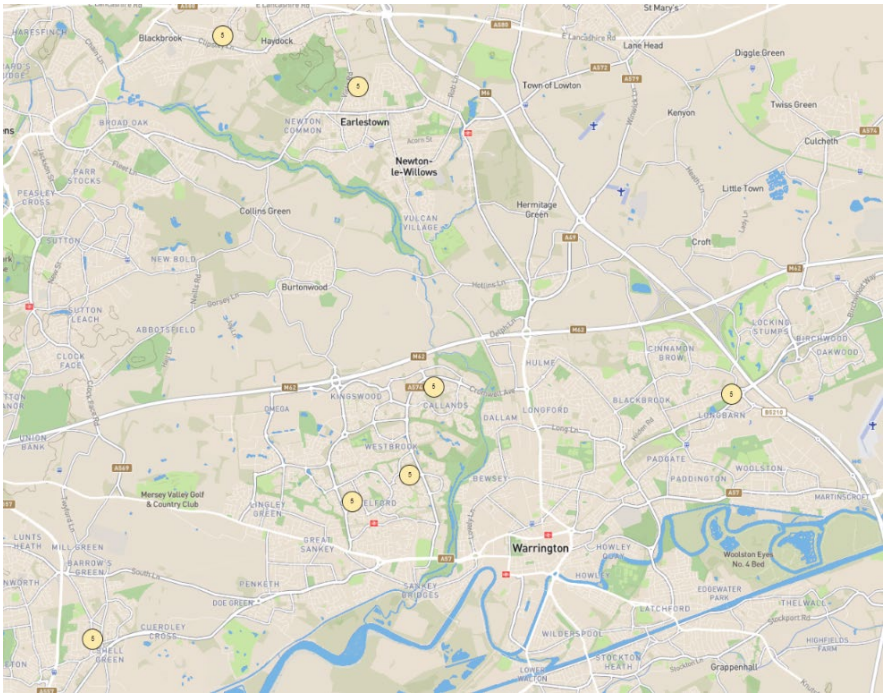
Rainfall data for 2023, extracted from Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. (Source: Environment Agency. Crown Copyright, 100024198, 2023). Rainfall data prior to 2023, extracted from Met Office HadUK 1km gridded rainfall dataset derived from registered rain gauges (Source: Met Office. Crown copyright, 2023).

Source: Environment Agency Monthly Water Situation Report – North West

3.3 Rainfall Data during Storm Babet

Met Office Weather Observation Website (WOW) provides a platform to share information recorded on Automatic Weather Stations (AWS). There are a number of AWS in and around the area of Warrington as shown on figure 7 below.

Figure 7: Location of Automatic Weather Stations in and around the Warrington area.



During Storm Babet, 59.7mm of rainfall was received over the 51 hour period (average across 3 rain gauges – values recorded in table 3.3.1 below)

