

Flood Investigation Report

Location of Investigation: Bethersden

Date of incident: 25 July 2021

This document has been prepared by Kent County Council Flood and Water Management Team as the Lead Local Flood Authority under Section 19 of the Flood and Water Management Act 2010, with the assistance of:

- Kent County Council (KCC)
- Environment Agency
- Southern Water
- Kent Fire and Rescue Service (KFRS)
- Bethersden Parish Council
- Ashford Borough Council

The findings in this report are based on the information available to KCC at the time of preparing the report. KCC expressly disclaim responsibility for any error in or omission from this report. KCC does not accept any liability for the use of this report or its contents by any third party.

This report can be found [here](#) where more information can be found about the requirements and trigger for a Section 19 investigation and the roles and responsibilities of Risk Management Authorities.

For further information or to provide comments, please contact us at flood@kent.gov.uk

Summary of Flood Event

On the 25 July 2021 intense rainfall caused flooding to Bethersden and the surrounding areas. The nearest rain gauge is located approximately 100m to the north of Wissenden Lane just to west of Bethersden. The gauge recorded approximately 101.75 mm of rainfall between 11:15 and 21:45 on the 25 July. Within this period the most intense rainfall occurred between 14:00 and 15:00, where approximately 58.77 mm of rainfall was recorded. The long-term monthly rainfall for July in Kent is approximately¹ 50.4 mm. This resulted in local river levels rising quickly within the Bethersden Stream and an unnamed tributary of the River Beult. As a result, the local highway surface water drainage network was unable to discharge into the watercourses and surcharged. Additionally, culverts located under Church Hill and Norton Lane surcharged due to the volume of water within the river channels. There were also reports that the local sewer network was unable to cope with the volume of rainfall causing sewer flooding in isolated areas.

Approximately 33 properties throughout Bethersden are reported to have been flooded on the 25 July 2021, 22 properties reported flooding internally with an additional 11 properties flooding externally. The approximate locations of the reported flood incidents are shown in Annex 1 at the

¹ Source: [water for life - regional rainfall](#)

end of the report (please note: only the roads where the properties are located have been mapped, and not the individual properties).

The Environment Agency undertook the emergency flood response including conducting a survey of affected residents in July 2021 collating information about the flood event. 80 surveys were collated by the Environment Agency regarding the flood event. There was also a multi-agency meeting held in October 2021 regarding the 25 July flood incident. Table 1 provides a summary of the flooding issues and known flood extents, including the information collated from the flood surveys and multi-agency meeting.

Table 1 - Summary of the investigated flooding issues

Location	Details of Reported Flooding	Source of Report
Norton Lane	1 property reported external flooding with reports of 100 cm of floodwater within the garden.	Environment Agency Flood Survey
Church Hill	4 properties flooded internally with reports of approximately 10 cm – 30 cm of floodwater within the property.	Environment Agency Flood Survey
Forgefield	4 properties flooded internally, and 3 properties reported external flooding. There were reports of approximately 10 cm of floodwater within the properties. One of the properties only avoided internal flooding by using sandbags.	Environment Agency Flood Survey
Chester Avenue	3 properties flooded externally.	Environment Agency Flood Survey
Ashford Road	12 properties flooded internally with reports of approximately 5 -15 cm of floodwater within properties. 2 properties reported flooding externally.	Environment Agency Flood Survey
Forge Hill	1 property flooded internally with reports of 20 cm of floodwater.	Environment Agency Flood Survey
Kiln Lane	1 property flooded internally with reports of approximately 90 cm of floodwater.	Environment Agency Flood Survey

Location	Details of Reported Flooding	Source of Report
The Street	2 properties flooded externally.	Environment Agency Flood Survey

Site Location, Topography and Flood Risk

The village of Bethersden is located approximately 7 km to the west of Ashford. The River Beult is located approximately 0.6 km to the south of the village, with two tributaries flowing through the village in an east to south-west direction. The northern unnamed tributary flows in an east to west direction, flowing beneath Norton Lane before discharging into the southern tributary just to the north of Wissenden Lane and is classified as an ordinary watercourse, regulated by the LLFA. The southern tributary is known locally as Bethersden Stream, rising upstream of Bethersden it becomes main river at Ashford Road and passes between the gardens of properties at Forge Field and Chester Avenue and flows beneath, Church Hill and Norton Lane before flowing through agricultural land before discharging into the River Beult approximately 1 km to the west of Bethersden. The Bethersden Stream and the River Beult are classified as main rivers regulated by the Environment Agency. There are also a number of ordinary watercourses which flow adjacent to field boundaries throughout Bethersden discharging into the main watercourses. Figure 1 below provides an overview of the main watercourses within Bethersden and the surrounding area.

