March 2019

Kent County Council

Flood Investigation Report

Flooding affecting the Swale Area on 29 May 2018

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**
- **Swale Borough Council**
- **Kent Fire and Rescue Service**
- **Southern Water**

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.

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

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Contents

1 Introduction

Significant flooding in parts of Kent was reported to Kent County Council (KCC) and other authorities on the 29 May 2018. Many of the areas affected experienced extensive surface water and fluvial flooding, resulting in the inundation of properties. As a consequence, KCC has undertaken an investigation into this flood event. This is the report of that investigation.

1.1 Requirement for Investigation

As the Lead Local Flood Authority (LLFA) for Kent, KCC has a duty to investigate flood incidents as set out in Section 19 of the Flood and Water Management Act 2010 (the Act). The Act says:

> (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.

A flood investigation does not necessarily require a thorough investigation of the flood and its mechanisms, only the determination of the risk management authorities who have the relevant functions. However, KCC may choose to undertake a more detailed investigation into a flood incident in order to better deliver the objectives of Kent's Local Flood Risk Management Strategy, for instance to improve the understanding of flood risk.

1.2 Trigger for Investigation

As the primary purpose of an investigation is to determine the responsible body or bodies to respond to the flood that occurred, KCC will undertake a flood investigation where no other risk management authority is exercising or is proposing to exercise its functions in respect of the flood and where the flood is significant.

A significant flood is defined by Section 5.1 of the Local Flood Risk Management Strategy for Kent, and is one that causes:

- internal flooding to one or more properties;
- external flooding of five or more properties;
- flooding of roads, rail and other transport infrastructure to an extent that they become impassable by vehicles;
- flooding of or near locally important services or infrastructure, for example health centres and electricity substations, to an extent that they cannot function normally.

1.3 This investigation

The flood event in Kent on the 29 May 2018 meets the criteria of a significant flood event and therefore requires investigation. Whilst other RMAs are exercising their functions in response to the event, an investigation was also deemed necessary due the widespread nature of the flooding and public interest, and to provide information for further studies into flood risk of this area.

2 Background Information

2.1 Location and Known Extent of Flooding

Widespread flooding was reported on 29 May 2018 across north Kent that caused flooding to number of properties, KCC has had reports of flooding to approximately 90 properties in the district of Swale. Table 1 provides a summary of the locations where properties were affected based on reports received by Swale Borough Council (SBC), Kent County Council (KCC), Kent Fire and Rescue Service, Environment Agency and Parish Councils.

Table 1 Summary of investigated flooding issues and known flooding extent.

Location	Details of flooding	Source of Report
Iwade		
Sheerstone	8 properties experienced internal flooding. 3 cars damaged/written-off Environment Agency overpumped water from the watercourse to lower water levels.	Iwade Parish Council KCC EA
Meadow Brown View and Purple Emperor Grove	2 properties experienced internal flooding on Meadow Brown View 3 properties experienced flooding with one property experiencing internal flooding on Purple Emperor Grove	SBC, KCC
Springvale	6 properties affected by flooding, internal flooding to one and one car damaged/written off	Iwade Parish Council, EA
Ferry Road	1 property affected by internal flooding	KCC
The Waterway	2 properties affected by flooding from main river	KCC
Sittingbourne		
Canterbury Road	6 properties reported internal flooding	SBC, KCC
Coombe Drive	Flooding to 5 properties	KCC
Prince Charles Avenue	Internal flooding to 2 properties	SBC, KCC
Gayhurst Drive	Flooding to 2 properties	KCC
Viners Close	Internal flooding to 3 properties	KCC
London Road	Internal flooding to commercial property	KCC
Brier Road	Flooding to 2 properties	KCC
Doddington		
Old Lenham Road The Street	8 properties affected by flooding Extensive highway flooding	KCC
A249		
	Extensive highway flooding resulting in road closure Stranded vehicles in Pett Road, Stockbury Valley Internal flooding at one property	KCC, KFRS
Lynstead		
The Street	5 properties affected by flooding	KCC

Newington		
Highstreet	Flooding to one commercial property	KCC
The Willows	Flooding to seven properties	KCC
Orchard Drive	Internal flooding to three properties	KCC
Frank Apps Close	Internal flooding to one property	KCC
Bull Lane	Flooding to one property	KCC
Teynham		
Lower Road	Flooding to three properties	KCC
Deerton Street	Internal flooding to one property	KCC
Frognal Lane	Internal flooding to one property	KCC
London Road	Internal flooding to two commercial properties Flooding on highway	KCC
Newgardens Road	Internal flooding to one property	KCC
Honeyball Walk	Internal flooding to one property	KCC
Harrys Road	External flooding at property	KCC
Borden		
Munsgore Lane	Internal flooding to one property	KCC
Tunstall		
Tunstall Road	Flooding to one property Tunstall Road	KCC
Sterling Road	Flooding to garages and driveway	KCC
Faversham		
East Street	Flooding to one commercial property	KCC
Ospringe Street	Flooding to one commercial property	KCC
Preston Avenue	Flooding to one property	KCC
Priory Road	Flooding to one property	SBC
Bapchild		
The Street	Internal flooding to one property Flooding to two other properties	KCC
Bredgar		
Vigo Lane	Internal flooding to one property	KCC
Gore Road	Internal flooding at two properties	KCC
Swanton Street	Internal flooding to two properties	KCC
Oare		
The Street	Internal flooding to one property	KCC
Stalisfield Green		
Green Lane	Internal flooding to one property	KCC

The locations of these flood events can be seen in Figure 1. It should be noted that this list of affected locations is not exhaustive, and many other localised incidences of road flooding were also reported at this time.

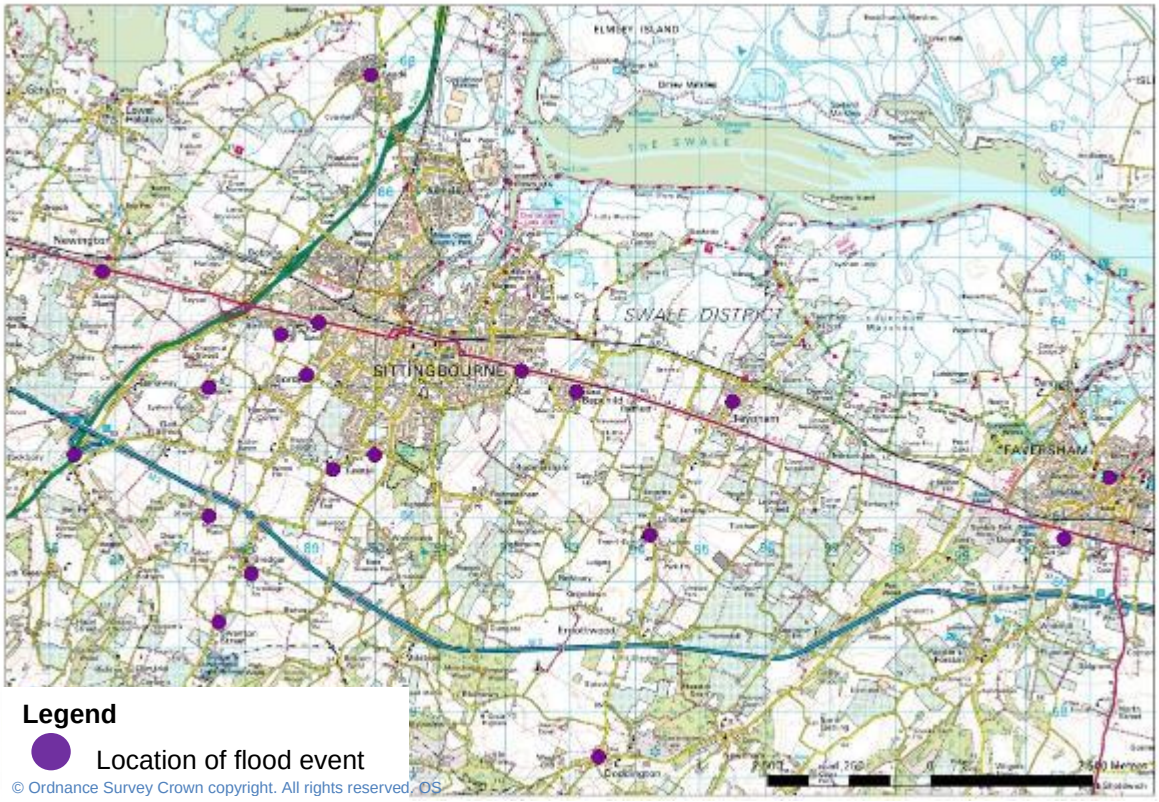

Figure 1 Location of flood events

2.2 Rainfall

Rainfall around the county is recorded by a series of rain gauges operated by the Environment Agency. Data has been collected from rain gauges at Sittingbourne, Throwley and Wigmore. These gauges record rainfall depth at 15-minute intervals. The location of these gauges is shown in Figure 2.

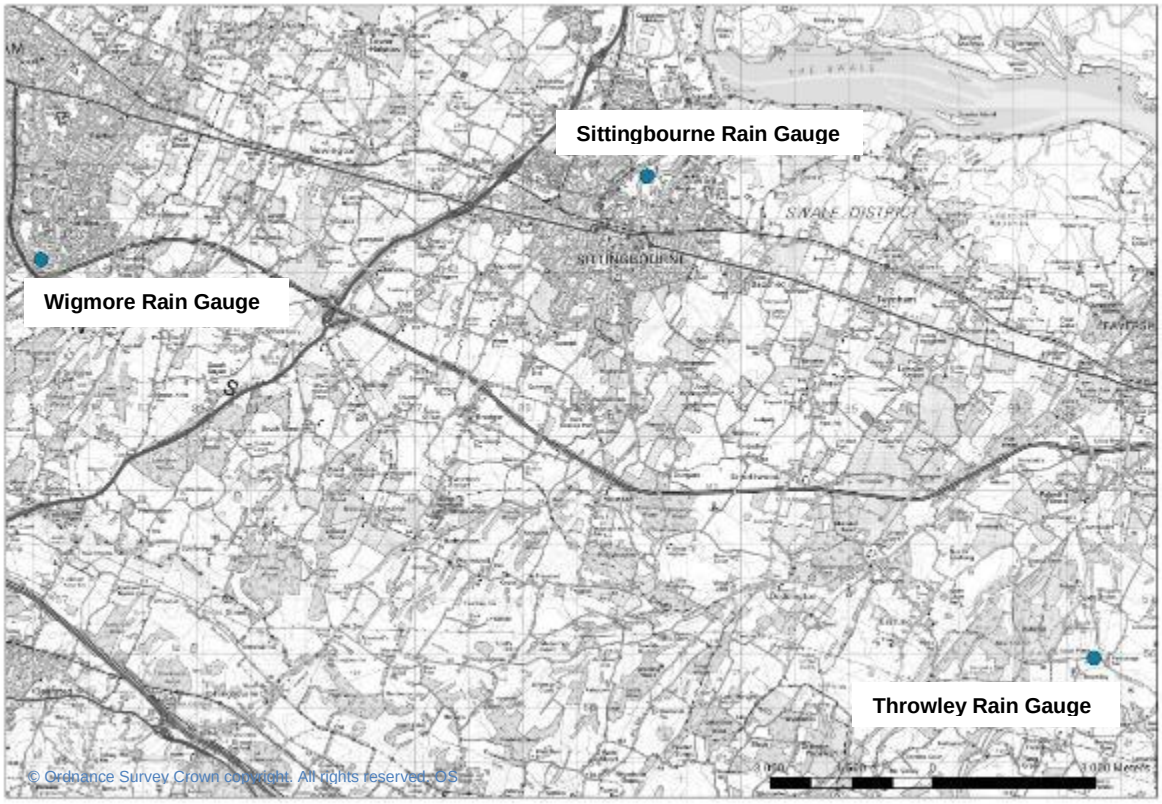

Figure 2 Location of rain gauges

The rainfall data from these three gauges on 29 May 2018 is shown in Figure 3[1].