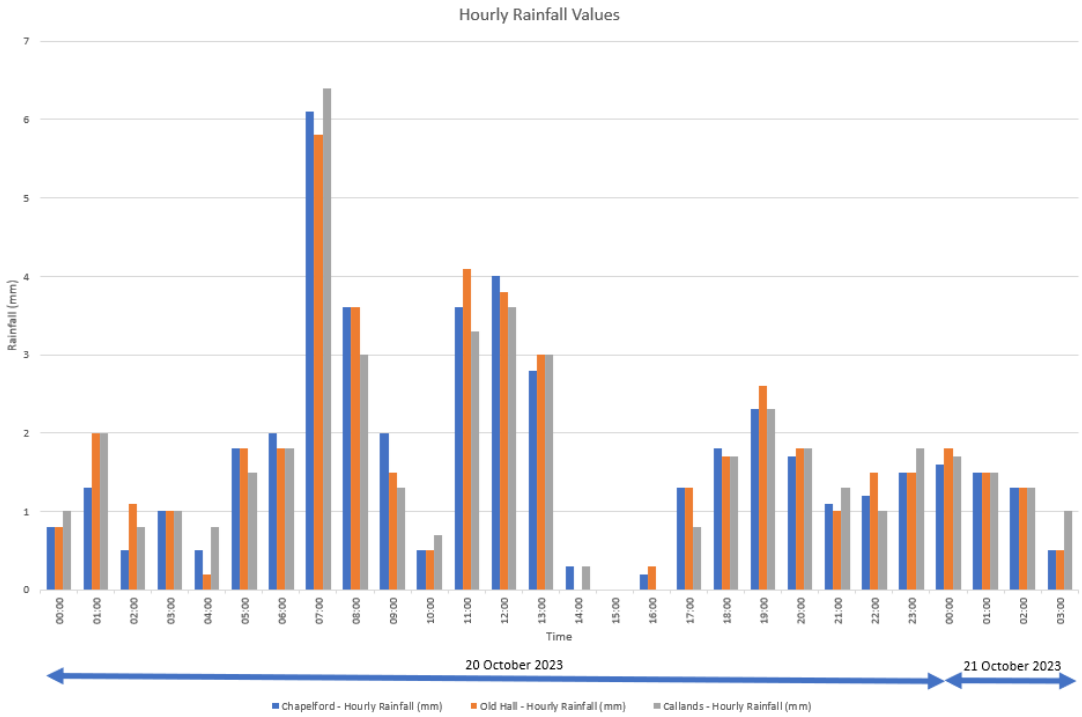
Table 3.3.1 – Recorded Rainfall Value at Rain Gauges

Location	Rainfall (mm)
Chapelford	59.2
Old Hall	60.7
Callands	59.2

57.3mm of rainfall was recorded at a rain gauge at Haydock, St Helens.

The rainfall experienced during Storm Babet was heavy and persistent and based on rain gauge information covered the whole borough of Warrington with some spatial variation.

Figure 8: Hourly Rainfall Values (mm) Recorded at Various Rain Gauges Across Warrington



4 Flood History and Long Term Flood Risk

4.1.1 Flood History

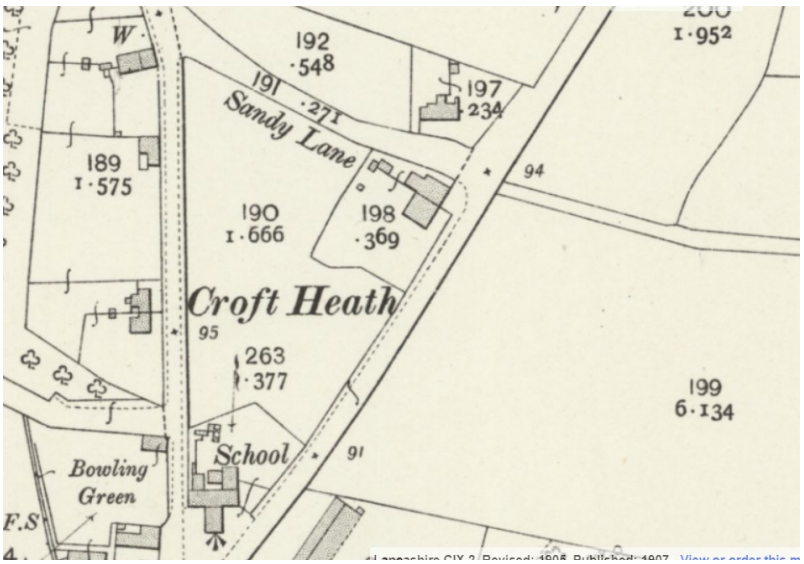
The Engineering and Flood Risk Team has no records of any historic flooding at this location but that is not to say flooding has not occurred.

4.1.2 Historic Mapping

Historic mapping was obtained for the area from the National Library of Scotland. There are no obvious signs of a watercourse flowing through the area or historic ponds / drainage features.