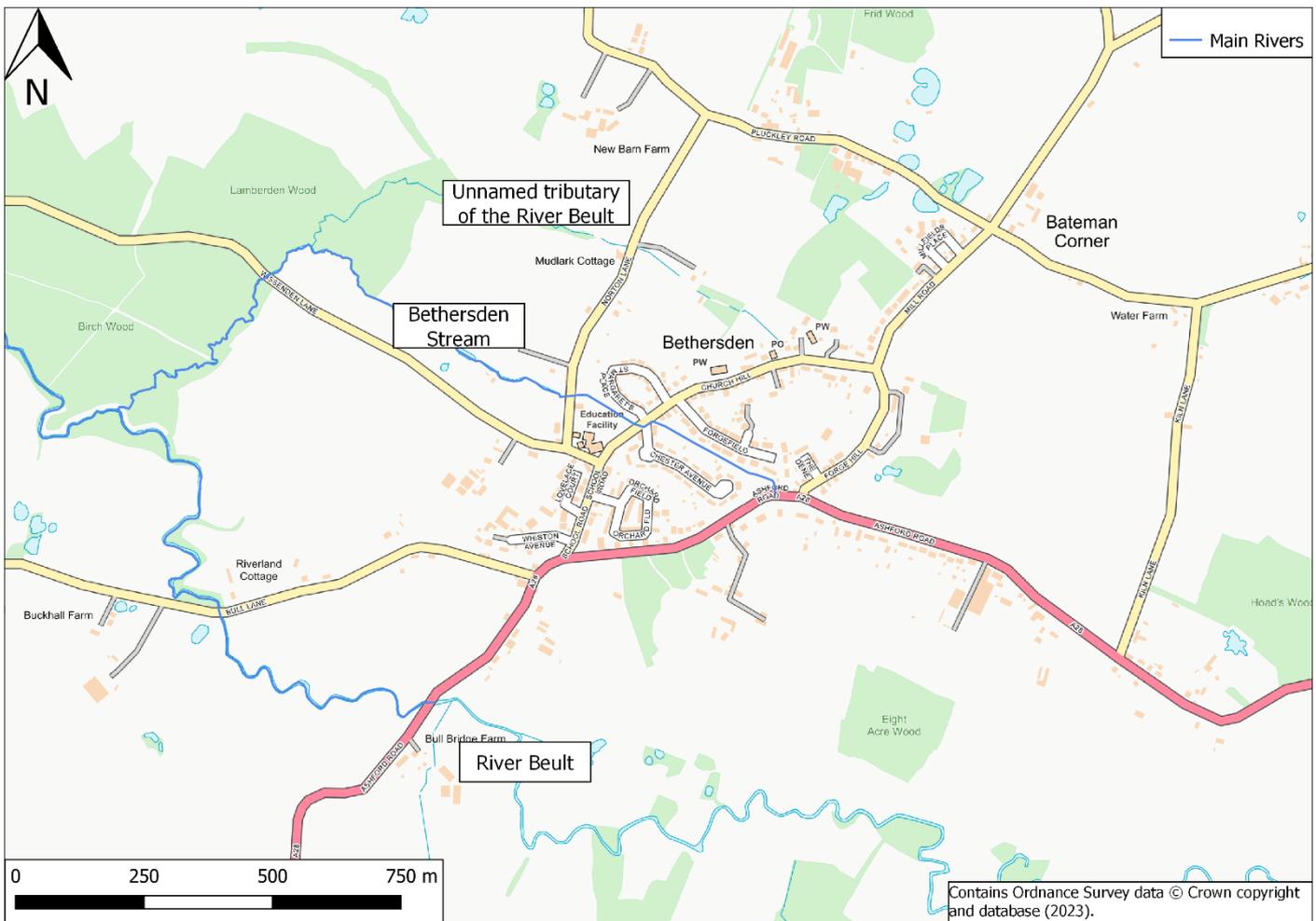


Figure 1 Map showing the watercourses within Bethersden and the surrounding area

The two tributaries of the River Beult have a combined catchment area of approximately 1.8 km² which extends to Pluckley Road to the north and to Kiln Lane to the east, covering Bethersden village and the surrounding woodland areas. The catchment slopes in an east to west direction through Bethersden.

The surface water drainage system within Bethersden primarily consists of private sewers which are owned and maintained by landowners and highway drainage infrastructure which is owned and maintained by KCC as the Highway Authority. The highway drainage system ultimately discharges into the two tributaries of the River Beult through either directly or via a network of small ditches.

A review of the Cranfield University Soilsdapes database² indicates that the underlying soils within Bethersden are classified as slowly permeable, seasonally wet with loamy and clayey soils and impeded drainage. This means that rainfall in this area is unlikely to significantly infiltrate into the ground and will runoff over land, especially in heavy rainfall.

Annex 2 at the end of the report shows an extract from the Environment Agency's Flood Map for Planning (Rivers and Sea). The map indicates that there is a small area along the Bethersden Stream located within the high-risk Flood Zone 3³. The fluvial flood risk is associated with the River Beult as the Environment Agency's Flood Map for Planning map does not take into consideration watercourses with a catchment area smaller than 5 km². The rest of Bethersden is located within the low-risk Flood Zone 1⁴.

Annex 3 at the end of the report shows an extract from the Environment Agency's Flood Risk from Surface Water map. Flooding from surface water is typically associated with natural overland flow paths (including the unnamed tributaries of the River Beult) and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events. The Environment Agency's map indicates that areas of risk from surface water runoff are predominately the lower lying areas associated with both tributaries of the River Beult. The areas at high risk of flooding largely corresponds with the location of the properties affected in the 25 July 2021 flood event.

Rain Gauge Analysis

Rainfall data from Bethersden (station number: 296200) on 25th July 2021:

Rainfall (Whole event, 11:15 – 21:45): 101.75mm

Estimated Annual Exceedance Probability (11:15 – 21:45): 1 in 171-year return period, 0.6% occurrence in any given year.

Rainfall (1 hour, 14:00 – 15:00): 58.77mm

Estimated Annual Exceedance Probability (14:00 – 15:00): 1 in 470-year return period, 0.2% occurrence in any given year.

² Source: [landis soilsdapes](#)

³ Flood Zone 3 is defined as having a greater than 1 in 100 year (1%) chance of flooding from fluvial sources.

⁴ Flood Zone 1 is defined as having a less than 1 in 1000 year (0.1%) chance of flooding from fluvial sources.

Rainfall Analysis

Rainfall around the country is recorded by a series of rain gauges operated by the Environment Agency. Reports received about the 25 July flood event indicate that flooding started at approximately 15:00. The closest Environment Agency rainfall gauge is located in Bethersden. Annex 4 at the end of the report shows the location of the Bethersden rain gauge. The rainfall gauge at Bethersden recorded a total of 101.75 mm on the 25 July between 11:15 and 21:45. Approximately half of the total rainfall (58.77 mm) fell between 14:00 and 15:00.

The Flood Estimation Handbook⁵ (FEH) web service Event Rarity Calculator assesses the Annual Exceedance Probability (AEP) of the recorded rainfall. This is the likelihood of rainfall of this depth or more falling in a year in that location when compared with the FEH rainfall probability model. For instance, a rainfall event with an AEP of 1% means that rainfall of this depth or greater would only have a 1% chance of occurring in any one year in that location. This is also known as a '1 in 100 year' event.

The Event Rarity Calculator assessed the July flood event as an approximate 1 in 171-year event at Bethersden when assessing the whole flood event (between 11:15 and 16:30). The Event Rarity Calculator also assessed the intense period of rainfall between 14:00 and 15:00 when approximately half of the total rainfall was recorded. It was assessed as an approximate 1 in 470-year event at Bethersden.

River Levels

There are no river gauges on the River Beult or its two tributaries located in close proximity to or within Bethersden. The nearest Environment Agency river gauge is located at Smarden on the River Beult approximately 5.3 km to the west of Bethersden. Although the River Beult is approximately twice the size of each of the two tributaries located within Bethersden, the Smarden gauge is located downstream of the site of interest. Annex 5 at the end of the report shows the location of the Smarden river level gauge in relation to the tributaries of the River Beult and Bethersden. Data obtained from the Environment Agency for the 25 July 2021 at the River Beult level gauge at Smarden is shown in Figure 2, clearly indicating a steep rise in river levels as a result of the heavy rainfall. The increase in river levels along the River Beult starts at approximately 20:00 on the 25 July at approximately 18.2 m, peaking at approximately 10:45 on the 26th July at 21.12 m.

⁵ FEH is the standard tool in the UK to estimate rainfall return periods. It is used by the Environment Agency and all professional hydrologists to estimate rainfall and rainfall return periods.