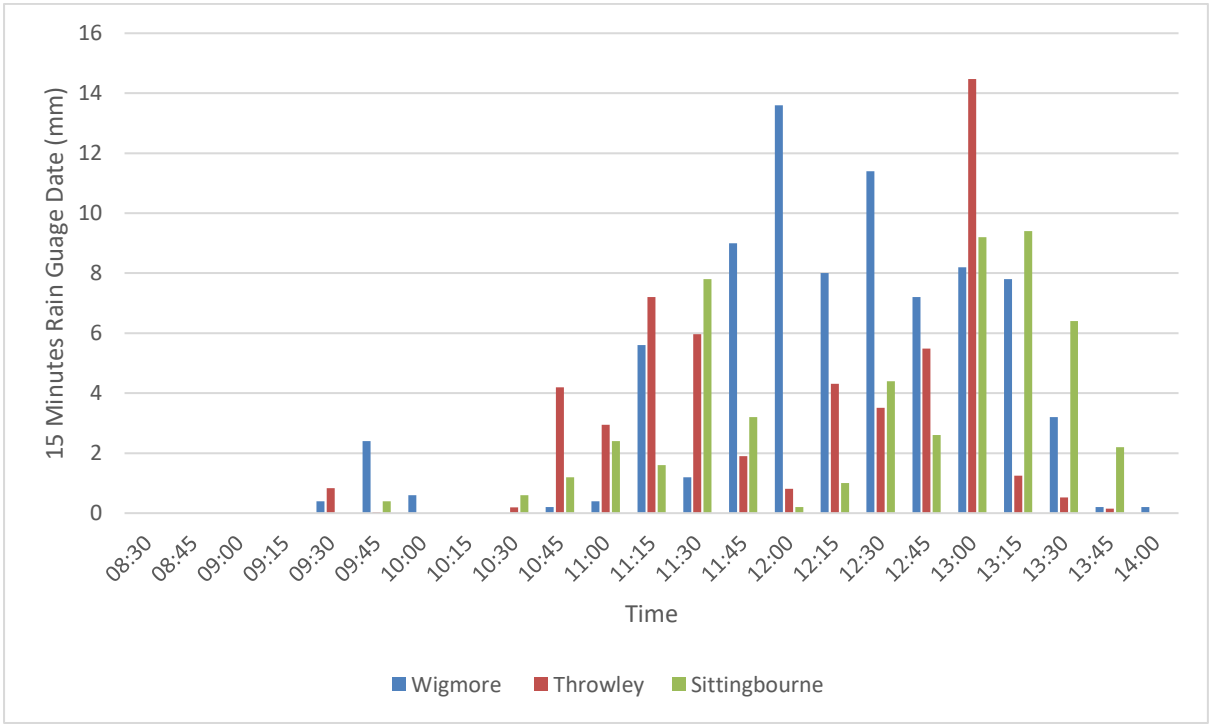

Figure 3 15-minute rain gauge data[1]

[1] Environment Agency rain gauges operate on Greenwich Mean Time, times have been adjusted for British Summer Time

The Wigmore rain gauge recorded 75.2 mm of rainfall in 2.5 hours between 11:15 and 13:45. The Sittingbourne rain gauge recorded a total of 51.6 mm of rainfall over a three-hour 15-minute period from 11:00. The Throwley rain gauge recorded a total of 50.8 mm of rainfall within 2.5 hours from 10:45.

To assess the rarity of the rainfall that fell the Flood Estimation Handbook[2] (FEH) Event Rarity Calculator 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.

The AEP of the rain that fell at Sittingbourne is estimated by FEH as 1.8% (or a 1 in 55.2-year return period) for the 51.6 mm that fell in a 3-hour 15-minute period. The AEP of the rain that fell at Wigmore is estimated by FEH as 0.2% (or a 453-year return period) for the 75.2 mm that fell in 2.5 hours. The AEP of the rain that fell at Throwley is estimated by FEH as 1.3% (or a 76.4-year return period) for the 50.8 mm that fell in 2.5 hours.

Data from the Sittingbourne rain gauge was applied to the Iwade Stream catchment, if the Iwade Stream catchment had experienced the 51.6 mm of rainfall that fell within an 3-hour 15 minute period in Sittingbourne across the whole catchment, FEH estimates the Annual Exceedance Probability (AEP) as a 1.46% (or a 1 in 68.5-year return period). Sittingbourne is the closest rain gauge to the Iwade stream, lying approximately 3 kilometres to the east. The Wigmore rain gauge lies approximately 8 kilometres to the west of the upper catchment and recorded a more intense rainfall, therefore the rainfall experienced by the Iwade Stream catchment may have been more intense that that recorded by the Sittingbourne rain gauge and consequently a rarer event.

The return period is different for Sittingbourne and the Iwade Stream catchment, as the locations are different and because the rainfall has been applied to the whole catchment on the Iwade Stream whereas it has only been applied to a small area at the rain gauge – rainfall of a given intensity is rarer when it covers a larger area.

Applying the Throwley rainfall data for the catchment around Doddington gives an estimation of 0.9% AEP (or 1 in 117-year return period) for the 50.8 mm that fell over 2 hours 30 minutes. This estimate differs from the estimate at Throwley for the same reasons the Sittingbourne rain gauge return period differs from the Iwade Stream return period.

2.3 Existing Drainage Infrastructure

2.3.1 Sewers

Modern sewerage in the UK is designed according to the standards set out in Sewers for Adoption guidance together with the sewerage undertaker's own supplementary design stations. Sewers for Adoption was first published in 1980 and sets out a design standard for sewers and drains of 1 in 30 years, i.e. a new sewer system should be designed to contain a storm of 1 in 30 years return period, storms that exceed this intensity needn't be contained in the sewer system. Water companies that own the public sewer network can invest in the sewers according to their business plan, however this investment is regulated by the water

[2] 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.

regulator, OfWat, and must be cost beneficial. Consequently, it is rare for improvement works on sewers to provide a capacity greater the 1 in 30-year standard where the existing system does not already exceed this standard.

2.3.2 Dry valleys and watercourses

There are only a few watercourses in the area covered by this report, generally the permeable nature of the soils in the area means that rainfall generally infiltrates into the ground and the landscape is characterised by dry valleys, ridges and plateaus carved within the chalk of the northern side of the North Downs ridge. The steep nature of these dry valleys forms natural flow pathways with multiple sources of water converging at the bottom of the valleys.

The chalk bedrock of the North Downs forms a principle aquifer supplying drinking water to London and Kent. During normal rainfall conditions the rainwater that falls in this area would infiltrate into the ground, serving to recharge this aquifer. During intensive rainfall, if the top layer of soil becomes saturated some water may runoff instead of infiltrating into the ground.

The chalk bedrock also provides an opportunity to install drainage infrastructure such as soakaways. Water collected by drains and gullies can be directed into these soakaways or other infiltration features (such as infiltration basins), which are engineered to utilise the natural infiltration capacity of the chalk to dispose of surface water into the ground.

One watercourse in this area is the Iwade Stream in the east of the Swale district. The Iwade Stream flows rises near Keycol and flows through the village of Iwade. It is a main river through Iwade, which means it is regulated by the Environment Agency. The Iwade Stream discharges into the Swale at Ridham. This catchment is underlain by less permeable soils than elsewhere in Swale, hence surface water is less likely to infiltrate into the ground and will instead run-off forming streams and watercourses .

2.3.3 Highway drains

Public highway drainage gullies and their associated pipework are owned and maintained by Kent County Council as the highway authority. The highway drainage in Swale is generally connected to soakaways that infiltrate the water into the ground. The chalk that underlays this area is highly permeable, and soakaways offer an efficient and sustainable means to discharge water. In Iwade, highway drainage will instead be connected to local watercourses.

Highway drainage is intended to clear surface water which falls upon the carriageway for the safety of highway users. These drainage assets are not intended to convey significant flows from areas outside of the highway boundary such as runoff from fields.

Soakaways and infiltration basins are only designed for a specific volume of water in a given space of time, once this is exceeded the drainage infrastructure will be overwhelmed and flooding may occur.

2.4 Roles and Responsibilities

2.4.1 Kent County Council

KCC is the lead local flood authority for Kent and the highway authority. The Flood and Water Management Act 2010 gives lead local flood authorities powers and duties for the strategic overview of local flooding and for some flood-risk management functions including:

- a duty to investigate flooding
- a duty to maintain a register of significant structures and features
- powers to regulate ordinary watercourses
- A duty as a statutory consultee to review drainage strategies and surface water management provisions associated with applications for major development

As the highway's authority KCC are responsible for the maintenance and operation of drainage gullies and pipework connecting these to the public sewers for the proper function of highways and safety of highway users.

2.4.2 Environment Agency

The Environment Agency is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion. The Agency also has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries .

2.4.3 Local Authorities

Swale Borough Council (SBC) is a category one responder under the Civil Contingencies Act 2004, along with KCC and the emergency services during emergency responses such as that required by a flooding event. SBC is also a coastal erosion risk management authority.

2.4.4 Statutory Undertaker for Public Sewers

Southern Water are responsible for the maintenance and operation of the public sewer network throughout the area carrying foul water, surface water or combined (sewers carrying both foul and surface water).

2.4.5 Riparian Landowners

Private landowners have responsibilities for the maintenance and upkeep of ordinary watercourses, including any associated culverts, and the bed / banks of any watercourse adjacent to or within their land. They should clear away any debris from the watercourse or culvert even if it did not originate from their land.

2.4.6 Residents and Property Owners

Private landowners are responsible for the maintenance and operation of drainage assets and connecting pipework located on privately owned roads and footways, car parks and other hard standings and for building surface water drainage.

Residents and property owners who know they are at risk of flooding have responsibilities to mitigate the risk of flood damage to their property as far as is reasonably practicable. They should take measures to protect themselves and their property when flooding is imminent. Residents and property owners have the right to defend their property as long as they do not subsequently increase the risk of flooding to other properties.

3 Analysis of the Flood Event

The details of the flooding in the areas affected during the event on 29 May are set out in more detail in this section of the report to collate existing and published information, and details recorded during the investigations of the flooding event.

3.1 Iwade

3.1.1 Summary of the event

Iwade was mainly affected by fluvial flooding from the Iwade Stream, resulting in internal flooding of 11 properties on Sheerstone Road, Springvale and The Waterway.

The Environment Agency, as the relevant flood risk management authority for the Iwade Stream in Iwade, monitor the Iwade weedscreens and river level. At 12:00 on 29 May the Parish Council reported to the Environment Agency that there was heavy rainfall in the village, which was causing surface water flooding on Springvale.

Fluvial flooding occurred within two hours of the storm starting, with water levels at the Iwade weedscreen recorded as rising by approximately 2 metres from 12:30. By 12:50 the Environment Agency level gauge recorded that the river at Sheerstone Road, on the main river section of the Iwade Stream, had reached a depth of 1.6 m causing the river to flow out of bank and through adjacent gardens and onto the road. The high water levels within the Iwade Stream continued until 15:30, reaching a peak of 2.18 m at 14:15. The water levels recorded by the level gauge are shown in Figure 6.

