

Flood Investigation Report

Location of Investigation: Horsmonden

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)

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 a period of thunderstorms and intense rainfall caused flooding in Horsmonden and the surrounding areas. The Met Office issued a yellow weather warning for the southern and south-eastern parts of England for thunderstorms.

The Horsmonden rain gauge, located approximately 2 km to the east of Horsmonden, recorded 28 mm of rainfall in 2 hours between 10:45 – 12:45. Rainfall radar data recorded an average of 44.20 mm over 4 hours across the estimated Horsmonden catchment, and 38.31 mm between 11:00 – 13:00, which was the most intense part of the storm. The average monthly rainfall for July in Kent is approximately 50.4 mm¹.

Approximately 20 properties flooded internally with an additional four properties flooding externally. Due to the intense rainfall, large volumes of surface water runoff flowed from surrounding agricultural land entering the local watercourses causing them and surface water drainage system to become overwhelmed. The approximate locations of the reported flood

¹ Source: <https://www.southernwater.co.uk/water-for-life/regional-rainfall>

incidents are shown in Annex 1, at the end of the report (please note: only the roads where the properties are located have been mapped, and not the individual properties).

KCC undertook a survey of affected residents in November 2021 collating information about the events of the flood to inform this Section 19 investigation. Table 1 provides a summary of the investigated flooding issues and known flood extents, including the information collated from the flood survey. 21 surveys were sent out to residents, with 13 responses received by KCC. As a result, the information detailed in Table 1 below may not include a complete summary of the properties affected or the impacts of the flooding. Appendix A provides a breakdown of the number of flood surveys that were sent to each road within Horsmonden.

Table 1 - Summary of the investigated flooding issues

| Location | Details of Reported Flooding | Source of Report |
|------------------|---|----------------------------|
| Furnace Lane | 4 properties flooded internally, with reports between 30 cm -100 cm of flood water within the properties. 2 properties reported flooding externally. KFRS pumped floodwater from 4 properties. | KCC / Flood Surveys / KFRS |
| Spout Lane | 2 properties experienced internal flooding reporting up to 25 cm of floodwater within the property. | KCC / Flood Surveys |
| Olivers Court | 1 property reported internal flooding. 1 property reported external flooding. 4 further properties reported flooding, but it is not known if they flooded internally. KFRS pumped floodwater from 10 properties. | KCC / Flood Surveys / KFRS |
| Lamberhurst Road | 1 property reported flooding, but it is not known if it was internal or external. There were also reports of carriageway flooding. | KCC |
| Marle Place Road | 1 property flooded internally, with reports of 8 - 10 cm of floodwater. There were another 2 properties which reported flooding, but it is not known if they flooded internally. | KCC / Flood Surveys / KFRS |

| Location | Details of Reported Flooding | Source of Report |
|-----------------|---|----------------------------|
| | KFRS made 1 property safe from flooding. | |
| Brenchley Road | 1 property reported internal flooding. KFRS pumped floodwater from 4 properties. | KCC / Flood Surveys / KFRS |
| Green Road | 1 property reported internal flooding. | KCC |
| Fromandez Drive | 1 property reported external flooding. There were also reports of carriageway flooding. | KCC |
| Orchard Close | 1 property reported internal flooding. | KCC |
| Kirkins Close | 1 property reported flooding, but it is not known if they flooded internally. | KCC |
| Back Lane | 1 property reported flooding, but it is not known if they flooded internally. | KCC |
| Lamberts Place | Carriageway flooding occurred. | KCC |
| Oast View | Carriageway flooding occurred. | KCC |

Site Location, Topography and Flood Risk

The village of Horsmonden is located approximately 10 km to the east of Royal Tunbridge Wells. An unnamed tributary of the River Teise flows in a predominantly west to east direction to the south of Horsmonden. The watercourse flows east from Sprivers Wood along the southern boundary of properties on Fromandez Drive and through a culvert beneath Lamberhurst Road, then travels through fields along the southern edge of Horsmonden before entering a culvert beneath Olivers Court, it becomes open watercourse from Horsmonden until it discharges into the River Teise approximately 1.9 km to the south-east of Horsmonden. This watercourse has a catchment area of approximately 1.5 km² which covers Horsmonden and extends south to Hazel Street. The catchment generally slopes towards the east.

Another watercourse called the Long Gill is located approximately 0.75 km to the northwest of Horsmonden, flowing in a southwest to northeast direction, before discharging into the River Teise approximately 3.5 km downstream to the north.

The unnamed tributaries of the River Teise and the Long Gill are classified as ordinary watercourses and are regulated by KCC. Figure 1 below provides an overview of the watercourses in Horsmonden and the surrounding area.