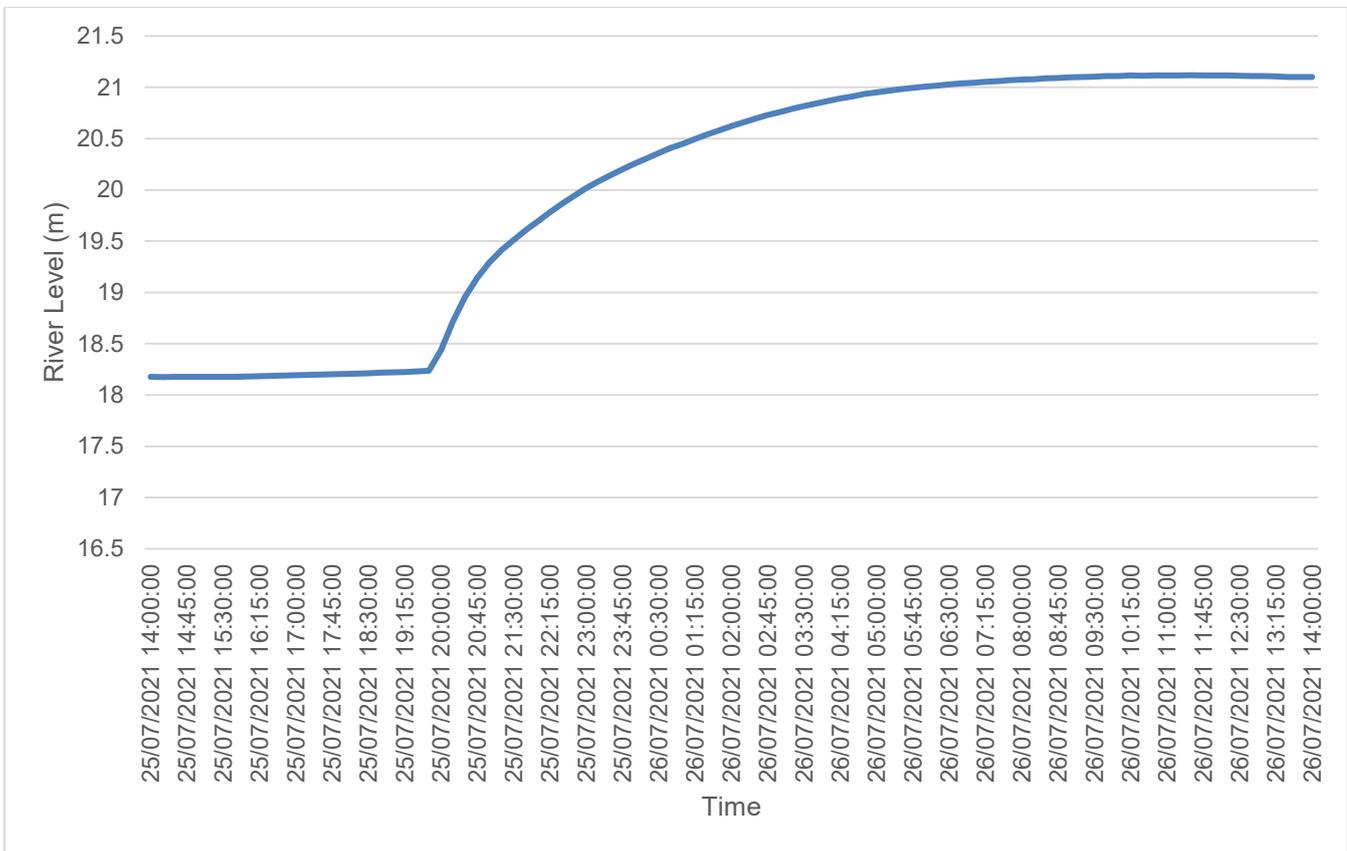


Figure 2 River level gauge data along the River Beult recorded during the flood event on 25th July 2021

Flood History

There are a number of historic flood events that have occurred in Bethersden prior to the event on the 25 July 2021. Bethersden has flooded on a number of occasions (November 1960, January 1988, December 1993, January 2011, November 2012 and December 2012) where flooding was associated with the Bethersden Stream.

Data for more recent events from KCC's flood incident database, reports from Ashford Borough Council, Surface Water Management Plans⁶ and the Environment Agency have been collated into Table 2.

Table 2 - Summary of the historic flood records

Location	Date of Flooding	Details of Flooding
Chester Avenue	January 1988	Property flooding
Forgefield	December 1993	External property flooding
Ashford Road	2008	Sewer flooding reported
Orchard Field	2008	Blocked drain
Ashford Road	2009	Carriageway flooded and sewer flooding reported
Ashford Road	2010	Sewer flooding reported
Forgefield	January 2011	Blocked storm water drain
Chester Avenue	April 2012	Blocked gullies caused property flooding
Woodchurch Road	June 2012	Property flooding
Forgefield	November 2012	Sewer flooding reported
Church Hill	November 2012	Culvert surcharged
Brissenden Green Lane	2012	Blocked gullies
Orchard Field	September 2015	Carriageway flooded
Ashford Road	December 2019	External flooding
Ashford Road	February 2020	2 properties reported external flooding
Ashford Road	March 2020	External flooding

⁶ Accessed November 2021 found at: [Ashford surface water management plan](#)

Location	Date of Flooding	Details of Flooding
Forgefield	March 2020	External property flooding
Pluckley Road	January 2021	Blocked gulley causing road flooding
The Street	February 2021	1 Property reported flooding

Flooding Description and Mechanism

The main cause of the flood event on the 25 July 2021 was the intense rainfall, particularly between 14:00 and 15:00, which exceeded the design capacity of any drainage system. The intense rainfall led to surface water drainage systems becoming overwhelmed and unable to discharge into the local drainage ditches and watercourses due to the high river levels. The watercourses also became overwhelmed and overtopped leading to flooding of properties. Overall, approximately 5 properties flooded as a result of main river flooding and 30 properties flooded as a result of surface water runoff and smaller watercourses. The sections below detail what happened during the flood event and what caused the flooding for the different areas of Bethersden.

Bailey Fields (Ashford Road)

A land drainage ditch is located to the south of the properties at Bailey Fields on Ashford Road which flows in an east to west direction. The ditch is fed from a pond to the south which collects surface water runoff from the adjacent fields and has an overflow pipe which connects into the ditch. The ditch discharges to a drainage pipe which flows north and discharges into the road surface water drainage system. A CCTV survey undertaken in August 2020 as part of a planning application submission indicated that the pipes were damaged and silted resulting in a decrease in the capacity of the system.

During the flood event it was reported to Ashford Borough Council and the Environment Agency that there was evidence of debris located near to the drainage pipes to the south of Bailey Fields. Reports indicate that during the intense rainfall the ditch was unable to cope with the overland flows from the land to the south and overtopped leading to flooding of properties along Ashford Road. KFRS attended Ashford Road on the 25 July 2021 to pump out floodwater from multiple properties. Figure 3 below shows the location of the pond and drainage ditch in relation to Ashford Road. KCC attended the site in December 2021 and inspected the land drainage ditch which was found to be in a good condition.