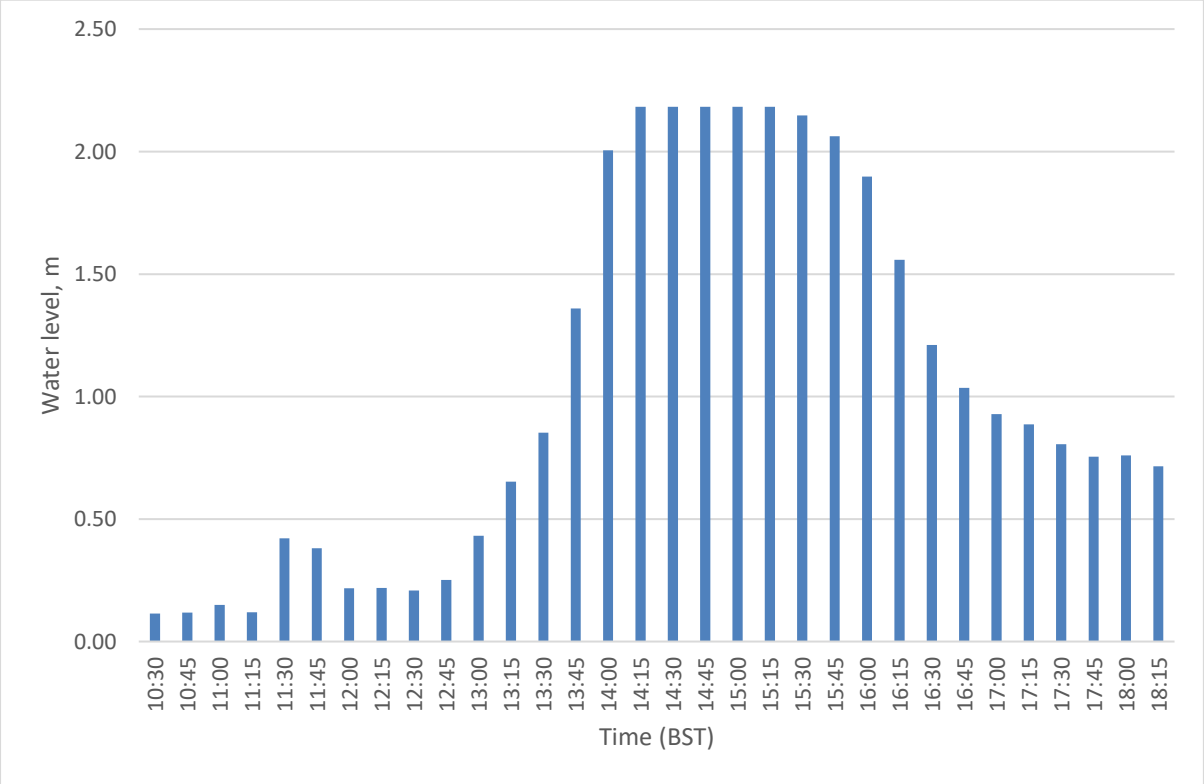

Figure 4 Iwade Stream level gauge

Following the call from Iwade Parish Council and another local resident the Environment Agency deployed teams to Iwade. They found travel on the roads was made difficult by flooding along the A2, with the public being diverted onto country lanes. However, all seven available Environment Agency operatives were able to reach Iwade to assist with the incident. Upon arrival water had already started to overwhelm the road culvert at Sheerstone and Springvale but an attempt was still made to clear the screens. It was found that there was little debris on the screens so the decision was made to deploy a 6” pump to overpump from one side of the Sheerstone culvert to the other. A image of the Sheerstone screen is shown in Image 1, taken at 13:45 BST.

Image 1 Sheerstone screen at 13:45 BST

Images 2 and 3 show the flooding to the front and rear of property on Sheerstone Road.

Images 2 and 3 Flooding to the front and rear of Sheerstone Road

Surface water flooding was reported on Meadow Brown View and Purple Emperor as the result of overland flow from the adjacent field. This overtopped a small bund and flowed onto the road. Surface water flooding affected five properties externally with three property experiencing flood water entering the garages. Highway flooding was reported at one property on Ferry Road, which was affected by surface water overtopping the drop kerbs during extreme rainfall and flows into the property.

3.1.2 Site Location, Topography and Published Flood Risk

Sheerstone Road, Springvale and The Waterways lie within the lowest parts of Iwade and are located next to the Iwade stream which runs through the centre of the village.

The Iwade stream catchment covers an area of 6km^2, the stream rises around Broom Down, Hawes Wood and Cold Harbour. There is a network of ordinary water courses in the upper catchment that join along its length until it becomes a single channel at Culnells Farm. The channel flows northeasterly towards Iwade and becomes a main river downstream of Coleshall Farm.

Adjacent to Chalkhill Close the stream passes through an Environment Agency weed screen and gantry which form part of the footbridge. The stream travels along the rear of properties on Sheerstone and passes under Sheerstone Road through a 0.9m concrete culvert, the culvert is fronted by an Environment Agency simple trash screen, the stream at this point is monitored by a level gauge and CCTV system. On exiting the culvert, the stream travels 91m before entering another culvert fronted by an Environment Agency weedscreen, the culvert passes under the public right of way which runs between Sheerstone and Springvale Road. The channel becomes open water course again passing through a privately-owned road culvert at The Waterways. The stream then enters a brick arch culvert underneath Ferry Road before returning to an open channel flowing into the Ridham Fleet on the Marshes, ultimately discharging into The Swale. A map of the Iwade Stream catchment is shown in Figure 4, including an approximate boundary of the catchment at Ferry Road.

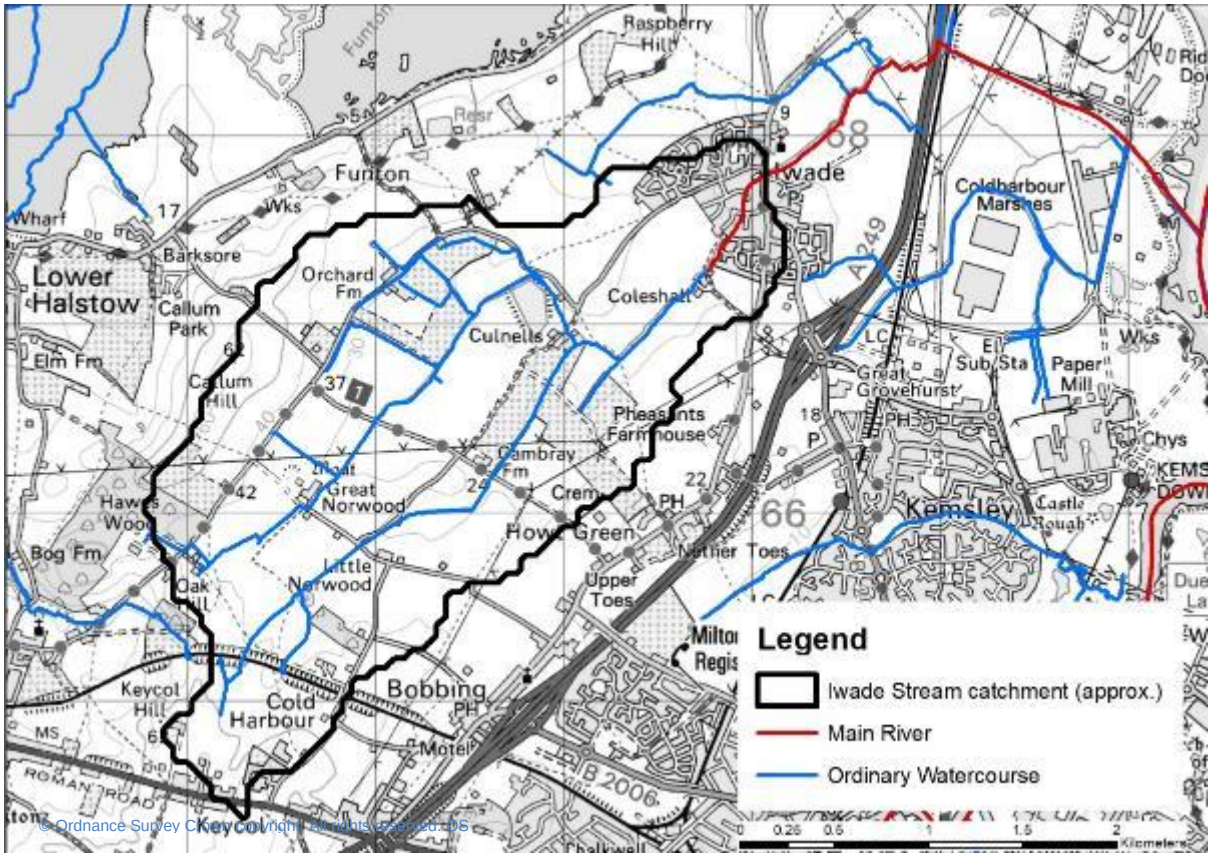

Figure 5 Iwade Stream catchment (showing catchment area at Ferry Road) (Source: Flood Estimation Handbook Web Service)

The Iwade Stream is a small watercourse and may contain little water, particularly during drier periods., However the large catchment area and relatively small channel size means that it can respond quickly to heavy rainfall and has a history of flooding. In 2002 the Environment Agency classified the channel as main river through Iwade in response to flood risk concerns.

The Environment Agency's Flood Map for Planning Flood Zone 3 is shown in Figure 5, this information is published on the Environment Agency website. Flood Zone 3 is considered to be a high risk of flooding with between a 1% and 3.3% chance of flooding each year. This map does not take into consideration the effect of any flood defences in the area.