A review of the Cranfield University Soilscales database indicates that the underlying soils in Horsmonden are loamy and clayey soils with impeded drainage. This means that rainfall in this area is unlikely to infiltrate the ground and will runoff over land, especially in heavy rainfall events.

The Environment Agency's Flood Risk from Surface Water map (Annex 2) indicates that the areas at a high risk of flooding from surface water sources are mainly associated with the unnamed tributaries of the River Teise². Flooding from surface water is typically associated with natural overland flow paths (including the unnamed tributaries of the River Teise) and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events. The areas indicated to be a high risk of flooding from surface water sources are relatively consistent with the locations of reported properties affected by the flood event.

² High risk of flooding from surface water is defined as having a greater than 1 in 30 (3.3%) chance of flooding.
Medium risk of flooding from surface water is defined as having between 1 in 100 (1%) and 1 in 30 (3.3%) chance of flooding.
Low risk of flooding from surface water is defined as having between 1 in 1000 (0.1%) and 1 in 100 (1%) chance of flooding.

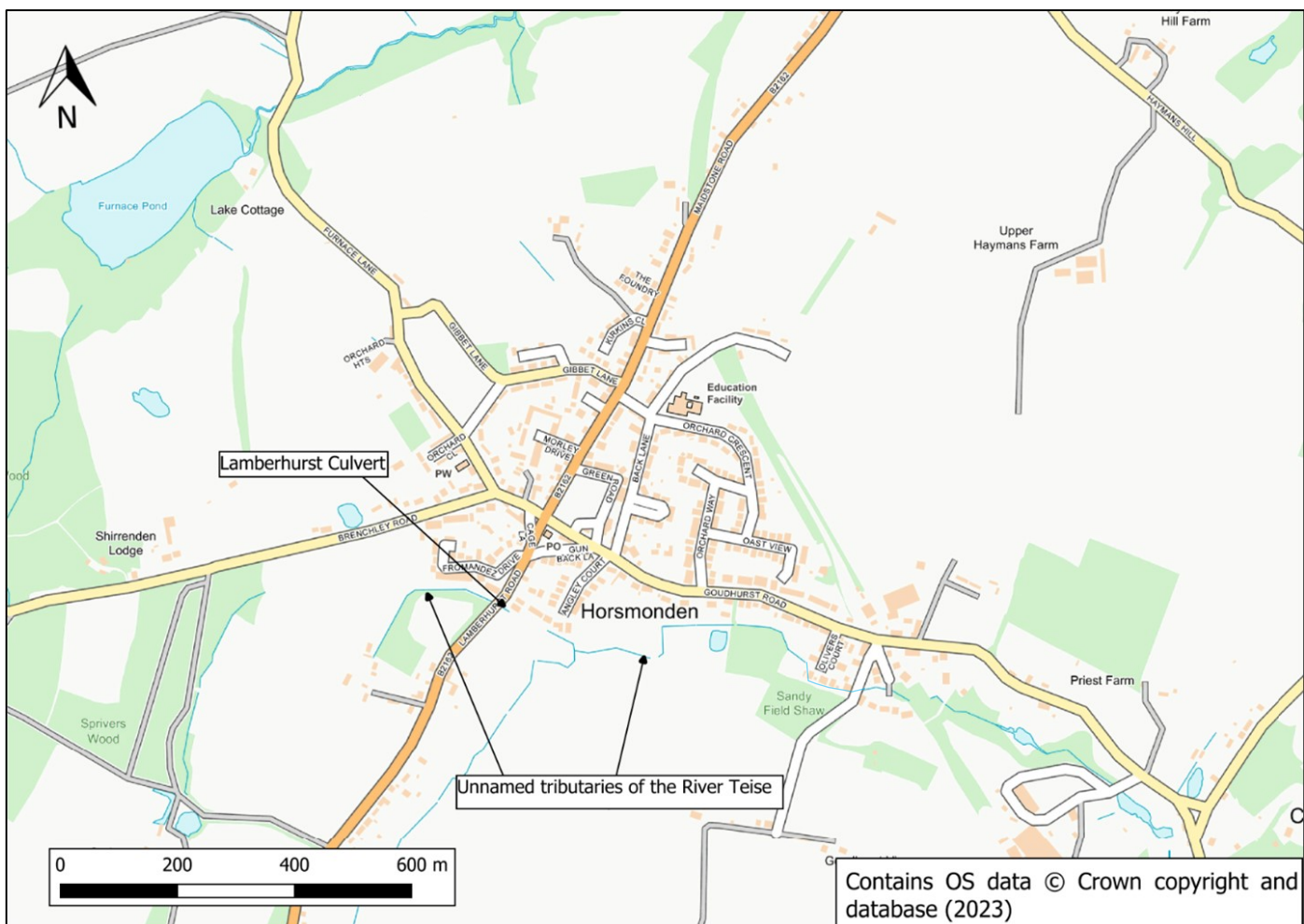


Figure 1 - Map showing the watercourses within Horsmonden and the surrounding area.