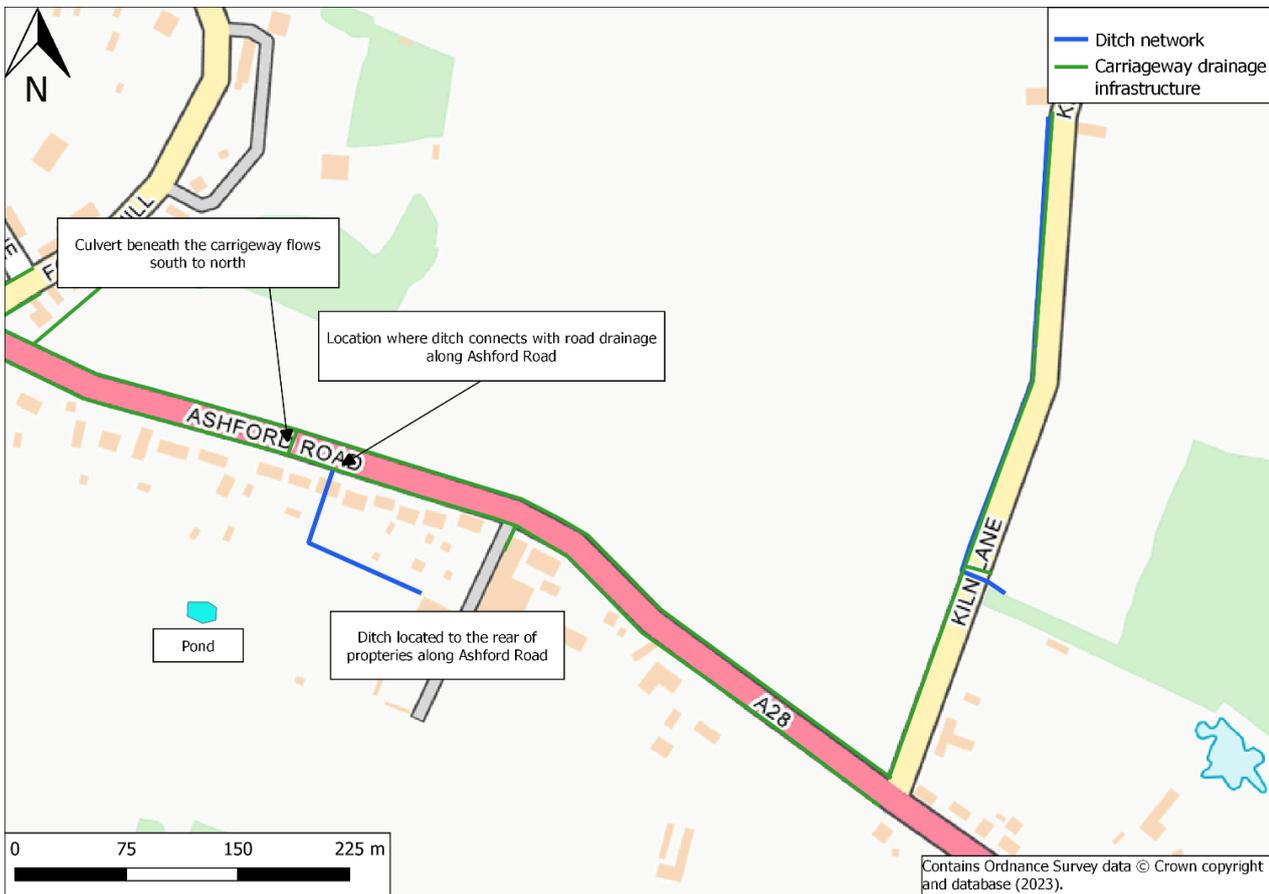


Figure 3 Flooding mechanism for properties located along Bailey Fields, Ashford Road

A report into the surface water drainage system for Ashford Road was undertaken by KCC Highways in 2022 which identified that there are two separate surface water drainage systems which run down either side of Ashford Road and discharge to the main river.

Surveys of the surface water system highlighted a number of defects including deformed pipes, partial collapse of pipes and root masses which would reduce the capacity across the systems.

An overland flow pathways across agricultural land to the north of the A28 connects to the drainage network and flow to the main river via culverts underneath Forge Hill. Land drainage for the field has been realigned and the ditch alongside Kiln Lane has been diverted away from Bethersden so that it flows south alongside Kiln Lane and crosses the carriageway through a culvert and continues into the fields to the east of Kiln Lane. Figure 4 below shows a comparison of the original and diverted alignments of the land drainage ditch.

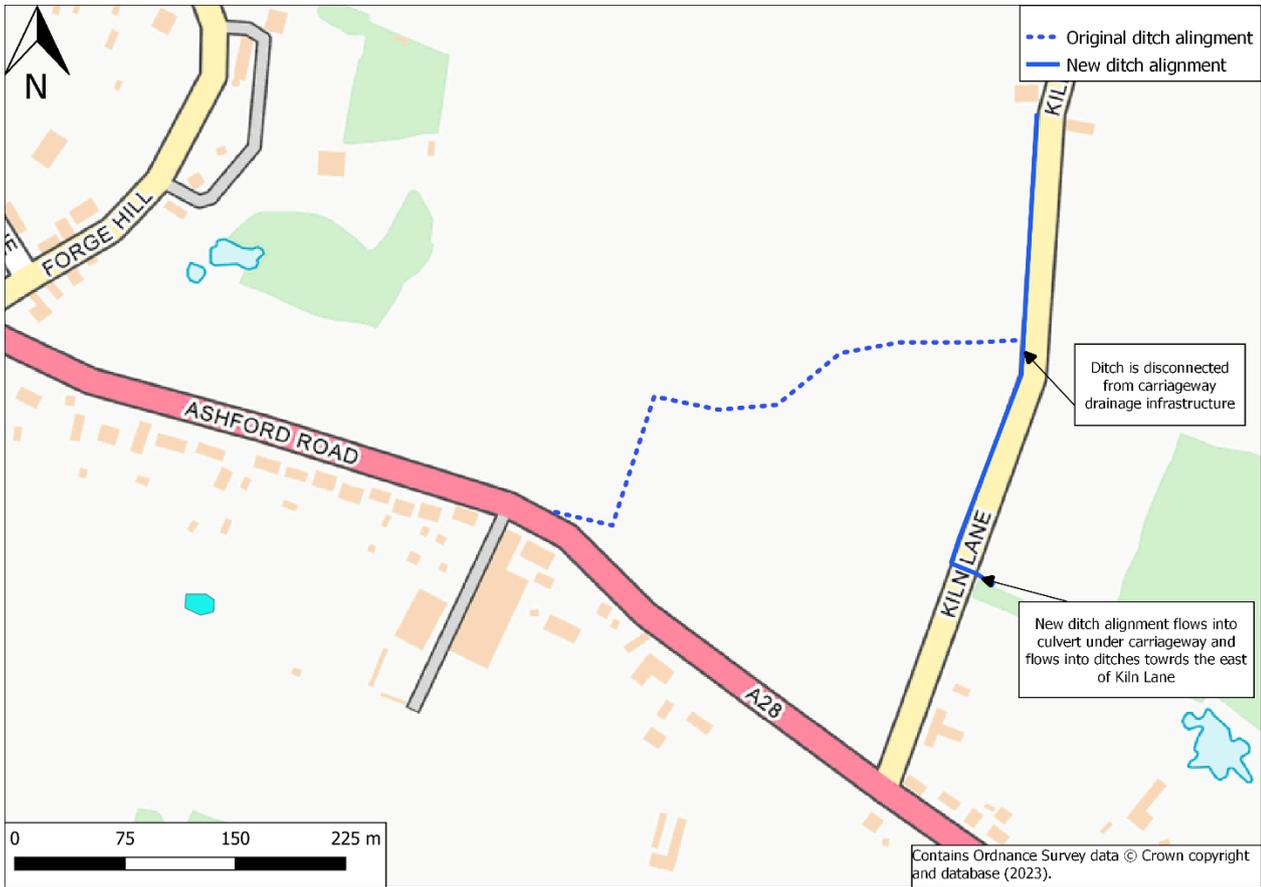


Figure 4 Comparison of original and new ditch alignments along Kiln Lane

Forge Hill / Forgefield / Chester Avenue

The Bethersden Stream flows through a 675 mm culvert beneath the junction of Forge Hill and Ashford Road A28. It then becomes open channel between the rear gardens of the properties on Forgefield and Chester Avenue. The Bethersden Stream is classified as a main river from Forge House. The junction of Forge Hill and the A28 is a low spot and surface water is known to pond at this location Figure 5 below provides an overview of the drainage infrastructure within Forge Hill and the surrounding area.