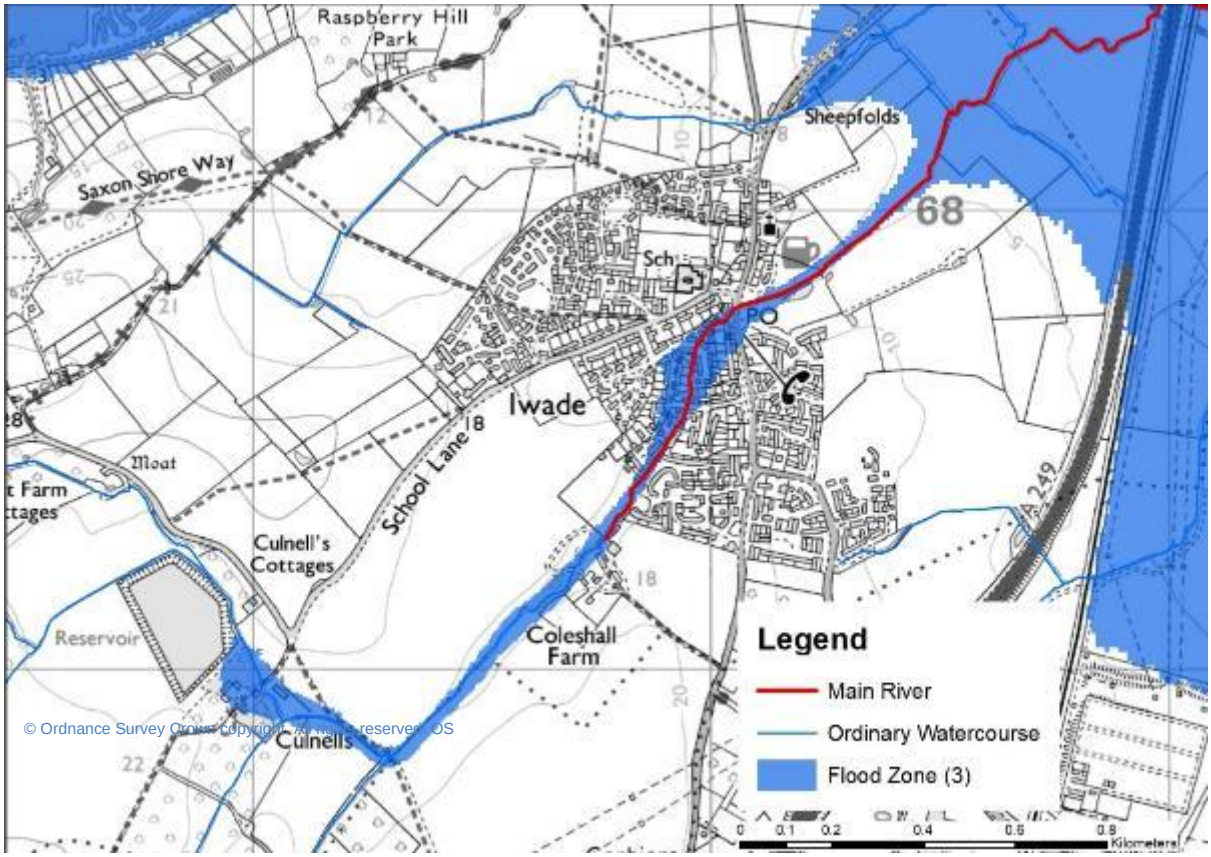

Figure 6 Environment Agency Flood Map for Planning

3.1.3 Flood History

Iwade previously experienced flooding in 2002 affecting the Springvale area - the flood event was reported as being due to a blockage within a pipe caused by fly-tipping. Following this event, the Environment Agency designated the stream through Iwade as main river, which means they are able to exercise their powers of management and maintenance on the channel, and they installed trash screens on the culverts in the village to reduce the risk of blockages.

Surface water flooding at Ferry Road, Meadow Brown and Purple Emperor have been reported to Kent County Council previously.

3.1.4 Flooding Mechanism

The primary cause of flooding was very heavy rainfall which occurred between 11:00 and 13:30 within the Iwade catchment. This generated high flows in the stream that exceeded

the capacity of the channel and culverts within the village of Iwade. Given that the Wigmore rain gauge recoded a more intense rainstorm event and that that is closer to the upper catchment of the Iwade Stream, the upper catchment may have experienced more intense rainfall than that in the village itself.

The Iwade catchment is predominantly rural with large scale arable fields and little tree cover and clayey ground, this would have generated rapid run-off that will have run into the Iwade Stream

Following the flooding from the Iwade Stream, the Parish Council and local residents reported concerns that the Orchard Farm brick earth quarry operated by Wienerberger had been the cause of the flooding. Figure 7 shows the Iwade catchment upstream from the Sheerstone culvert and the extent of the Wienerberger Quarry site (note the extent of the boundary in Figure 7 is the planning red line boundary, not the extent of the works on the site).

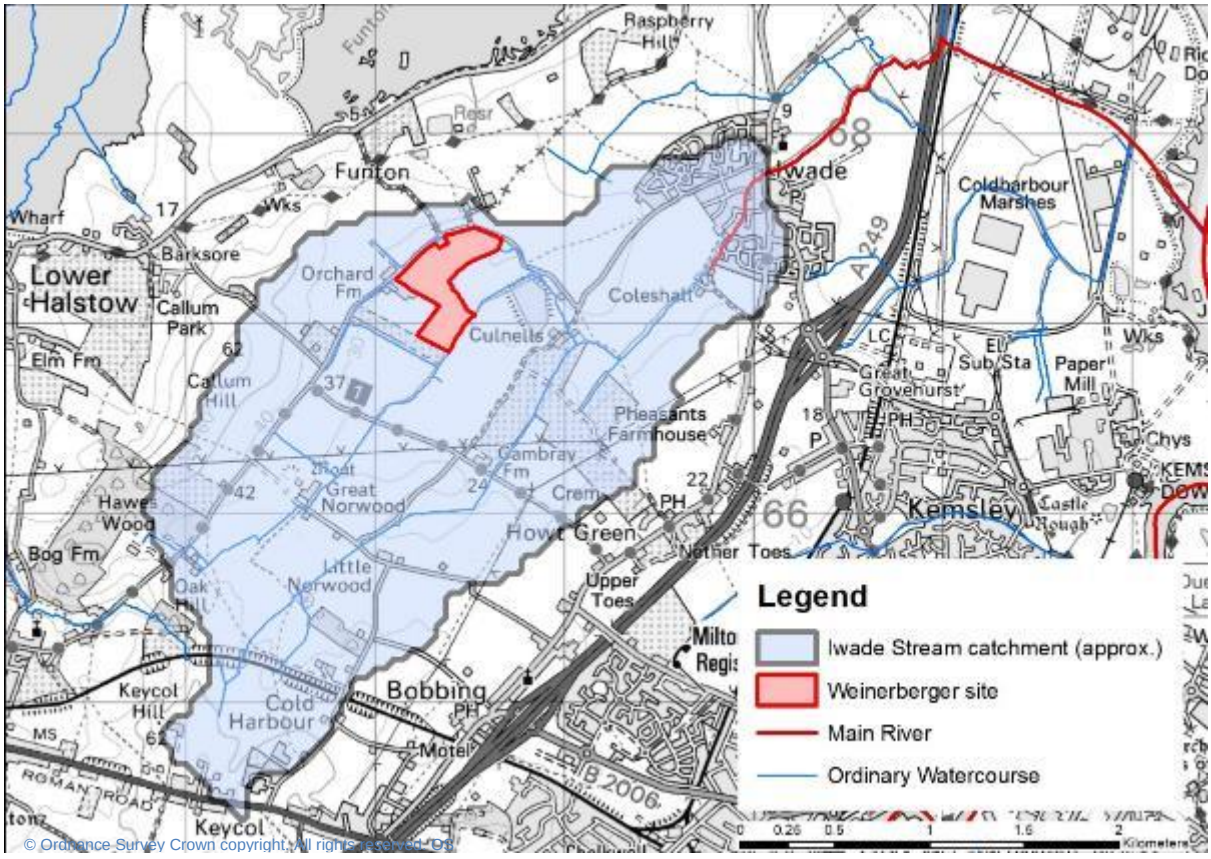

Figure 7 Map of the Iwade Stream catchment showing extent of Wienerberger site (Source: Flood Estimation Handbook Web Service)

The Wienerberger quarry is located to the west of Iwade near Orchard Farm. It is extracting brick earth from the 14.6 ha site. The operation is leaving brickearth on the surface, that is, the full depth of the brickearth is not being extracted from the quarry.

The works include a large lagoon to capture surface water run-off from the site and discharge it to the Iwade Stream. The primary purpose of the lagoon is to lower the flowrate of surface water run-off such that suspended solids can settle out into the lagoon and reduce sediment pollution of the watercourse. The lagoon has a maximum capacity of 3,950m^3.

The outlet pipe from the lagoon is 300mm in diameter. The outlet from the lagoon is controlled by a gate valve that in front of the outlet pipe. The size of the outlet pipe was chosen such that the flow out of the lagoon cannot exceed the 1 in 100-year greenfield run-off rate[3] irrespective of the position of the gate valve. If the valve was fully opened, it would take over 9 hours for the lagoon to drain down from full due to the size of the pipe. From this it can be seen that run-off the site in itself is unlikely to contribute to flash flooding downstream.

The quarry represents less than 3% of the total catchment of the Iwade Stream.. Even if the lagoon was not present, due to the small area of the site relative to the catchment area, increased runoff from the site would not explain the high flows in the stream on its own.

Changing land management can increase the amount of runoff from a site, however large increases would only be experienced on a site that changed from greenfield to one covered with impermeable surfacing (for example buildings and roads), whereas the quarry still has soil on its surface and any increase in runoff rate from the pre-development condition is reduced compared with other development.

As part of this investigation Kent County Council has spoken to adjacent landowners to the brickearth quarry to understand the impacts of flooding immediately downstream. The tenant farmers for the land surrounding the quarry site were able to confirm that clearance work to the ditch and land drains was carried out in Spring 2018 prior to the flood event. The location of clearance work shown in Figure 8. This clearance work concurs with reports that the channel contained no vegetation at the time of flooding. The subsequent hot dry weather experienced in the summer of 2018 is likely to have prevented significant weed growth after this weed clearance.

[3] Greenfield runoff is the flow from a site as it would be if it was not developed.

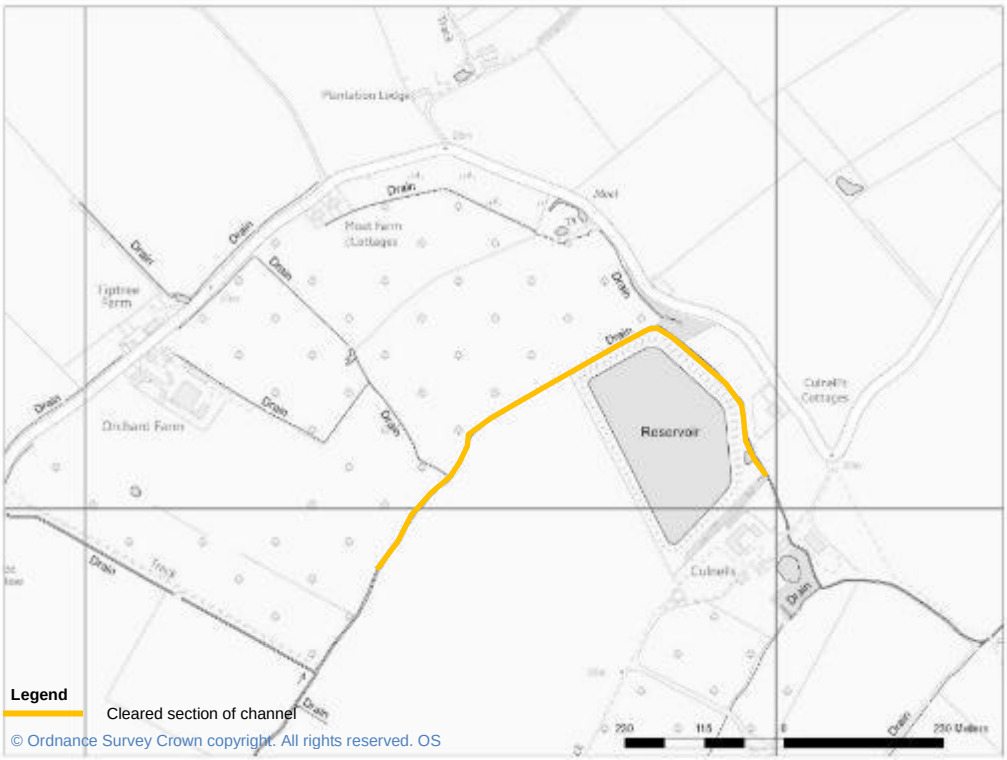

Figure 8 Location of clearance work along Iwade Stream

Downstream of the reservoir, approximately 735 metres from the quarry site is Culnells Farm, this complex consists of a number of small businesses, which reported that they experienced overland flooding from run-off from the fields and highway, however at this location there was no fluvial flooding, the flow in the Iwade Stream remained in bank at this location.