Flood History

There are a number of historic flood events that have occurred in Horsmonden prior to the event on the 25 July 2021. Horsmonden and the surrounding areas have flooded on a number of occasions in association with the River Teise, ordinary watercourses, surface water runoff and blocked drains.

Data for more recent events from the KCC's flood incident database and Surface Water Management Plans have been collated into Table 2.

Table 2 - Summary of the historic flood records

| Location | Date of Flooding | Details of Flooding |
|-----------------|------------------|--|
| Lamberts Place | 2000 | Fluvial flooding from ordinary water course. |
| Horsmonden Road | 2000 | Flooding from ordinary watercourse. |
| Brick Kiln Lane | September 2008 | Carriageway flooding. |

| Location | Date of Flooding | Details of Flooding |
|---------------------|------------------|--|
| Maidstone Road | January 2009 | Surface water runoff from blocked gully caused internal flooding to a depth of 2 inches. |
| Spelmonden Road | January 2009 | Blocked gully caused carriageway flooding. |
| Haymans Hill | January 2009 | Blocked gully caused carriageway road and property flooding. |
| Smallbridge Road | January 2009 | Carriageway flooding. |
| Brenchley Road | February 2009 | Drainage ditch problems caused flooding. |
| Haymans Hill | December 2009 | Carriageway flooding. |
| Furnace Lane | January 2010 | Surface water flooding with blocked gully. |
| Back Lane | July 2010 | Blocked gully causing carriage flooding. |
| Goudhurst Road | August 2010 | Blocked drain/gully causing road flooding. |
| Horsmonden Road | 2012 | Overflow of foul sewers from hydraulic overload. |
| The Heath | May 2012 | Property damaged by flooding. |
| Goudhurst Road | November 2012 | Carriageway flooded. |
| Lamberhurst Road | January 2014 | Blocked gully causing water to flood road. |
| Yew Tree Green Road | December 2019 | Ponding and flooding from surface water along road (8 inches deep). |

| Location | Date of Flooding | Details of Flooding |
|-----------------|-----------------------|---|
| Spout Lane | December 2019 | Property flooding. |
| Brenchley Road | February 2020 | Blocked gully causing carriageway road and property flooding. |
| Spout Lane | February & March 2020 | Property flooding. |
| Grovehurst Lane | February 2021 | Blocked gully causing road flooding. |
| Maidstone Road | May 2021 | Property damaged from internal flooding. |

Rainfall

Rainfall around the county is recorded by a series of rain gauges operated by the Environment Agency.

To assess the rarity of the rainfall that fell the Flood Estimation Handbook³ (FEH) Event Rarity Calculator is used to gain an Annual Exceedance Probability (AEP), which is the likelihood of rainfall of this depth or more falling in a year. For instance, a rainfall event with an AEP of 1% means that rainfall of this depth or greater would only be expected on average once in 100 years, or 10 times in 1,000 years.

For the flood event on 25 July 2021 the observed rainfall from the Horsmonden rain gauge, which is in close proximity to the affected properties, and radar data across the estimated Horsmonden catchment was used.

It is important to note that this rainfall analysis and the AEP estimates are approximates based on observed rainfall data which comes with a degree of uncertainty. Other factors such as catchment characteristics and antecedent rainfall conditions have not been considered for this analysis. Assessment of AEP based solely on rainfall data can only ever provide an approximation of the resultant flood event. Other local factors, such as asset condition and blockage, may also have had an effect on the flooding seen, rather than simply the magnitude of the rainfall.

The assessment has been undertaken using the FEH13 rainfall model.

Rain Gauge Analysis

Rainfall data from Horsmonden (Station Number: E2040. Grid Reference: TQ721405) on 25th July 2021:

Rainfall: 28.00mm (2 hours: 10:45 – 12:45)

Estimated Annual Exceedance Probability (10:45 – 12:45): 1 in 5-year return period, 20% occurrence in any given year.

The closest Environment Agency rainfall gauge is located in Horsmonden, approximately 2 km to the east of the village and approximately 1 km to the east of the edge of the estimated surface water runoff catchment for Horsmonden (no other rain gauges were considered to be appropriate to be used due to the significant distances from Horsmonden). Annex 3 at the end of the report shows the location of the Horsmonden rain gauge and the estimated Horsmonden catchment.

The rain gauge first recorded rainfall on the 25 July at 10:45, this is in agreement with the reports received from the residential surveys. Between 10:45 to 12:45, 28.00 mm was recorded.

³ 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.