Figure 9: Extract of Historic Mapping – Published 1953 (National Library of Scotland)

Figure 10: Extract of Historic Mapping – Published 1907 (National Library of Scotland)

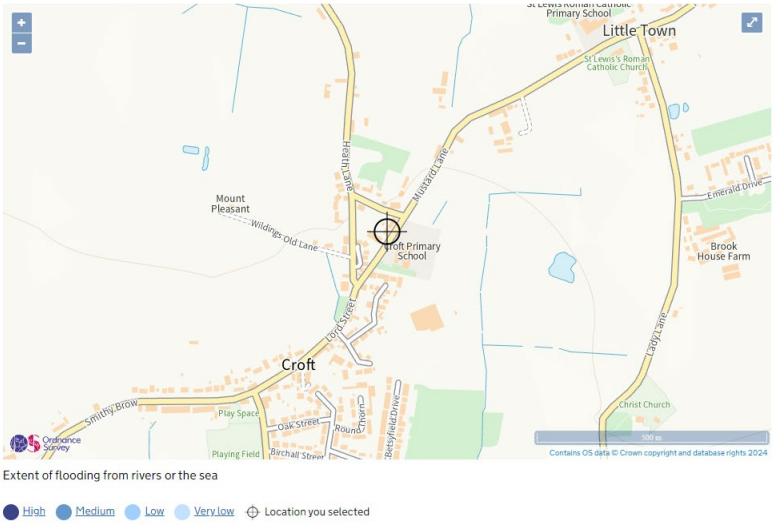


4.1.3 Long Term Flood Risk

Fluvial / Tidal Long Term Flood Risk
The Environment Agency Flood Map for Planning shows Mustard Lane and surrounding area as being in Flood Zone 1. Flood Zone 1 is defined as "Land having less than a 1 in 1000 annual probability of river or sea flooding".

Therefore, Mustard Lane is considered as having a low probability of flooding from rivers or the sea.

Figure 11: Extract of Environment Agency Flooding from Rivers or the Sea Mapping



Note: The Environment Agency Flood Map for Planning does not show the risk of flooding from watercourses with a catchment area of less than 3km^2 and does not provide information on flood depth, speed or volume of flow.

Surface Water Long Term Flood Risk
Whilst the management of surface water falls under the remit of Warrington Borough Council as the LLFA, the Environment Agency has produced the national Updated Flood Map for Surface Water (UFMfSW) in its Strategic Overview role in flood risk management. This mapping has been designed to indicate areas that may be at risk of surface water flooding for 30 year (high risk), 100 year (medium risk) and 1000 year (low risk) storms.

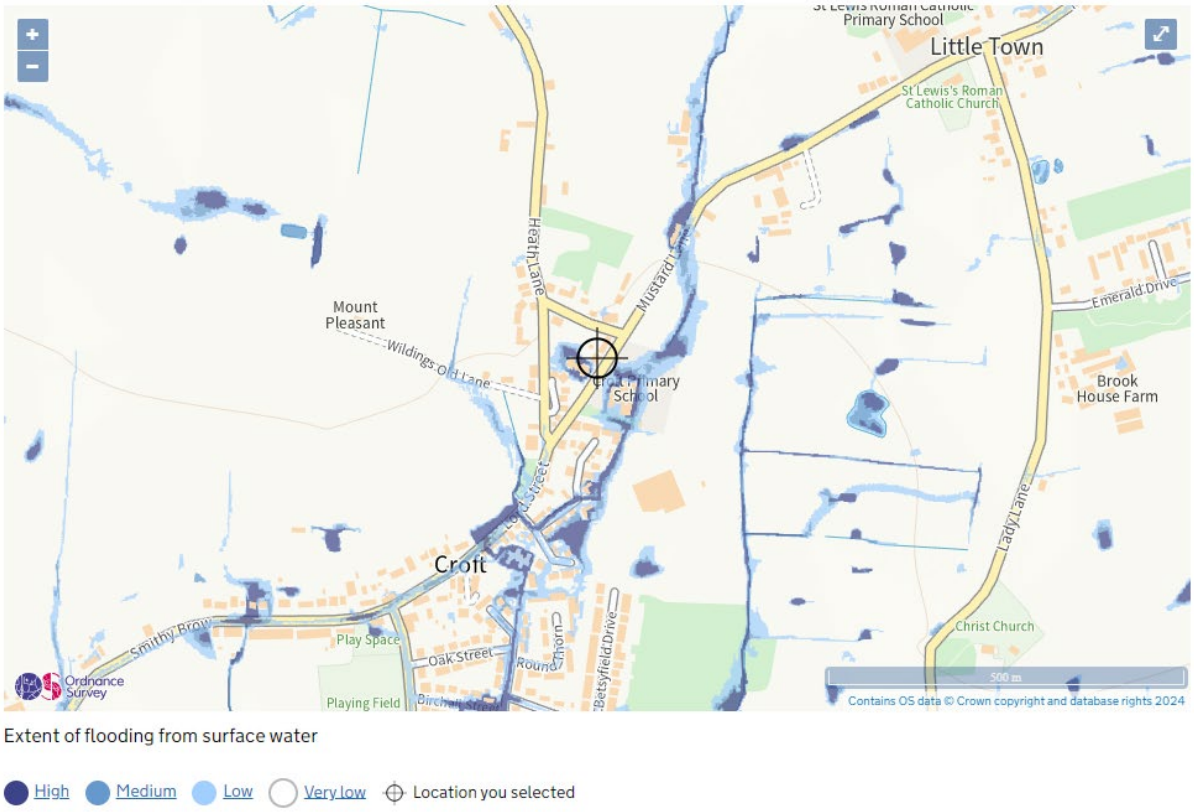
It is important to note that this is national mapping product and does not represent or reflect local detailed sewer drainage networks and is not designed to represent the risk of fluvial flooding from watercourses.