Surface Water flooding occurred on Meadow Brown View and Purple Emperor Grove, a relatively new development which is located on the south western edge of Iwade. Water from the adjacent field flowed in a north easterly direction and over a low bund which was designed to prevent water flowing onto the road. The volume of water that accumulated on the field overwhelmed the bund.

The cause of the flooding in Iwade is most likely to be the heavy rainfall that was experienced across Swale and Medway at the time leading to high flows in the Iwade Stream and surface water flooding. The operation of the Wienerberger quarry is not thought to be a factor.

3.2 Sittingbourne

3.2.1 Summary of event

In total 18 properties reported flooding during and after the event, the reports were from three areas in Sittingbourne, however flooding is likely to have occurred elsewhere within Sittingbourne that was not reported formally.

Kent Police closed Canterbury Road to prevent vehicles from exacerbating the flooding by creating bow waves. Swale Borough Council provided support and advice to flooded residents. KCC delivered Flood Sax to properties in Park Avenue and Viners Close.

Image 3 shows the flooding on Canterbury Road.

Image 3. Flooding at Snipeshill

3.2.2 Site Location, Topography and Flood Risk

The Snipeshill area sits around a dry valley in the local topography that forms near Highsted to the south and falls in a northeasterly direction towards the marshes at East Hall. This valley feature channels water to the low points in the area, at the green space near the Greenways and Canterbury Road, the southern corner of Woodberry Drive and the northern end of Coombe Drive.

Sittingbourne is predominantly drained by soakaways that collect surface water and discharge into the ground, there are areas of surface water sewers that also collect surface water and convey it towards The Swale.

A surface water sewer runs from Swantree Avenue to the green area at the Greenways and Canterbury road. The sewer collects water from Rectory Road, St John's Avenue, Middle Way and Greenways. It discharges into a series of soakaways and storage tanks under the green space there. The soakaways are connected to the combined sewer network through a controlled overflow, allowing the system to drain continuously if the soakaways are unable to drain the water that enters this system by themselves.

Coombe Drive has a fall of over 5m towards the lowest part of the road, the dead-end, at this point two soakaways drain the surface water.

The updated Flood Map for Surface Water (uFMfSW), shown in Figure 9, is published on the Environment Agency website and provides information on areas considered risk of flooding due to surface water. The public surface water sewers are also shown in Figure 9.

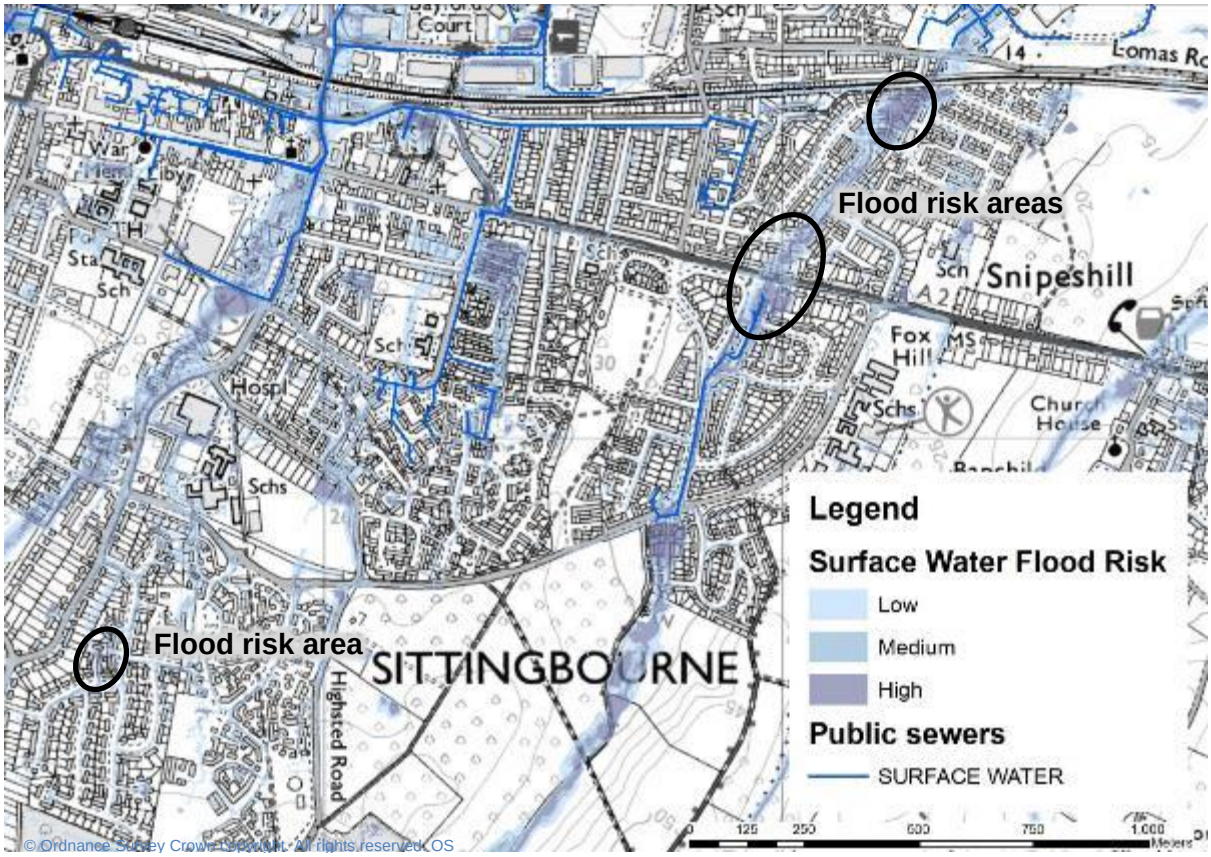

Figure 9 Surface Water Flood Map showing flood risk at Snipeshill

The end of Viners Close lies 1m below the junction with The Fairway, surface water naturally drains to the lower end of the road where there are soakways to drain the water.

In Chalkwell and Key Street, between the A2 and the railway line, there is a broad low-lying area that is the lower end of a relatively large dry valley feature that follows the route of the A249 before it reaches the marshes of the coastal plain around Milton Regis. The natural topography of the landscape is affected by the excavation for the A249 as it passes under the Key Street roundabout, as a consequence this low-lying area is not hydraulically connected to the rest of the valley feature so will not be at risk of flows from the A249 and upstream (except in very extreme circumstances that can fill the depression created by the A249 under the roundabout). However, the area remains susceptible to surface water flooding from runoff that falls in the vicinity.

To the south of the A2 in Chalkwell and Key Street the slope of the land is slightly steeper, but there are localised low points on the roads. The Chalkwell and Key Street area is predominantly drained by soakaways.

The updated Flood Map for Surface Water (uFMfSW), shown in Figure 10 for the Chalkwell and Key Street area, is published on the Environment Agency website and provides information on areas considered risk of flooding from surface water. The public surface water sewers are also shown in Figure 10.

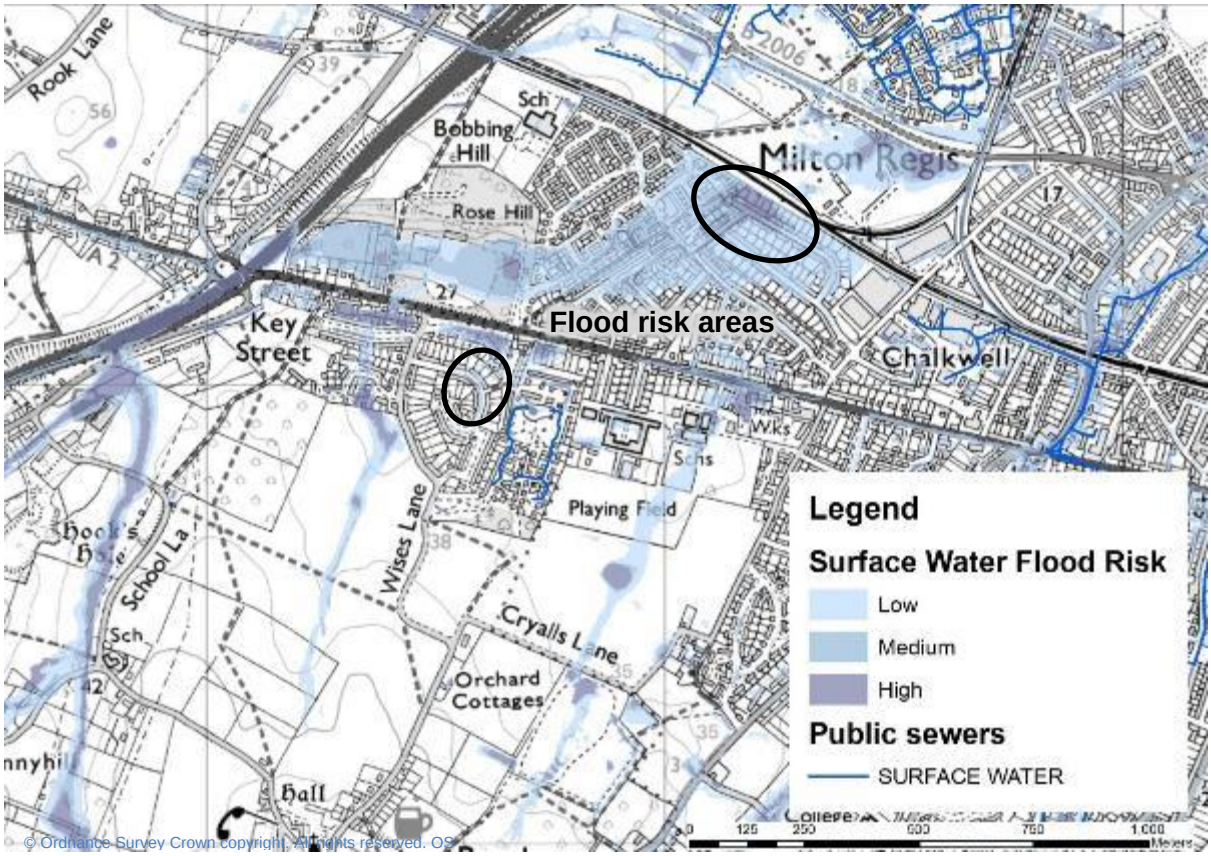

Figure 10 Surface Water Flood Map showing flood risk in the Chalkwell and Key Street area

3.2.3 Flood History

Flooding has been reported to KCC on previous occasions in Sittingbourne in November 2009, January 2011, January 2014, March 2014, May 2018 and August 2018. On these occasions the flooding has been the result of blocked drains resulting in the road flooding and entering properties, which sit at a lower level than the road, rather than the capacity of the drainage system being overwhelmed

3.2.4 Flooding Mechanism

The main cause of the flooding was the intensive rainfall which exceeded the capacity of drainage systems in the area. The urban areas within Sittingbourne are drained by soakaways which quickly became filled by the intense rainfall that was experienced. Once the capacity of the drainage was exceeded,runoff collected in topographical low points.

At Canterbury Road the soakaways located underneath the green adjacent to the Greenways have reached the end of their design life, of approximately 50 years, and no longer operate to their original design standard. Water entering the system instead is able to be drawn downvia the overflow into the public sewer system, which is remains fully functional. However the intensity of rainfall in this event filled this system beyond its storage capacity, which led to above ground flooding occurring across the green.

3.3 Doddington

Flooding occurred on The Street within Doddington as water flowed down Old Lenham Road, resulting in 8 properties experiencing internal flooding. The highway was inundated by

surface water and vehicles driving through the flood water may have caused a bow wave effect which led to additional damage to property.