Assuming this same depth of rainfall fell on the Horsmonden catchment in this time period gives an estimated 20% AEP.

It should be noted that on the 25 July Kent experienced a number of intense rainfall events generated from thunderstorms, these events were extremely localised in nature. The rain gauge located in Bethersden, which lies 14 miles to the east of Horsmonden, recorded 58.77mm within an hour, indicating the intensity of rainfall on that occurred on that day.

Rainfall Radar Analysis

Rainfall: 38.31mm (2 hours: 11:00 – 13:00)

Estimated Annual Exceedance Probability (11:00 – 13:00): 1 in 15-year return period, 7% occurrence in any given year.

Rainfall: 44.20mm (4 hours: 11:00 – 15:00)

Estimated Annual Exceedance Probability (11:00 – 15:00): 1 in 13-year return period, 8% occurrence in any given year.

Due to the significant distance of the rain gauge from the affected flooded properties and the localised nature of intense rainfall events, it is possible that the Horsmonden rain gauge is not accurately representing the rainfall experienced across the Horsmonden catchment. As a result, radar data was purchased from the Met Office to support the rainfall analysis. Assessing the radar data also provides an indication of the spatial distribution of rainfall across the area.

The radar data was purchased for three 1x1 km grid squares across Horsmonden, this covered all the recorded flooded properties from the flood event in the village and the northern part of the catchment which drains towards Horsmonden. The rainfall distribution of the three 1x1 km grid squares was assumed to encompass the estimated Horsmonden catchment area and then averaged, producing hourly rainfall values for the catchment.

Similar to reports by affected residents and to the Horsmonden rain gauge, the highest hourly rainfall was recorded between 11:00 – 12:00, with an average rainfall across the catchment at 23.17 mm. Further rainfall lasted until 15:00; over the 4 hours a total of 44.20 mm was recorded, and 38.31 mm between 11:00 – 13:00, the most intense part of the storm. Rainfall depths recorded by radar data may be less accurate than those recorded at rain gauges.

Error! Reference source not found. below shows the recorded rainfall distribution across the main Horsmonden catchment based on the radar data between 11:00 – 15:00. The radar data suggests the storm was more intense to the west of Horsmonden; with some slight indication the storm tracked from west to east, although this is not explicitly clear. Intense localised rainfall was experienced elsewhere in the county and this supports a view that the return periods estimated using the rain gauge and radar data are likely to be inaccurate and indicating an event of lesser severity than experienced in Horsmonden.