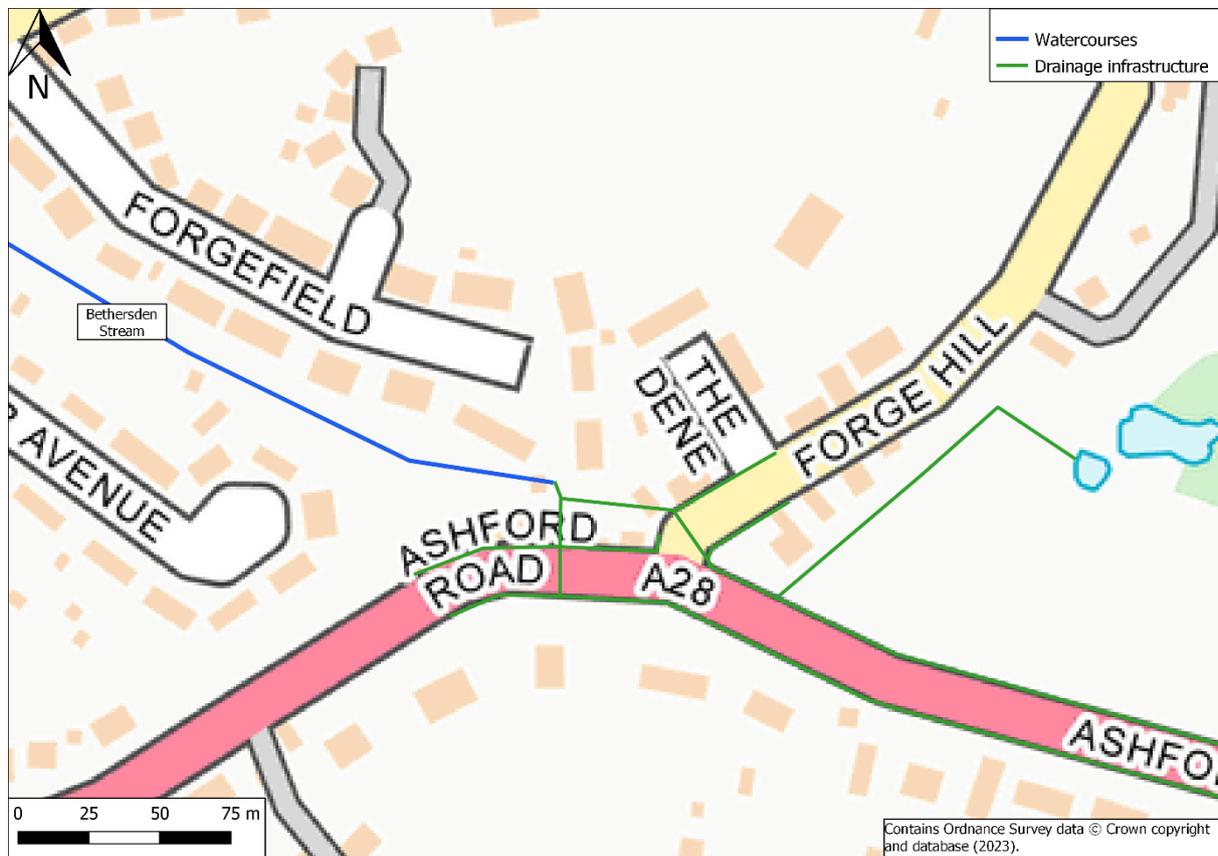


Figure 5 Overview of Forge Hill area

During the 25 July 2021 flood event it was reported during the flood response undertaken by the Environment Agency that the culvert beneath Forge Hill was being bypassed by the high flows within the river channel.

KFRS attended the flood event and pumped out floodwater from inside properties at Forge Hill into the Bethersden Stream. However, it was reported to the Environment Agency and councils that this may have contributed to flooding of additional properties downstream due to the additional water flowing into a channel which was already overwhelmed.

The width of the Bethersden Stream is reported to be restricted by a number of sheds and fences which overhang the boundary, these may have caused local restrictions within the watercourse channel. These local restrictions could have potentially impacted flow conveyance leading to water coming out of bank.

Church Hill / Norton Lane

During the flood event the culverts beneath Church Hill and Norton Lane were reported to have surcharged and floodwater was flowing onto the adjacent roads. The Environment Agency

confirmed that there was no evidence of any blockages within the culverts along Bethersden Stream beneath Church Hill and Norton Lane during the flood event.

Bethersden Parish Council have a licence to clean the watercourse downstream of Norton Lane. It was reported that this section of watercourse performed well during the flood event and did not contribute to the problems experienced upstream.

North Bethersden

The unnamed tributary of the River Beult is conveyed through small privately owned culverts under the properties to the north of The Street, the watercourse becomes open channel between St Peters Row and Larks Meadow where it travels west through agricultural land and woodland before meeting the Bethersden Stream.

It was reported by local residents to the Environment Agency flood response team that the watercourse through Larks Meadow was not being maintained at the time of the flood event on the 25 July 2021.

Since the flood event KCC has undertaken a survey of the culvert and its condition. The survey identified that the culvert beneath Union Chapel has collapsed. During the flood event floodwater surcharged and flooded the surrounding properties. KFRS attended the July flood event at The Street to pump floodwater from a property.

A pond at Sunnyside receives overland flow from the field to the north via the field ditch and pipe. Since the July flood event the bank of the field pond located in the field to the north of Sunnyside has been raised to help manage overtopping of the field pond and reduce overland flows reaching the ditch and ultimately the Sunnyside pond.

Flood Response

KCC attended the flood event on the 25 July 2021 and in the subsequent days provided road tankers to assist with the clearing of floodwater and assist the local emergency services.

A multi-agency meeting with the relevant risk management authorities and Parish Council was held on the 20 October 2021 to discuss the local flood risk issues that contributed to the flooding experienced on the 25 July 2021. A number of actions were agreed at the meeting and are described in more detail below.

KCC Highways undertook a review of the surface water drainage infrastructure for Ashford Road including CCTV surveys to understand the condition and connectivity. The culvert and surrounding drainage system located at The Street and Forge Hill junction was cleaned and pipe repairs were undertaken in March 2022.