On the 29 May KCC received two reports of highway flooding, with a further 12 reports received in the following days. Kent County Council could not provide an immediate response for Doddington due to the severity of flooding reports from across the county - priority had to be given to the most severe risks and to maintain highway safety on the strategic road network..

3.3.1 Site Location, Topography and Flood Risk

Doddington village is located to the south east of Sittingbourne. The village sits at the bottom of a steep dry valley and the topography naturally drains towards the village. The Faversham Road is the main route into the village from the west, at the edge of the village Faversham Road meets Ringlestone Stone and the two join to become The Street. The Faversham Road is relatively steep with a 1:20 gradient. Old Lenham Road runs parallel to the Faversham Road to the south-eastern side of the hill. Old Lenham Road runs along the base of the dry valley, with the land either side Falling towards the road and the road also falling in a north-easterly direction.

Hopes Hill and Chequers Hill join Faversham Road at the centre of the village. Hope Hill to the south has a gentle gradient, whilst the Chequers Hill to the north slopes steeply into the village. Church Hill enters the village on the eastern side and cuts down the northern slope of the valley and like Chequers Hill is slopes steeply into the village.

The topography of the land around Doddington means that water that is not absorbed by the ground will flow towards the village. The updated Flood Map for Surface Water (uFMfSW) shown in Figure 10 is published on the Environment Agency website, it shows The Street to be at high risk of surface water flooding.

The majority of the properties within the village are set-back from the road and have either a front garden or driveway, with the exception of a small number of older buildings which are set against the pavement.

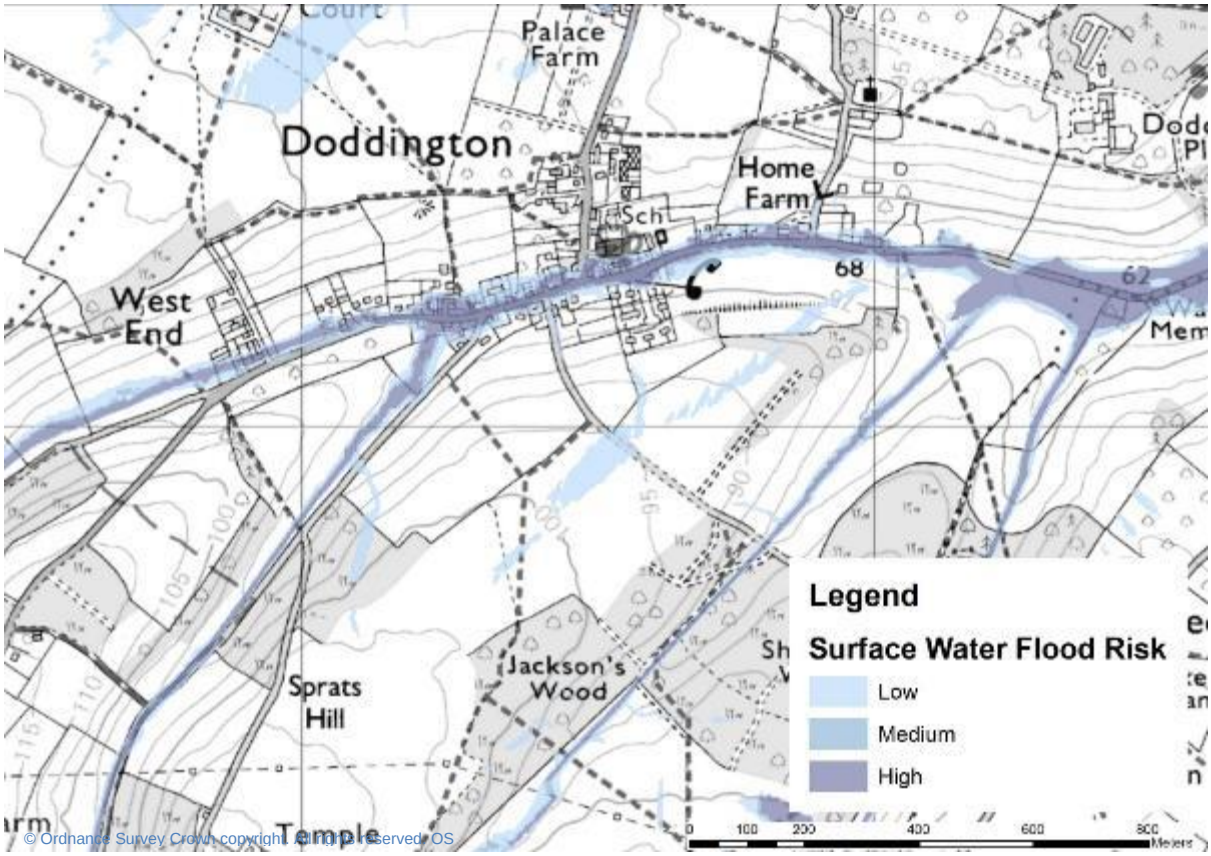

Figure 11 Surface Water Flood Map showing flood risk at Doddington

3.3.2 Flooding History

The Parish Council have reported that the last known flooding incident was in 1993 but have raised concerns about flood risk more recently as a result of blocked drains.

3.3.3 Flooding Mechanism

The prolonged period and intensity of rainfall is likely to have saturated the ground increasing the rate of run-off from the surrounding fields onto the roads which quickly funnelled the water downhill into the village and onto The Street.

The intensity and volume of rainfall far exceeded the capacity of the highway drainage systems. Blocked drains have since been reported to KCC. Highway drainage is generally designed to an operational standard of 1 in 5-years, therefore it is likely that these drains would have been overwhelmed..

3.4 Lynsted

Flooding affected five properties on the Street in Lynsted on 29 May as a result of surface water and foul water entering the properties.

3.4.1 Site, Topography and Flood Risk

The village of Lynsted sits on the northern side of the North Downs, the topography generally slopes down from the south to the north, though local topography creates two dry valleys that meet within Lynsted. At The Street between the junctions with Ludgate Road and The Valance is a broad flat area that forms part of one of these dry valleys, this low area is approximately 80 cm lower than either junction at its lowest.

Three of the properties that flooded have thresholds level with the pavement and the other 2 properties have basements with windows which are below pavement level. A Southern Water pumping station is also located at this low point. The pumping station serves the foul sewer in the village, pumping the sewage from this low point in the village to the sewer main to the north.

The updated Flood Map for Surface Water (uFMfSW) shown in Figure 11 is published on the Environment Agency website, shows that the that this area is at high risk of flooding from surface water. The flow pathways come from the higher area to the west and collects within this low-lying area.

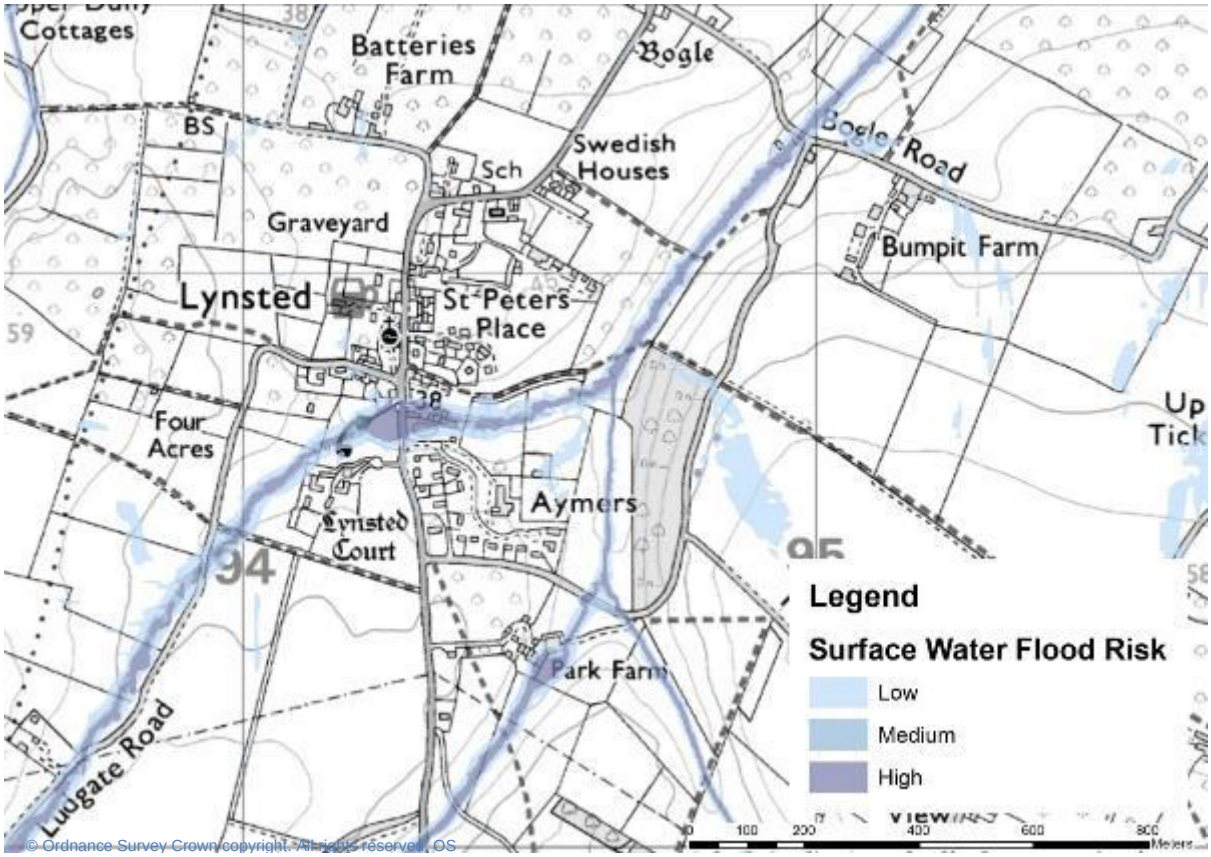

Figure 12 Surface Water Flood Map showing flood risk at Lynsted

3.4.2 Flooding Mechanism

The intensity of the storm will have caused significant run-off from the surrounding fields as experienced elsewhere, this is likely to have caused water to build up quickly within the depression on The Street. The highway drainage system discharges to a near-by pond, this reached capacity and over-topped causing the highway to flood.

The Southern Water pumping station is located within depression by The Street and was infiltrated by the surface water run-off from the surrounding area, which caused the pump to loss power. As a result, the foul sewers that the pump serves began to overflow and contributed to the flooding.

KCC held a meeting with local residents, where they reported that they believe a relatively new development in the village is overloading the foul sewer and during periods of heavy rain the foul sewer overflows, indicating that the surface water may be entering the system.

3.5 Newington

Flooding affected 13 properties as a result of surface water run-off and highway flooding, including sink holes forming on the High Street and Playstool Road.

3.5.1 Site, Topography and Flood Risk

The village of Newington is situated on the north side of the North Downs on the A2. It is surrounded by smalls peaks to the south (Standard Hill), northwest (Mill Hill) and north east (Keycol Hill). The catchment upstream is relatively small and only drains the area from Standard Hill. On the northern edge of the village is the railway line with the A2 High Street road running through the centre of the oldest part of the village and newer development to the south.

Newington's highway system is drained solely by soakaways with no connections to surface water sewers and no combined sewers present within the village.

The updated Flood Map for Surface Water (uFMfSW) shown in Figure 13 is published on the Environment Agency website shows the area is generally at low risk of surface water flooding, though there are areas with higher risk.