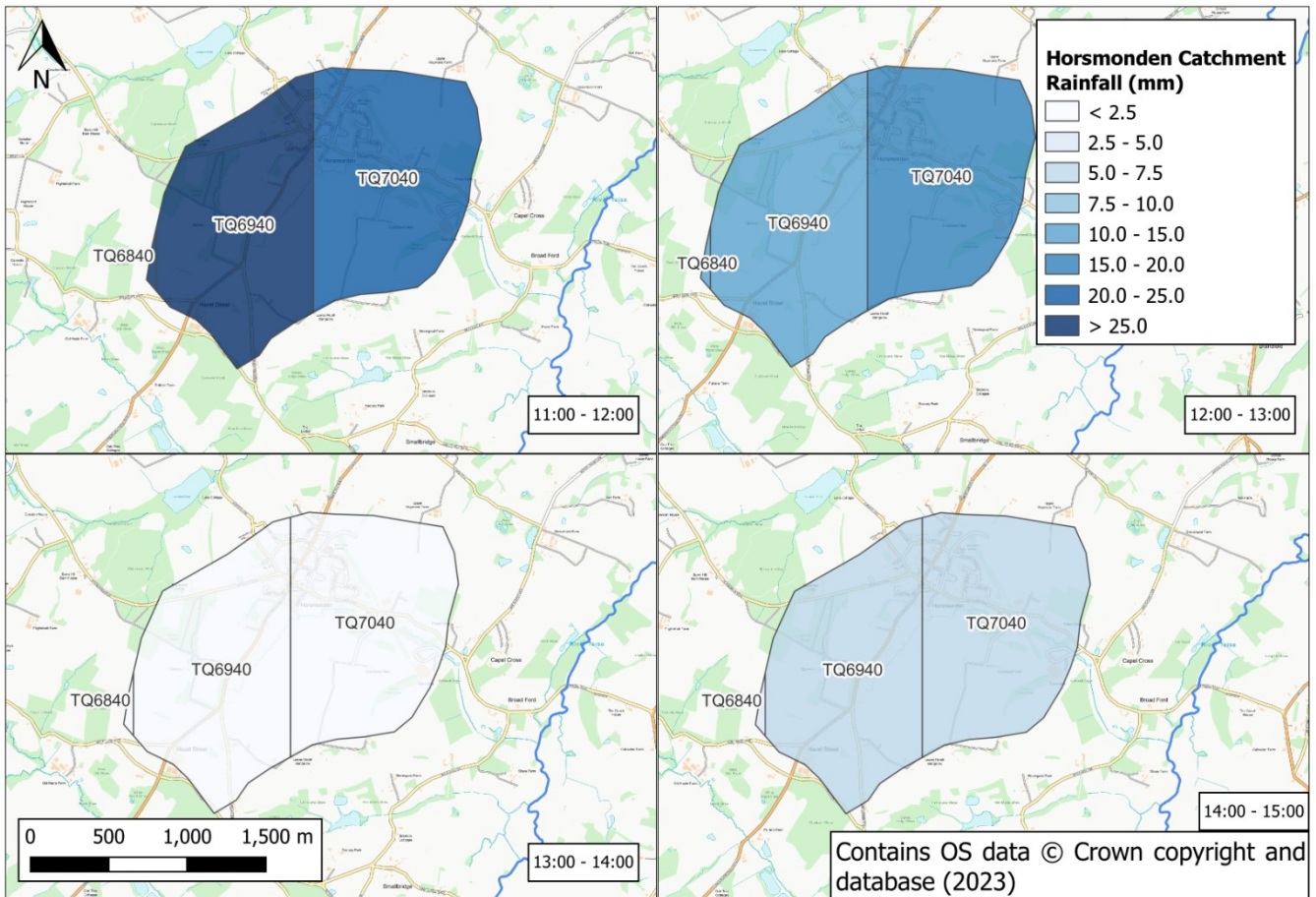


Figure 2 Hourly rainfall radar data from the Met Office from 11:00 - 15:00 across the estimated Horsmonden catchment.

Flooding Description and Mechanism

Residents reported that flooding occurred between 13:00 and 14:00, the short intense period of rainfall caused numerous issues throughout Horsmonden including overwhelming the drainage and sewer systems, with surface runoff from the surrounding agricultural land causing carriageway flooding and property flooding. Agricultural land nearby Furnace Lane, had removed orchards and replaced the crops with blackcurrants. Plastic sheeting had been placed between the crops increasing the impermeable area which is likely to have increased the volume and flow of runoff. The surface water runoff caused flooding to the properties on Furnace Lane as existing drainage systems were overwhelmed.

The highway drainage system on Lamberhurst Road, surcharged due to the capacity of the pipe being exceeded. Residents reported to KCC Highways during the flood event that the road surface along Lamberhurst Road and Fromandez Drive started to break up as a result of the floodwater.

Ordinary watercourses run along the northern and southern boundary of the field west to Olivers Court (Figure 3). The grills covering the inlet to a culvert in the northern watercourse, were blocked with leaf litter and the channels had been maintained. This caused the culvert to become blocked,

and the watercourse backed up and over topped. The southern watercourse had also not been maintained recently and a large log became stuck in the culvert between Olivers Court and Lamberts Place. This caused the watercourse to overtop and flow towards the properties on both Olivers Court and Lamberts Place, once the log was removed by KFRS the flood water began to clear.



Figure 3 Map showing watercourses and blockages around Olivers Court.

Flood Response

During the flood event on the 25 July 2021, the KFRS attended 4 flooding incidents in Horsmonden on Brenchley Road, Furnace Lane, Marle Place Road and Olivers Court. Residents reported that KFRS created channels in order to aid water flow away from properties, distributed sandbags and drained a communal pond. KFRS also pumped out water from 18 properties.

KCC Highways also attended Oast View, Lamberhurst Road and Lamberts Place. A road closure was put in place along Lamberhurst Road at the junction with Fromandez Drive and a manhole was damaged as a result of floodwater surcharging. A tanker also attended the flood event along Lamberhurst Road. KCC reported that floodwater had subsided along Oast View and Lamberts Place by the time KCC Highways attended and no further action was taken.

Since the flood incident, an inspection of highway drains and gullies located around the areas that experienced flooding has been carried out by KCC Highways. KCC Highways have cleared the full highway surface water drainage system along Lamberhurst Road at the section from Gun Back Lane to the unnamed tributary of the River Teise making sure that it is operating well. KCC Highways have also installed a new gully on the junction with Gun Back Lane. Some of the highways drainage system along Lamberhurst Road has been increased in size from 150mm to 300mm however the entire system could not be upgraded due to the number of utility services located within the carriageway. KCC Highways are currently undertaking feasibility assessments for a future scheme at this location.

The maintenance company, of the land west of Olivers Court, have removed the grills covering the inlet to the northern culvert and have agreed to inspect the watercourses every 6 months.

In February 2022 the agricultural plastic sheeting between crops near Furnace lane, were removed.