The Risk of Flooding from Surface Water Mapping is indicative of low-lying areas or localised depressions in topography.

According to the Environment Agency Risk of Flooding from Surface Water mapping, there is a significant surface water flow path running north to south through the area which appears to affect Croft Primary School. The school is shown at high risk of surface water flooding.

Croft Memorial Hall is shown as being at high risk of surface water flooding within its own independent pocket of flooding indicating a localised depression in the topography. It was verified during a site visit that Croft Memorial Hall is located in a localised depression in topography.

Figure 12: Extract of Environment Agency Flooding from Surface Water Mapping



Sewer Long Term Flood Risk
Warrington Borough Council is not aware of the condition / capacity etc. of the United Utilities public sewer systems in the area.

Reservoir Long Term Flood Risk
The Environment Agency Flood Risk from Reservoirs map indicates that Mustard Lane is not at risk of flooding from reservoirs.

5 On Site Investigation

5.1.1 Customer Testimony

The common theme throughout discussion with customers was that water was surcharging from a chamber on Sandy Lane and flowing down the road and accumulating in the low area around Croft Memorial Hall.

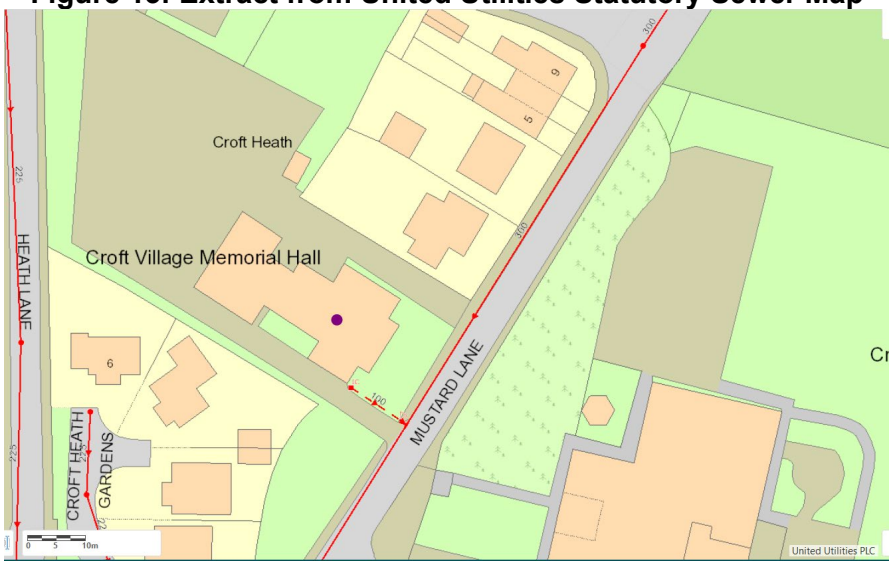
Warrington Borough Council delivered sandbags to site to control the flow of water along Mustard Lane. The highway gullies on Mustard Lane to the south of the Memorial Hall were functional and drained the excess water.