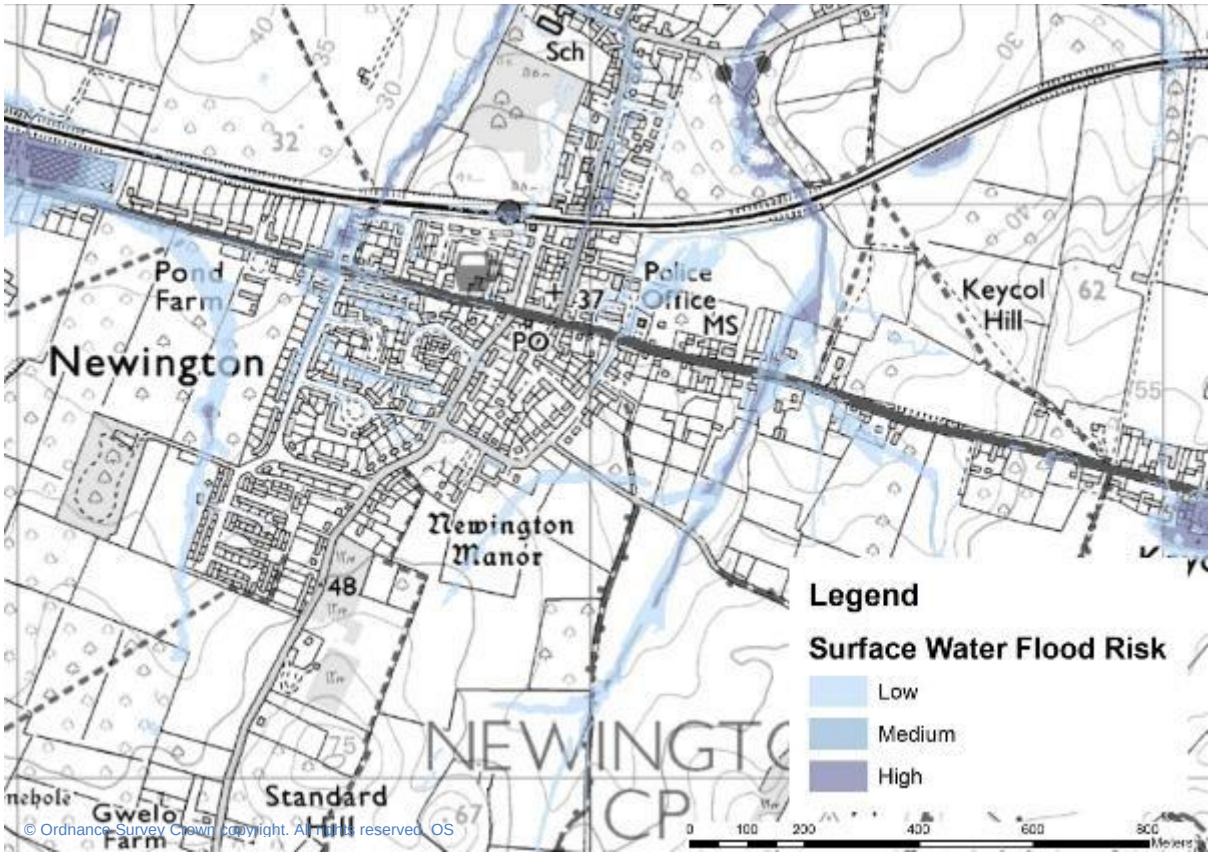

Figure 13 Surface Water Flood Map showing flood risk at Newington

Bull Lane, to the south of Newington, is situated amongst farmland, which drains towards the road. The land has recently changed from orchards to arable crops.

3.5.2 Flooding Mechanism

Flooding was reported to have quickly accumulated on the highway within the topographical low points in Newington. As the surface water flooding from the surrounding areas collected,

the highway drainage become inundated and exceeded capacity resulting in the water reaching sufficient depths to enter property.

On Bull Lane, overland flows from surrounding agricultural land flowed onto the highway, it then flowed along the road and entered the driveways of properties.

3.6 Teynham

Flooding in Teynham is reported to have affected a total of 13 properties, nine within the village of Teynham and a further three properties across the parish. KCC delivered Flood Sax to properties in the Lower Road.

3.6.1 Site, Topography and Flood Risk

Teynham is relatively flat, lying further north in the borough of Swale on the edge of the north Kent marshes. Whilst this means that it does not suffer from large flows from upstream that cause flooding, it does mean that water may not drain away quickly and can accumulate in low points, such as those on the A2 by the junction with Frognal Lane, Lower Road near Harry's Road and the roads to the south of this, including Honeyball Walk.

The updated Flood Map for Surface Water (uFMfSW) shown in Figure 14 is published on the Environment Agency website shows that a number of the areas affected by flooding have a high risk of surface water flooding, however, a number of areas have a no or low risk of surface water flooding suggesting that the flooding experienced was the result of the intensity of the rainfall and the inability for surface water to drain away quickly enough.

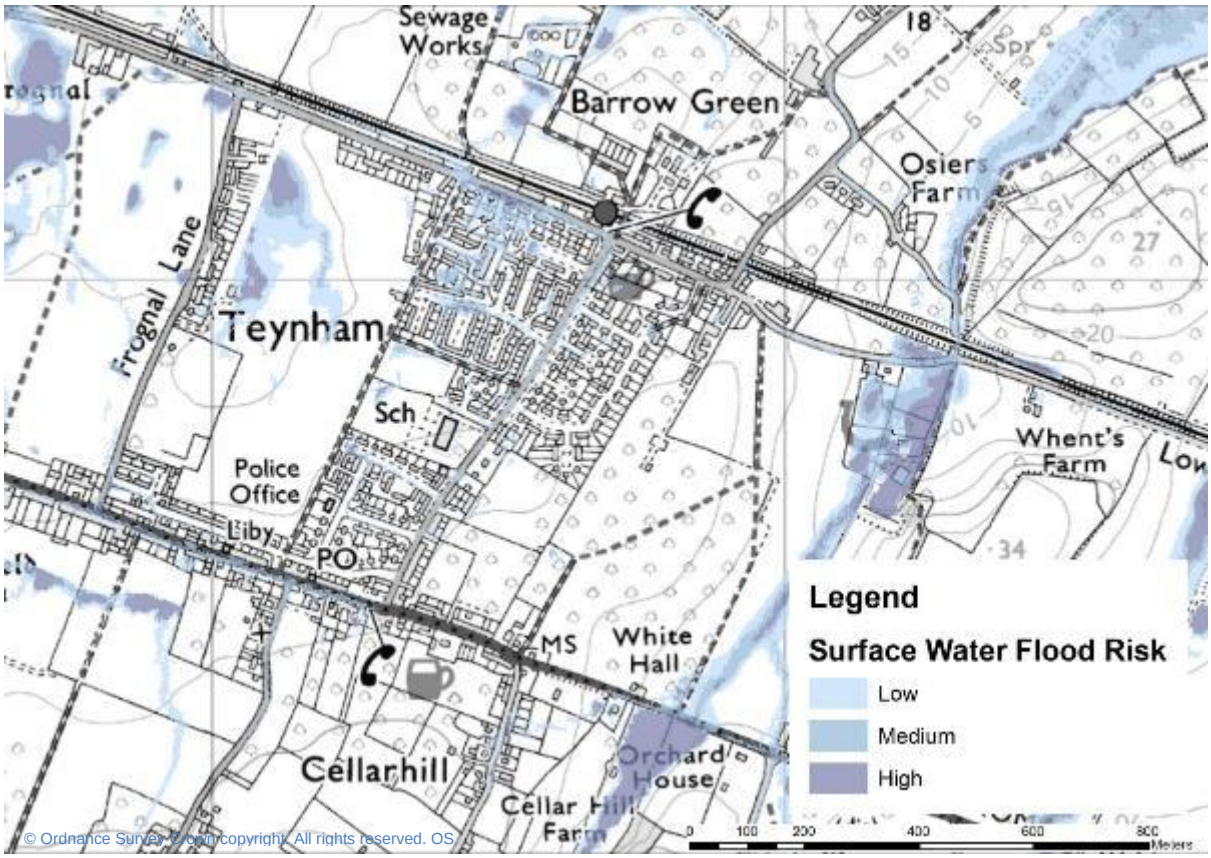

Figure 14 Surface Water Flood Map showing areas at risk within Teynham

3.6.2 Flood mechanism

Flooding was reported to have quickly accumulated on the highway within the topographical low points. As the surface water flooding from the surrounding areas collected, the highway drainage become inundated and exceeded capacity resulting in the water reaching sufficient depths to enter property. The highway drain in this location is partially blocked, which reduced its capacity.

Bow waves contributed to the issue of internal property flooding as vehicles drove through the flood water on the highway. On the Lower Road in Teynham at least one vehicle became stranded as a result of attempting to drive through the flood water.

Image 3. Flooding on the Lower Road, Teynham

The highway drains in this area on the Lower Road drain via into a culvert that runs tothe north under the railway line. This culvert is known to be partially blocked. This blockage may have contributed to the flooding in this location.

3.7 A249

The A249 to the south of the Stockbury roundabout had to be closed on 29 May from 15:30 until the following day. One property was flooded at this location and a number of cars had to be abandoned in the flood waters.

3.7.1 Summary of the event

Flood water began flowing onto the highway at around 11:30 on 29 May 2018, most of this water is likely to have been the result of run-off from the adjacent land. By 12:00 surface water flooding near the Stockbury roundabout had begun to occur and by 15:30 the road was closed due to severe flooding, the road remained closed until the following day.

Image 4. Flooding on the A28 (Source KentOnline)

As a result of the flooding a number of vehicles became stranded on the A249 and within Petts Lane and Kent Fire and Rescue Services were deployed to assist passengers trapped within vehicles.

One property in the immediate vicinity of the A249 was affected by flooding, this property lies at the topographical low point and is highlighted on the Surface water flood map as being at high risk of flooding.

3.7.2 Site, Topography and Flood Risk

The A249 follows the bottom of a dry valley feature that falls in a northeasterly direction from the top of Delting Hill to the Stockbury roundabout (the Maidstone Road continues to follow this valley feature to Key Street, but the new northern section of the A249 from the Stockbury roundabout now follows a new path at a slightly higher level).

The catchment for this dry valley is a large area to the east of the A249, where smaller dry valley features feature in areas around Bicknor and Hucking. These valley features fall in a northly direction and meet the A249 valley feature between Detling Hill and Stockbury. The valley feature flattens to the south of the Stockbury roundabout at the junction between the A249 and Oad Street.

There are no surface water sewers on the A249 or in the vicinity. The A249 is drained by lateral collector drains that run along the edge or centre of carriageway and highway gullies to collect the surface water from the road surface itself. These direct it into soakaways and infiltration ponds that discharge the water into the ground.

The updated Flood Map for Surface Water (uFMfSW), shown in Figure 15, is published on the Environment Agency website, it shows that the Stockbury roundabout at the junction of the A249 and the M2 is at high risk of flooding from surface water. It also shows the flow paths from the land to the east of the A249 that join it.