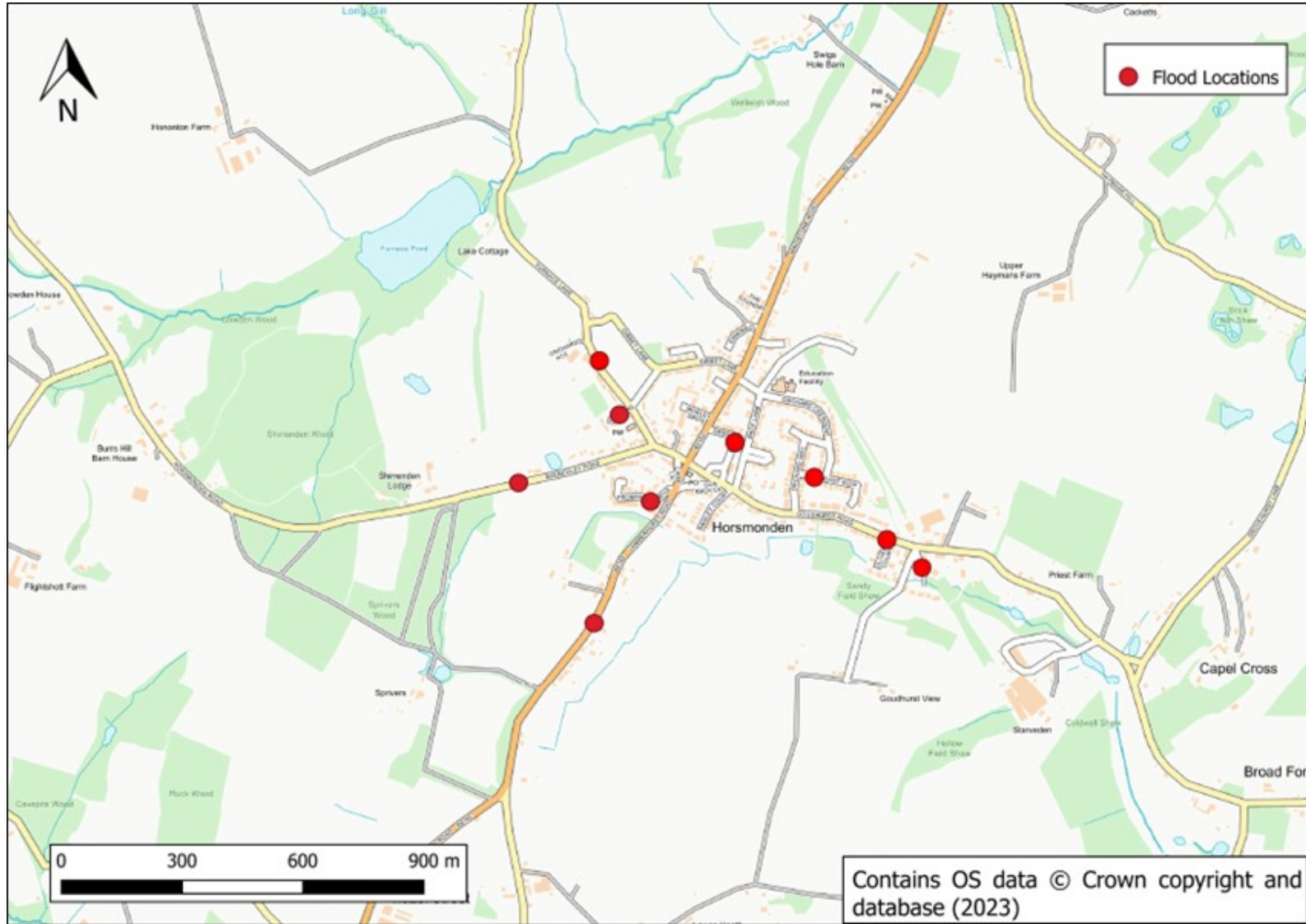
Conclusions and Recommendations

On the 25 July 2021 short intense rainfall overwhelmed the surface water drainage and sewage systems in Horsmonden. The rain gauge, located approximately 2 km to the east of Horsmonden, recorded 28 mm of rain fell between 10:45 and 12:45. Rainfall radar data from the Met Office showed that over 4 hours a total of 44.20 mm was recorded, however a total 38.31 of this fell within 2 hours. During the 25 July 2021 Kent experienced localised intensive rainfall as a result of thunderstorms with high levels of rainfall recorded elsewhere in the county. It is possible that the Horsmonden area was impacted by a more intensive event which has not been accurately recorded by the rain gauge or the radar data and resulted in the level of flooding experienced.