It is understood that flooding to Croft Primary School was as a result of water coming into the building via underground ducting. The flooding was reported to be ankle deep and restricted to a couple rooms, the school continued to operate.

5.1.2 United Utilities Statutory Sewer Map

The Statutory Sewer Map was obtained from United Utilities showing the affected area of Mustard Lane. The mapping shows a 300mm diameter combined public sewer running northeast to southwest on Mustard Lane. Warrington Borough Council is not aware of foul flooding during the flood event.

Figure 13: Extract from United Utilities Statutory Sewer Map



5.2 Existing Drainage System

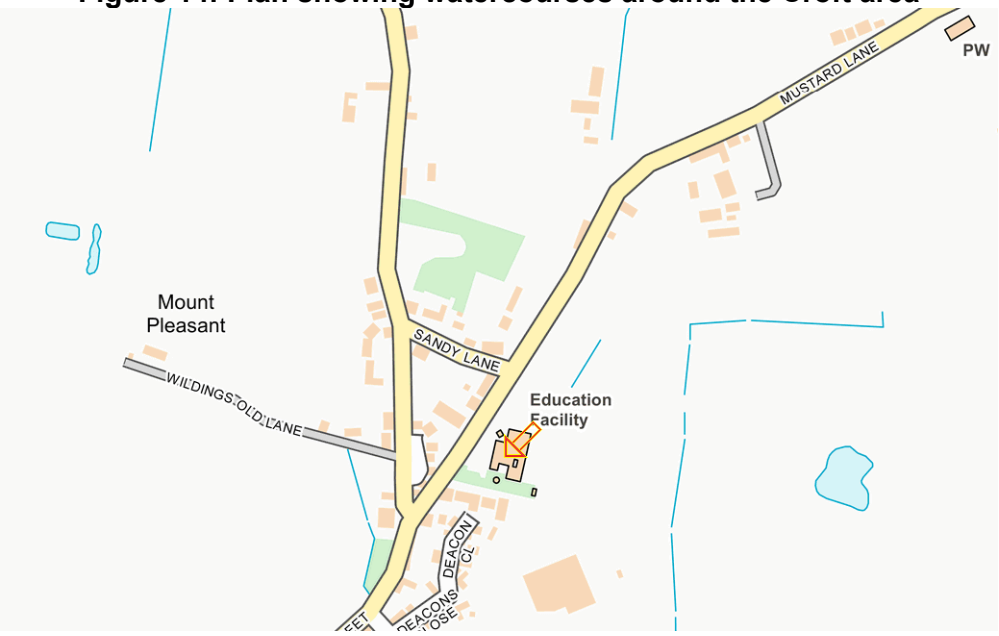
There are a number of watercourses in and around the Croft area as shown by the light blue lines on the map extract below (figure 14).

It is understood that a number of these watercourses are connected to a 375mm diameter existing drainage system which runs along Mustard Lane both under the highway and through private property. It is also understood that the drainage system provides land drainage to a number of fields in the area via various inlets. Also, there is evidence to show that some properties drain surface water elements into the drainage system.

Due to the several sources of connectivity, this drainage system receives a significant volume of water from highway, property and land drainage systems and is considered to be a very important system. As the drainage system passes through many properties and land, responsibility for its maintenance falls to the riparian owner e.g. owner of land or property.

Where the drainage system is located under public highway, Warrington Borough Council as Highway Authority is the riparian landowner.

Figure 14: Plan showing watercourses around the Croft area



Although there is no flow gauge data available for the watercourses in Croft, it is likely given the high volume of rainfall as discussed in section 3.3 above that these watercourses would have been running at a high-level or capacity during Storm Babet and discharging large volumes of water into the existing drainage system where connected.