The Environment Agency undertook site walkovers in February and March 2022 of Bethersden Stream and consulted with local landowners regarding their riparian landowner responsibilities to maintain and keep the watercourse channel free from any obstructions. The Environment Agency flood resilience team engaged with KFRS regarding the procedures to pump floodwater from properties and where the flood water was pumped to.

A catchment assessment of the flood risk to Bethersden was commissioned by KCC to look at all sources of local flood risk and to consider options for potential schemes to manage flood risk, including culvert upgrades at Church Hill.

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A community flood resilience meeting was hosted by the Environment Agency for the local community within Bethersden in February 2022. Following this meeting a community flood plan will be prepared and established to help the local community react to future flood events and be more prepared.

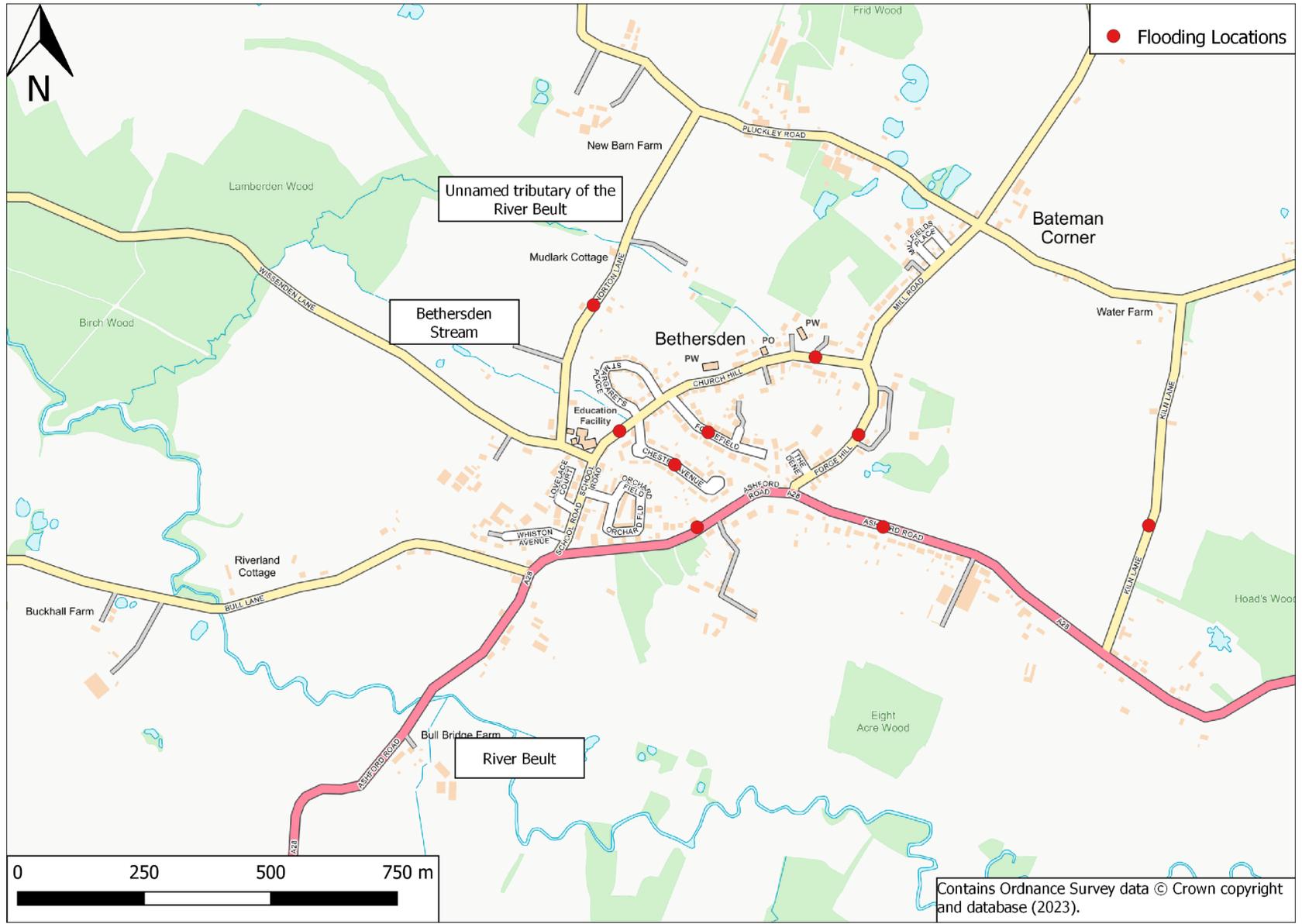
Conclusions

On the 25 July 2021 intense rainfall overwhelmed the local surface water drainage systems and local watercourses, causing flooding to 33 properties and carriageway flooding of local roads.

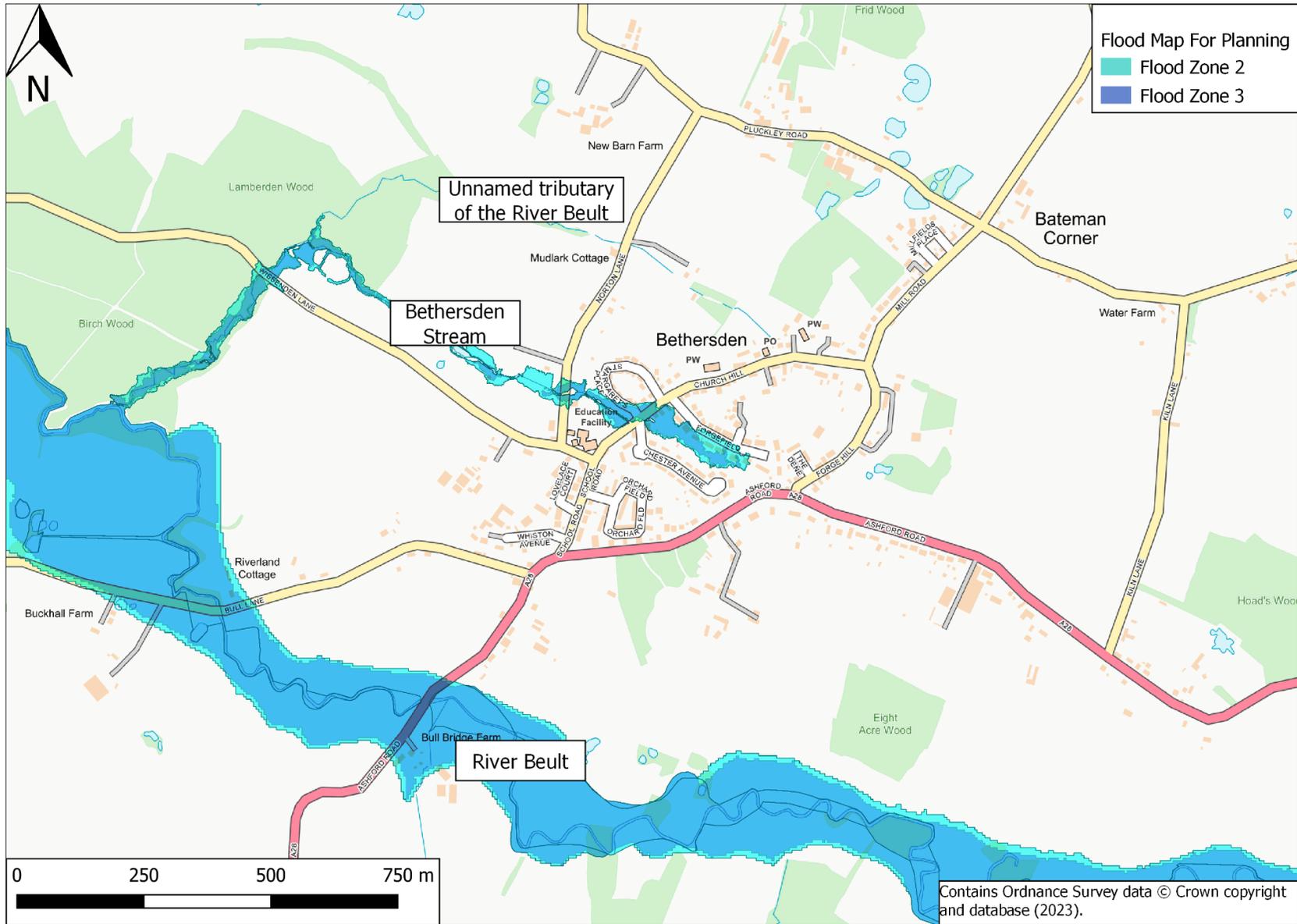
The rain gauge which is located approximately 100m to the north of Wissenden Lane just west of Bethersden, recorded a total of 101.75mm over 10.5 hours, however 58.77mm of this total fell within an hour resulting an annual exceedance probability of a 1 in 470-year event.