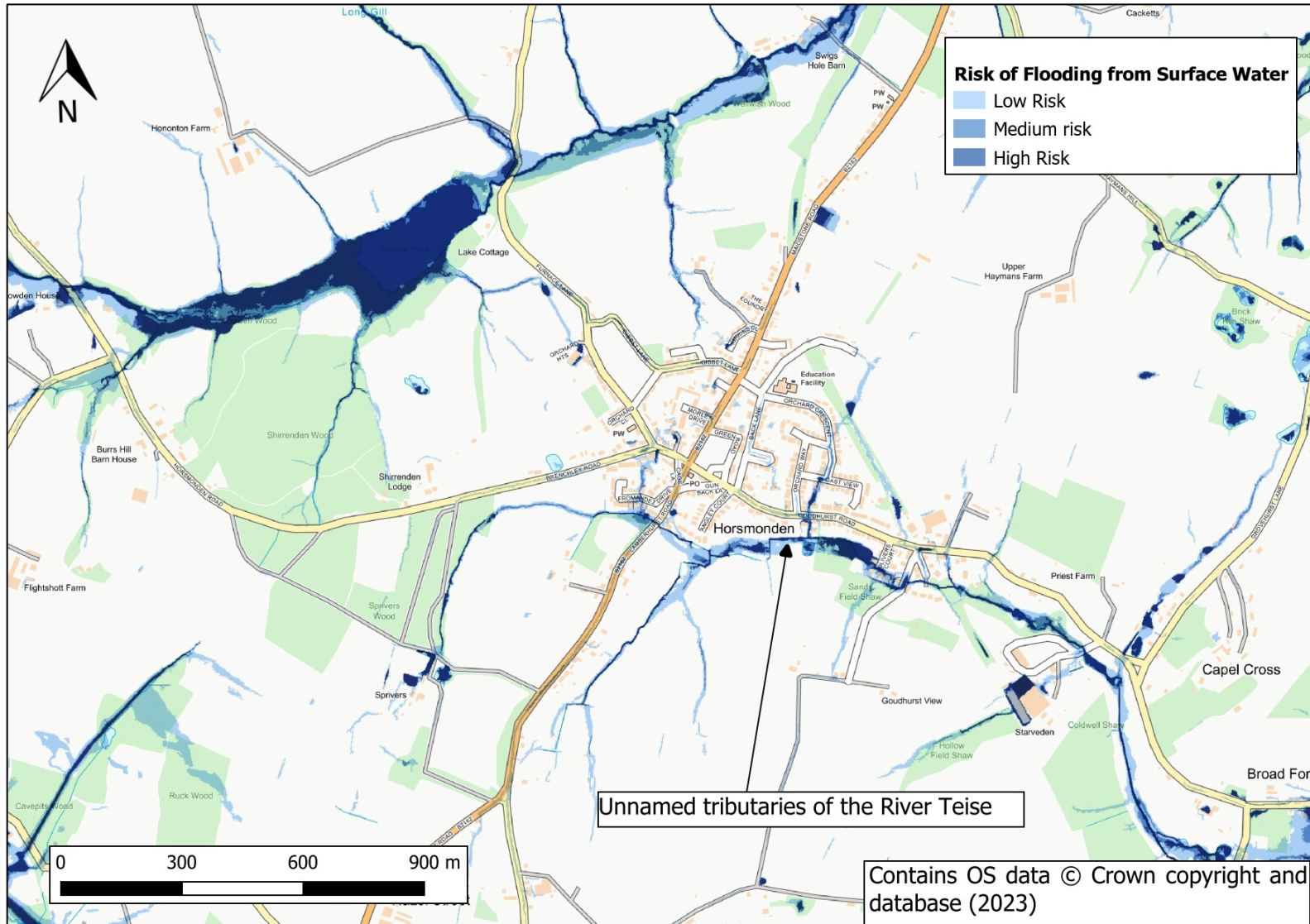
Land use changes and the introduction of impermeable covering around crops is likely to have increased the overland flows and surface runoff from the agricultural land. Surface water runoff would have increased the volumes of water that had to be managed by the highway drainage system, further overwhelming it. Blockages and undersized pipes within the highway drainage system and culverted watercourses caused the systems to surcharge in the intense rainfall. This caused 20 properties to flood internally with an additional four properties flooding externally as well as carriageway flooding.