5.2.1 Drainage System Issue

The surcharging of the drainage system indicated a blockage of the drainage system in the vicinity of Sandy Lane. This appears to have been observed by customer testimony (see section 5.1.1 above). A CCTV survey of the system was arranged which identified the following issues;

- Apparent lack of capacity of the drainage system to cope with overland flow from a very large catchment area (basic study).
- Significant tree roots in the drainage system.
- Partial failure of the liner installed circa 2016.
- Failure of the pipe adjacent to the chamber near No1 Mustard Lane creating a significant void.

Although there were issues with the drainage system, additional drain cleaning ensured the drainage system was operational albeit with a slightly reduced flow.

The Contractor responsible for the installation of the liner was made aware of the defect and returned to site towards the end of 2023 and in January 2024 to remove the defective section of liner using mechanical means. Removal of the defective liner was a complicated and time-consuming operation which took an extended period of time to complete due to high flows in the drainage system.

During this process, it is thought that the pipe was further weakened and as a result has subsequently failed due to the increased pressure which the drainage system had been exposed to during Storm Babet.

Figure 15: Extract from CCTV Survey

Figure 16: Photograph of Flooding

5.2.2 Flood Mitigation over Christmas Period

A pump was positioned on site and emergency contact details by the Contractor to the Council's term maintenance contractor to operate the pump in an emergency.

5.2.3 Works to Repair Drainage System

Following removal of the defective liner, a further CCTV and cleaning operation was undertaken to understand the condition of the drainage system. This confirmed the extent and exact location of the failed section of drainage system as 1.0m from the chamber outside 1 Mustard Lane for a distance of approx. 10.0m upstream.

Due to severity of the failure, open cut methodology was the only option to initiate repair. Open cut repair was completed in January 2024.

Under normal circumstances, the repairs to the system would be the responsibility of the riparian landowner. However, as this is related to defects following lining works, Warrington Borough Council pursued this with the responsible contractor to a resolution.

Figure 17: Extract from CCTV Survey Upon Completion of Works Showing Repairs Section of Pipe

The final stage in the drainage system repairs is to undertake a continuous liner to the full length of the drainage system from the chamber in Sandy Lane to the chamber in the footway adjacent to N°1 Mustard Lane (approx. 50.0m).

The liner has been ordered from Germany and lining works are currently scheduled to be undertaken later this year when general water levels in the area have reduced.

6 Flooding Mechanism Conclusion & Risk Management Authority

In the absence of further information, it is the opinion of Warrington Borough Council that the flooding to property on Mustard Lane between the 19th and 20th October 2023 was due to a combination of the following;

- A significant storm event (Babet).
- Prolonged heavy rainfall and saturated catchment due to persistent rainfall in 2023 (40% increase in rainfall compared to 2022)
- Lack of capacity of the drainage system to cope with overland flow from a very large catchment area.
- Significant tree roots in the drainage system.
- Failure of the liner in sections (installed circa 2016).
- Failure of the pipe adjacent to the chamber near No1 Mustard Lane creating a significant void.
- Flooding to the school as a result of water flowing through the underground service ducting, not overland flow.

As the failed liner undertaken circa 2016 by a specialist lining contractor was a contributing factor to the surcharging of the drainage system, Warrington Borough Council worked pursued defect correction as appropriate.

It is worthy of note that the original lining Contractor was taken over by a different company. Our contact has been with the latest company who demonstrated their willingness to assist in the resolution of this matter. Although this presented some delays, the actual repair works were undertaken quickly with the exception of the outstanding liner at the time of writing.

Warrington Borough Council has the relevant flood risk management functions in respect of Storm Babet and has exercised its functions in response to the flood.

6.1.1 Actions

Warrington Borough Council will:

- Continue to monitor this area for flooding.
- Require the contractor to line the affected section of drainage system later in 2024 via Cured-in-Place-Pipe (CIPP) lining.

Appendix A – Glossary

The table below defines some of the frequently used terminology / abbreviations within the flood risk management industry and this document.