As a result of this intense rainfall local surface water drainage infrastructure, which is not designed to accommodate rainfall of this magnitude was completely overwhelmed. In addition to this, high-water levels within the receiving watercourses prevented the drainage network from discharging. Whilst the condition of the drainage infrastructure was found to be poor in a number of locations, due to the volume of rainfall it would be have been unable to discharge the water and the condition is not considered to be a significant mechanism of the flooding experienced.

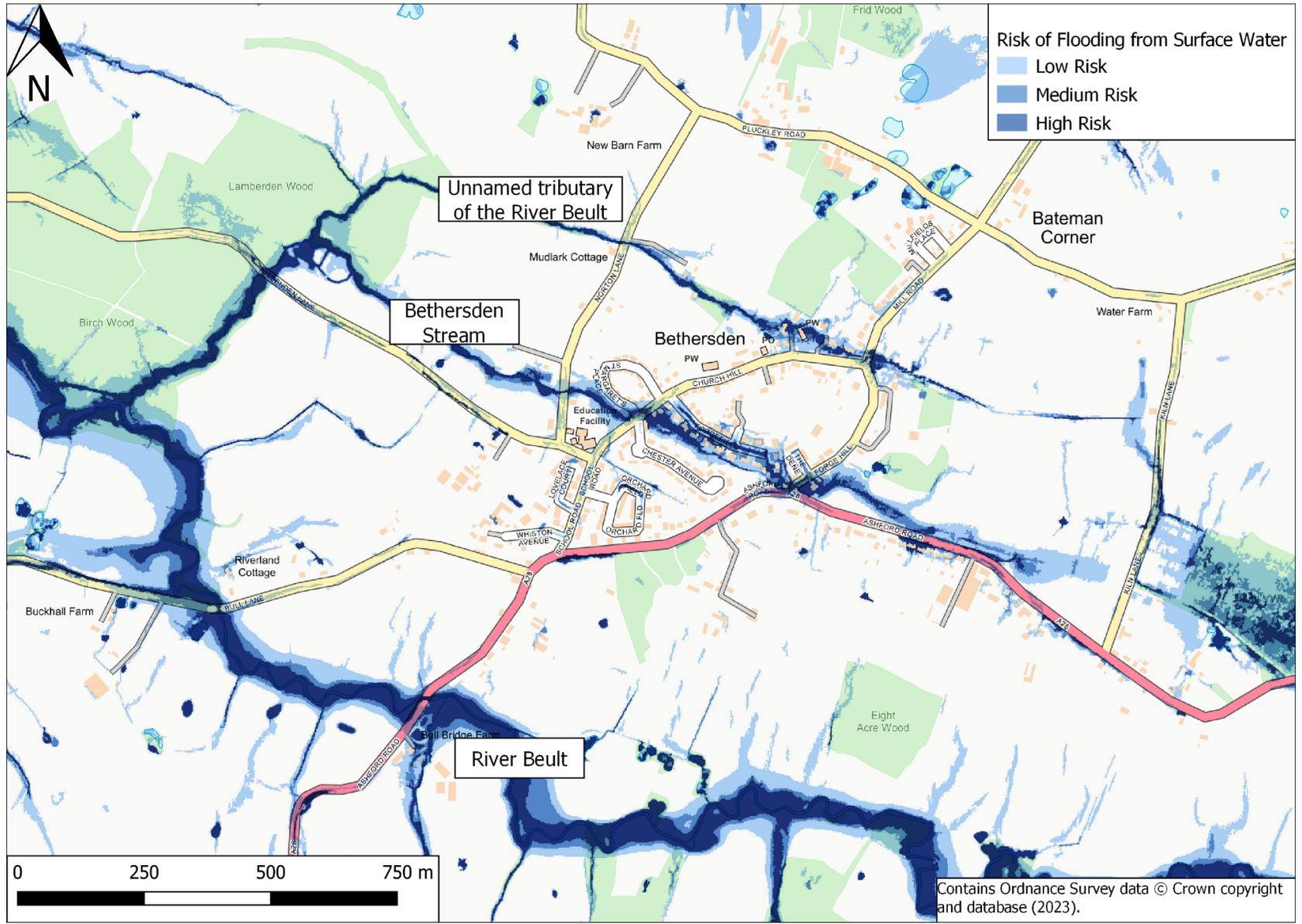
Work has been undertaken by KCC to repair the highway drainage on the A28. Opportunities should be investigated to mitigate flooding, which is being undertaken by the risk management agencies, including improvements to the culverts at Church Hill.