A number of options to be considered as a result of the flood event are detailed below:

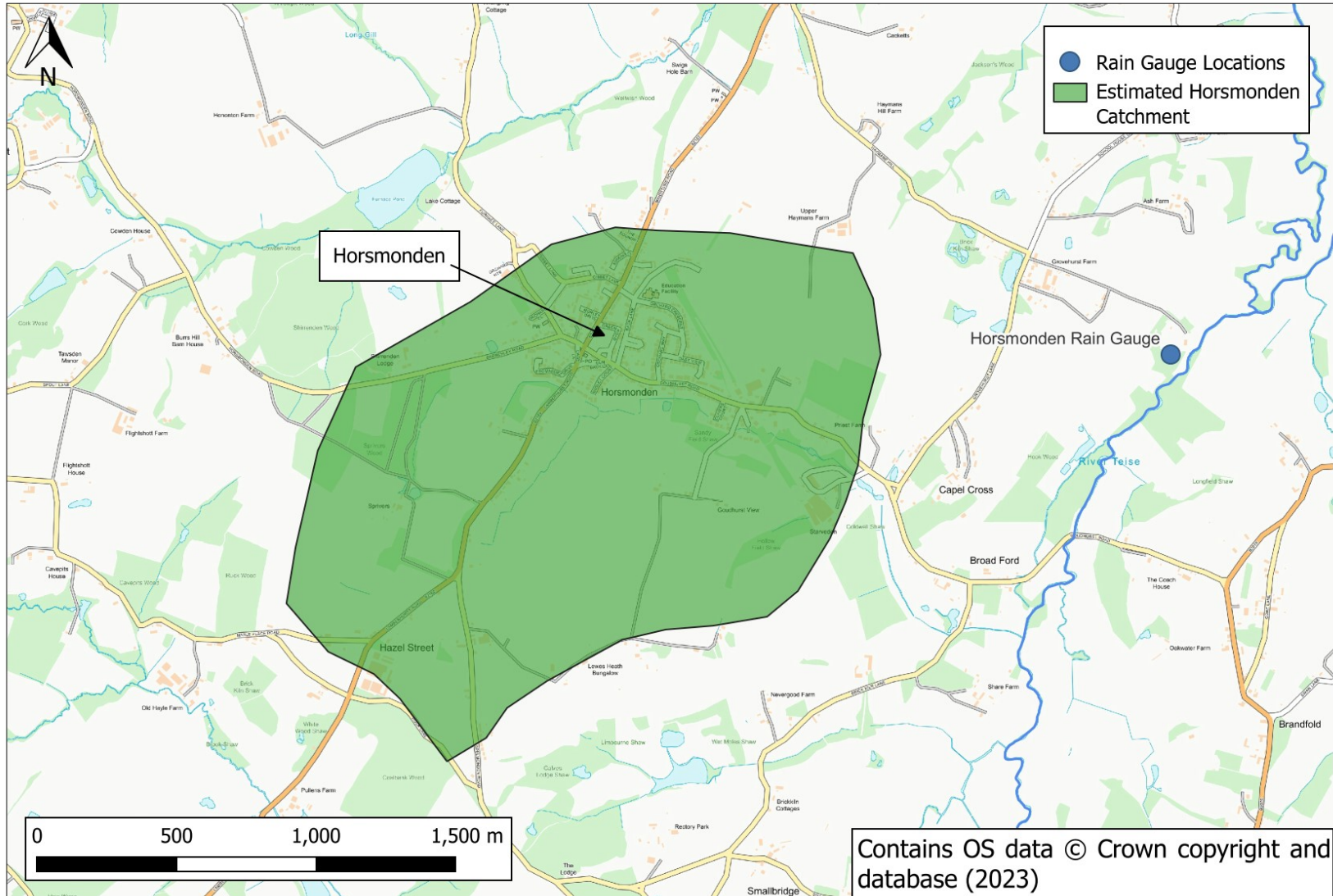
- Evaluation of the current highway drainage maintenance undertaken in Horsmonden to understand if it is appropriate.
- Communication with local residents regarding local flood risks and consultation regarding actions that the community could undertake in future flood events.
- Consultation with local landowners outlining their riparian responsibilities and best practices regarding land management.
- Further investigation into potential improvement works to the culvert located beneath Lamberhurst Road.
- Investigation into the condition and suitability of the culvert located beneath Olivers Court.



Annex 1 – Location of reported flood incidents in Horsmonden



Annex 2 - Extract from the Environment Agency's Flood Risk from Surface Water Map



Annex 3 – Estimated Horsmonden catchment and location of Horsmonden rain gauge

Appendix A: Flood Surveys

Table 2 below provides a breakdown of all of the roads that flood surveys were sent to and compares the number of flood surveys per road with the number of responses received.

Table 2 - Summary of flood surveys

| Location | No. of flood surveys sent | No. of flood surveys received |
|------------------|---------------------------|-------------------------------|
| Furnace Lane | 4 | 4 |
| Olivers Court | 6 | 2 |
| Marle Place Road | 4 | 1 |
| Spout Lane | 2 | 1 |
| Brenchley Road | 1 | 1 |
| Fromandez Drive | 1 | 1 |
| Lamberhurst Road | 1 | 0 |
| Back Lane | 1 | 0 |