Table A1: Definition of Terms

Term	Definition
Annual Probability	Flood events are defined according to their likelihood of a particular flood occurrence in any one year. For example, a flood with an annual probability of 1 in 100 can also be referred to as a flood with a 1% annual probability. This means that every year there is a 1% chance that this magnitude flood could occur.
EA	Environmental Agency
Flooding Asset Register	The register is a record of all structures or features designated by the EA, the LLFA, the district and borough councils or the IDB which have an effect on flood risk as part of Section 21 for the Flood and Water Management Act (2010).
Flood Risk Management Function	A function listed in the Act (or related Acts) which may be exercised by a risk management authority for a purpose connected with flood risk management.
FWMA (2010)	Flood and Water Management Act 2010
Very Low Flood Risk	Area with a very low probability of flooding from rivers (< 1 in 1,000 annual chance of flooding or <0.1%).
Low Flood Risk	Area with a low probability of flooding from rivers (between a 1 in 1000 and 1 in 100 annual chance of flooding or between 0.1% and 1%)
Medium Flood Risk	Area with a medium probability of flooding from rivers (between a 1 in 100 and 1 in 30 annual chance of flooding or between 1% and 3.33%).
High Flood Risk	Area with a high probability of flooding from rivers (> 1 in 30 annual chance of flooding or greater than 3.3%).
IDB	Internal Drainage Board
Instances of property flooding	This is a count of the reported incidents of internal property flooding that occurred across the event. Properties which were flooded twice are accounted for twice and therefore not a count of the number of properties.
LLFA	Lead Local Flood Authority – Warrington Borough Council as designated under by the Flood and Water Management Act 2010.
Main River	Main rivers are usually larger streams and rivers, but some of them are smaller

Term	Definition
	watercourses of local significance. Main Rivers indicate those watercourses for which the Environment Agency is the relevant risk management authority.
Ordinary Watercourse	An ordinary watercourse includes every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than public sewer) and passage through which water flows which does not from part of a Main River. The Lead Local Flood Authority, District/Borough Council or Internal Drainage Board is the relevant risk management authority.
Riparian Owner	Owner of land adjoining, above or with a watercourse running through it who has certain rights and responsibilities, i.e. maintenance of the watercourse to prevent restrictions thus leading to fluvial flooding.
RMA	Risk Management Authority
UU	United Utilities

Appendix B – Sources of Flooding

The table below identifies the different sources of flooding. The flood event may only experience one source or a combination.

Table B1: Sources of Flooding

Source	Description
Fluvial flooding	Exceedance of the flow capacity of river channels (whether this is a Main River or an Ordinary Watercourse), leading to overtopping of the river banks and inundation of the surrounding land.
Tidal flooding	Propagation of high tides and storm surges up tidal river channels, leading to overtopping of the river banks and inundation of the surrounding land.
Surface water flooding (aka pluvial flooding)	Intense rainfall exceeds the available infiltration capacity and/or the drainage capacity leading to overland flows and surface water flooding.
Groundwater flooding	Emergence of groundwater at the surface (and subsequent overland flows) or into subsurface voids as a result of abnormally high groundwater flows, the introduction of an obstruction to groundwater flow and/or the rebound of previously depressed groundwater levels.
Sewer flooding	Flooding from sewers is caused by the exceedance of sewer capacity and/or a blockage in the sewer network. In areas with a combined sewer network system, there is a risk that land and infrastructure could be flooded with contaminated water. In cases where a separate sewer network is in place, sites are not sensitive to flooding from the foul sewer system.
Other sources of flood risk	Flooding from canals, reservoirs (breach or overtopping) and failure of flood defences.

Appendix C – DCLG Definitions of Affected and Flooded Properties

According to the Department for Communities and Local Government:
The definition of a “flooded property” is a property (includes both homes and businesses), where flood water has internally entered the fabric of a building, this definition includes:

- Basements and below ground level floors;
- Garages, if they form part of the fabric of a building. However, garages adjacent to, or separate from the main building are not included;
- Occupied caravans and park homes, but not tents.

According to the Department for Communities and Local Government:
The definition of an “affected property” is one where:

- Water has entered gardens or surrounding areas restricting access to a property; and/or
- Flooding has disrupted essential services to the property, such as utility services e.g. sewage, drinking water, gas, electricity etc;
- And for businesses, this includes those businesses where flood waters are preventing an enterprise from trading as usual.