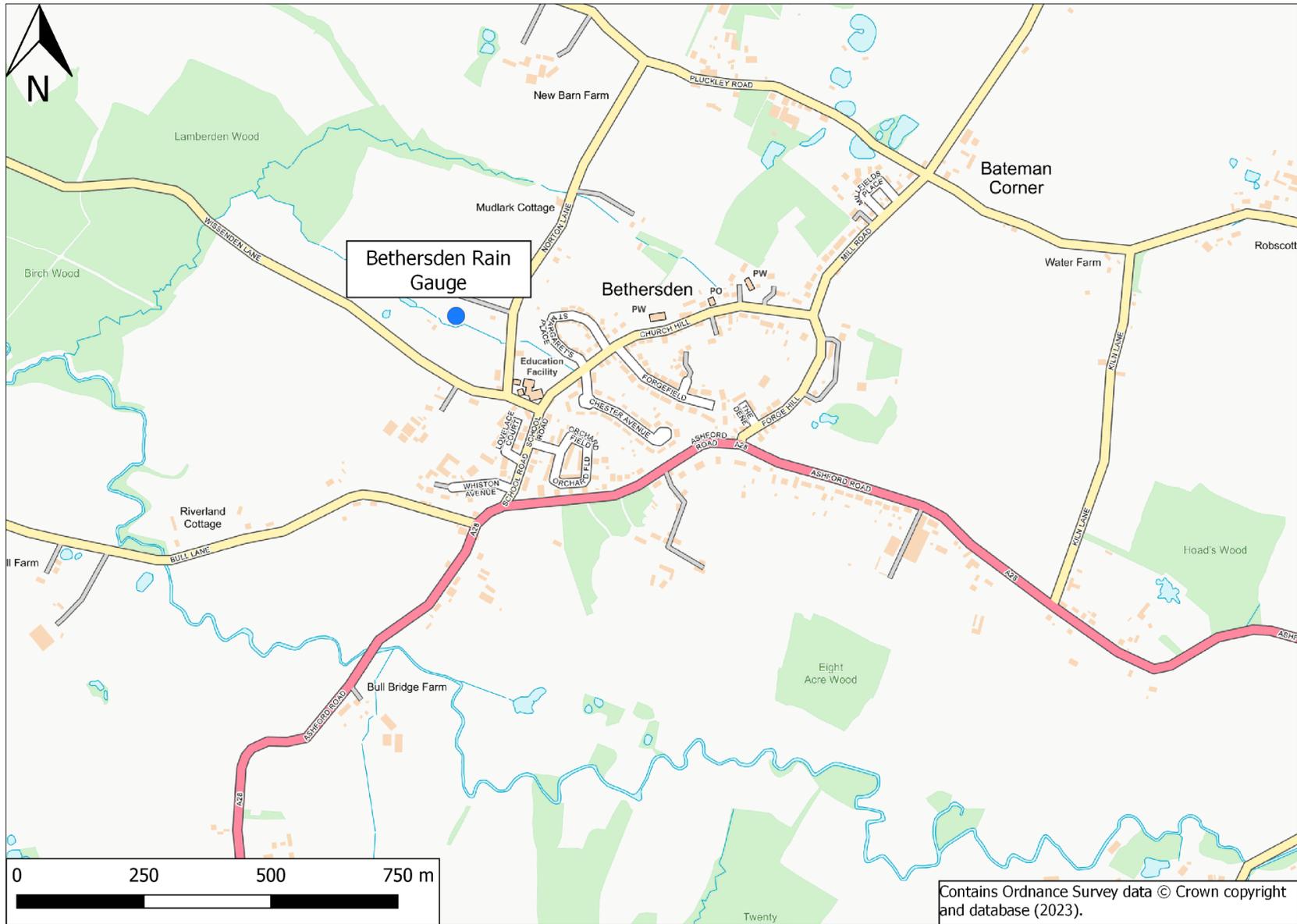
Annex 1 – Location of reported flood incidents across Bethersden



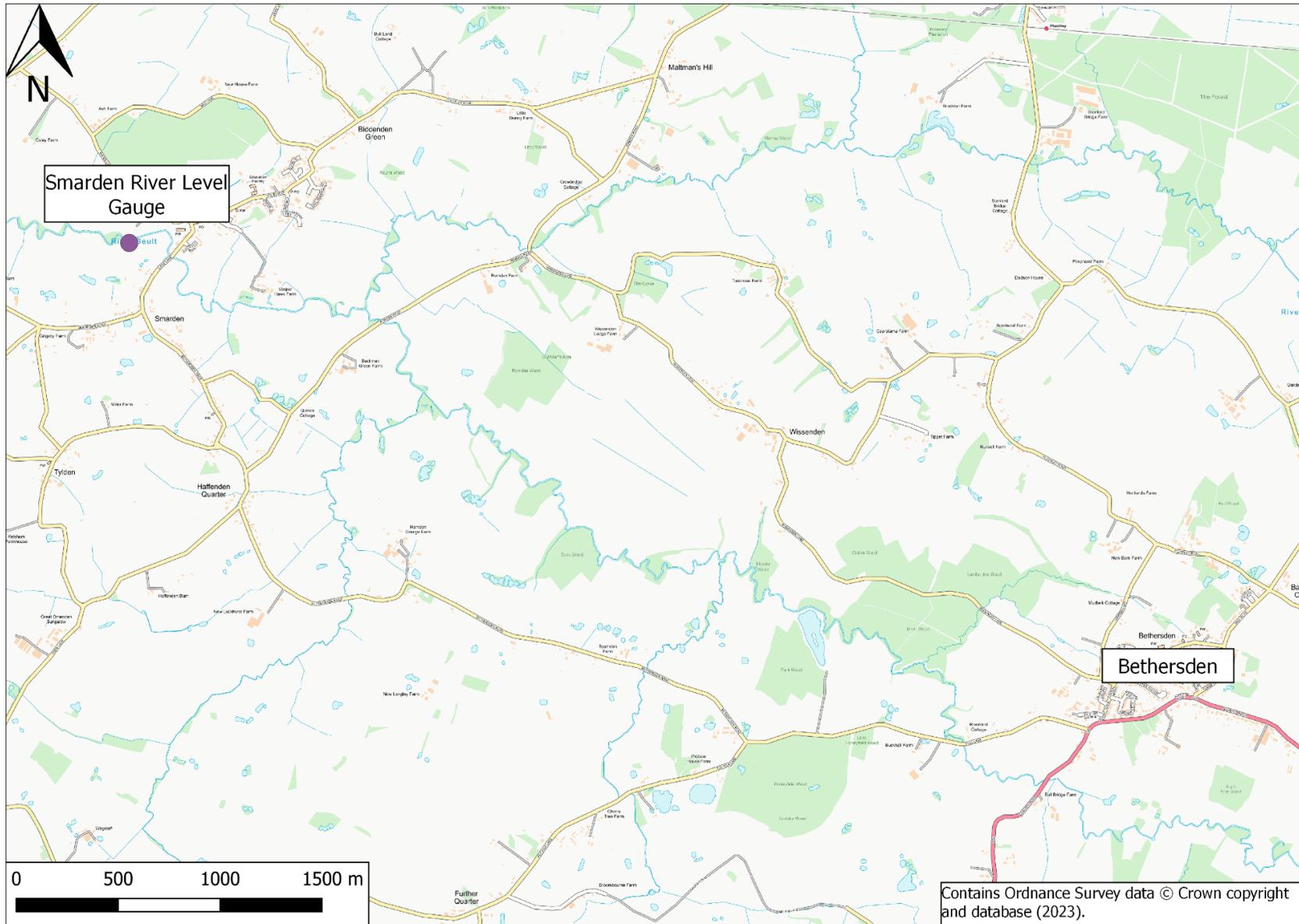
Annex 2 – Extract from the Environment Agency's Flood Map for Planning



Annex 3 – Extract from the Environment Agency's Flood Risk from Surface Water Map



Annex 4 – Location of Bethersden rainfall gauge



Annex 4 – Location of the River level gauge in Smarden