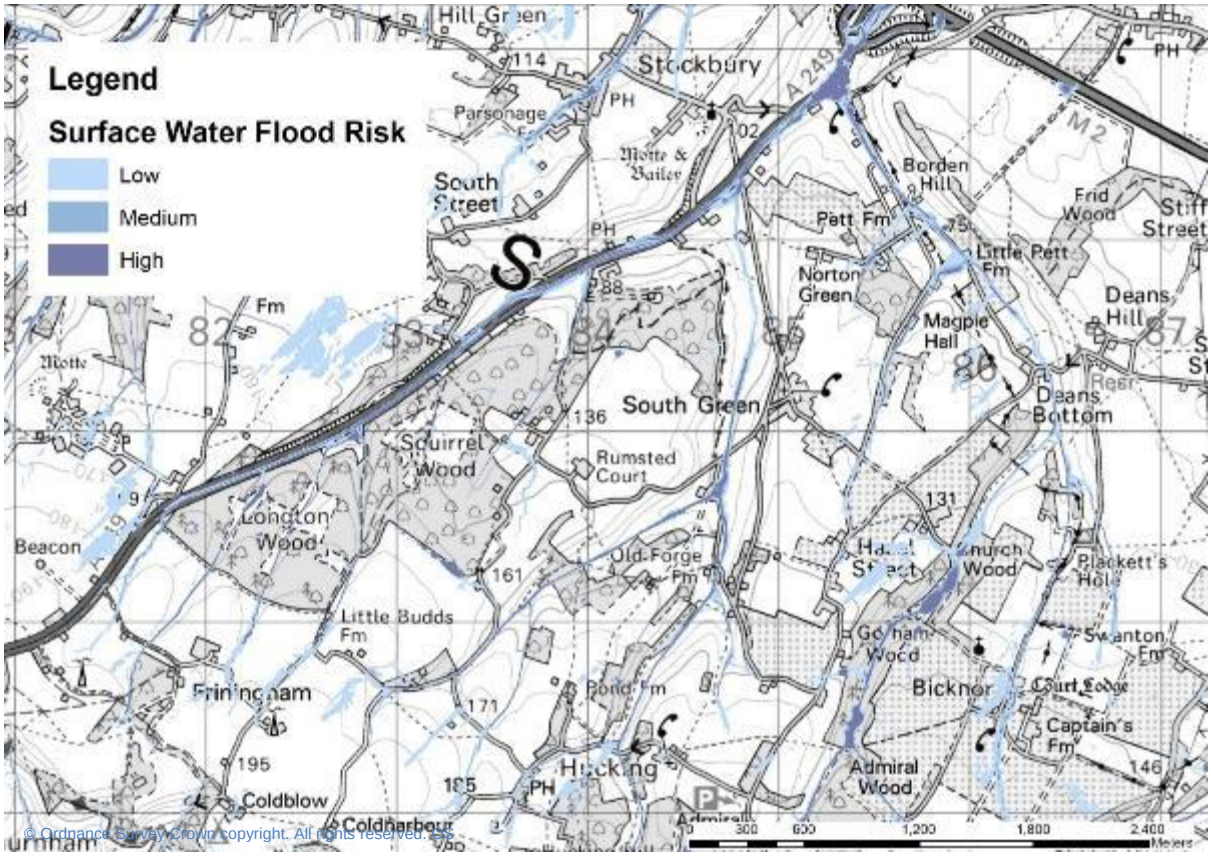

Figure 15 Surface Water Flood Map showing risk of flooding at the Stockbury Roundabout

3.7.3 Flood mechanism

The intense rainfall that fell on 29 May 2019 led to rapid runoff from the surrounding land. The flows that were generated by this rainfall accumulated on the A249 and overwhelmed the drainage infrastructure. This led to deep ponding at the lowest points, particularly the area around the junction between the A249 and Oad Street.

3.8 Localised incidents of flooding

Intensive rainfall was experienced across much of north Kent, resulting in individual or small-scale incidents of flooding occurring at a large number of locations. Areas affected included, Borden, Tunstall, Faversham, Bapchild, Bredgar, Oare and Stalisfield Green. The flooding was largely due to the intensity of the rainfall that fell, which was unable to infiltrate and caused surface run-off and highways acting as conduits to channel water into topographical low points where it was unable to drain or overwhelmed the drainage systems within these areas. Below is a summary of the areas affected and the cause of the flooding experienced.

3.8.1 Bapchild

Three properties on The Street were affected by flooding, the surface water flood map indicates that a dry valley to the south west of the village would have contributed to water collecting on The Street. The low level of thresholds of the properties resulted in water becoming deep enough to overtop the threshold and bow waves from vehicles passing through flood water further exacerbated flooding at the properties.

The highway gullies near the Fox and Goose public house discharge into the watercourse at the rear of the pub. This watercourse is overgrown and in need of maintenance, which contributed to the build up of water on this part of The Street.

The other part of The Street is drained by soakaways which were overwhelmed by the volume of water.

3.8.2 Bredgar

Two properties flooded within Bredgar, these were affected by rural run-off, which entered the drainage system which runs to a ditch which became overwhelmed. The village overflowed increasing the volume of water which had to be managed by the drainage system. Rural run-off from surrounding fields caused drains to become blocked with debris. KCC Highways is continuing to investigate flooding within the area.

Rural run-off from surrounding farmland flowed onto the highway at Vigo Lane, which acted as a conduit for the flood waters and led to property flooding.

Two properties on Swanton Street experienced flooding, rural run-off drains towards the junction of Swanton Street and Blind Marys Lane where it collects at the topographical low point. The local soakaway became overwhelmed by water from the highway and run off from local fields.

3.8.3 Faversham

A property on Preston Avenue was flooded due to the volume of water overwhelming the local drainage systems.

On Priory Road, runoff from the surrounding area is believed to have concentrated in the garden of a property that led to flooding.

The commercial property on Ospringe Street is suspected to have been flooded from an overloaded surface water sewer. Southern Water is still investigating this. This property has flooded previously.

Another commercial property on East Street flooding when roof drainage could not discharge properly due to a suspected blockage in the pipe.

3.8.4 Tunstall

One property flooded within Tunstall which is a predominantly rural area, the highway drains to soakaways and a pond, which were overwhelmed by the volume of rainfall that fell. The volume of water on the highway increased due to blocked drains in the wider locality and run off from local fields. The flooded property is located at a topographical low point that is at high risk of surface water flooding.

3.8.5 Oare

One property flooded on The Street, Oare, the property is situated at a low point in the road. The volume of water in this event overwhelmed the highway drainage and runoff collected at the low point, which led to property flooding.

3.8.6 Stalisfield Green

One property flooded on Green Lane, Stalisfield Green. Green Lane is a local low point in Stalisfield where runoff from land in the area is likely to collect. There are no drains on the

highway to collect the water. In this event the intensity of the rainfall will have cause significant runoff from the surrounding area that collected on Green Lane and rose to a level to flood the property. KCC provided Flood Sax to the property.

4 Further works

4.1 Highway maintenance

The following maintenance work has been undertaken on highway drainage assets in the Swale area since the flooding in May.

Location	Details of work	Date attended
Iwade		
Springvale	Gully outside No.34 cleansed, free flowing.	21/06/2018
Sittingbourne		
Anatase Close	All gullies from 20-29 cleansed, all free flowing.	10/07/2018
Avenue of Remembrance	Gullies at junction with Bell Road cleansed, no issues reported.	03/12/2018
Bell Road	Gullies between Bell Road and Stanhope Junction cleansed, all free flowing.	05/11/2018
Bell Road	Gullies just past junction with Highsted Road cleansed, all free flowing.	03/12/2018
Burnup Bank	Gullies cleansed, all free flowing.	09/07/2018
Brier Road	Gullies cleansed and free flowing	06/06/2018
Brier Road	Gullies cleansed and free flowing	09/01/2019
Canterbury Road	Soakaways cleansed	22/11/2018
Charlotte Street	Gullies outside 40 cleansed, all free flowing.	18/07/2018
Chegworth Gardens	Gullies cleansed, all free flowing.	09/07/2018
Coombe Drive	Gullies cleansed from Lansdown Road, all free flowing.	19/06/2018
Coombe Drive	Gully outside 58/60 cleansed, free flowing.	17/10/2018
Elm Grove	Gullies cleansed, all free flowing.	19/06/2018
Farm Crescent	Gullies outside 3 cleansed, all free flowing.	19/06/2018
Galena Close	Gullies cleansed, all free flowing.	19/06/2018
Gayhurst Drive	Gullies cleansed, all free flowing, soakaways look clear.	25/06/2018
Godwin Close	Gullies cleansed, all free flowing.	10/07/2018
Godwin Close	Gullies cleansed outside 24/13, soakaway needs cleansing and roots removed.	10/08/2018
Gorse Road	Gullies cleansed, all free flowing.	10/07/2018
High Street	Gullies cleansed, all free flowing.	09/08/2018
Hugh Price Close	Gullies opposite 57 cleansed, all free flowing.	10/07/2018
Lansdown Road	Gully cleansed opposite No. 15, all free flowing.	06/06/2018
Lansdown Road	Gullies cleansed, all free flowing. One jammed lid.	26/06/2018
Lime Grove	Gullies cleansed, all free flowing.	10/07/2018
London Road	All gullies between Staplehurst Road and Sandford Road cleansed, all free flowing.	05/06/2018
Monarch Drive	Gullies outside 51 cleansed, free flowing.	29/08/2018
Olivine Close	Gullies cleansed, all free flowing.	18/07/2018
Park Drive	Gullies cleansed, all free flowing.	06/08/2018
Prince Charles Avenue	Gullies cleansed, all free flowing.	12/09/2018

Roman Square	Gullies outside job centre cleansed, all free flowing.	29/08/2018
Roman Square	Gullies cleansed, all free flowing.	26/11/2018
Roseleigh Road	Gullies cleansed, all free flowing.	15/08/2018
St Pauls Street	Gully next to The Stumble Inn cleansed, free flowing.	06/09/2018
Swan Close	Gully outside No.1 Swan Close cleansed, free flowing.	18/07/2018
Terrace Road	Gullies cleansed, all free flowing.	20/12/2018
The Fieldings	Gullies outside No.3 cleansed, all free flowing.	18/07/2018
The Wall	Gully cleansed behind Pizza Hut, free flowing.	29/08/2018
Doddington		
Old Lenham Road	Gullies on whole road cleansed, free flowing.	25/07/2018
Lady Margaret Manor Road	Gullies on Spratts Hill, cleansed, free flowing but a soakaway needs cleansing.	25/07/2018
The Street	Gullies cleansed, all free flowing.	17/09/2018
Old Lenham Road	Gullies from Ringlestone Road to Old Lenham Road cleansed, free flowing.	18/09/2018
The Street	Gullies opposite Doddington Service Station cleansed, free flowing	25/01/2019
The Street	Gullies cleansed, all free flowing.	01/08/2018
A249		
	Gullies cleansed from Oad street to Vale Cottages, all free flowing.	26/06/2018
Lynstead		
Lynsted Lane	Gullies cleansed, all free flowing.	16/10/2018
Lynsted Lane	Gully outside and opposite Pond Cottage cleansed, free flowing.	14/12/2018
Lynsted Lane	Gullies close to London Road junction cleansed, all free flowing.	20/12/2018
The Street	Gully cleansed, all free flowing.	15/06/2018
The Vallance	Gullies cleansed, all free flowing.	22/06/2018
Newington		
Bull Lane	Gullies cleansed, all free flowing.	11/12/2018
High Street	Gullies between 104 and 106 cleansed, free flowing.	16/01/2018
Orchard Drive	Gullies outside No.6 cleansed, all free flowing.	07/11/2018
Faversham Road	Gullies cleansed, all free flowing.	02/07/2018
Faversham Road	Gullies around Whitehall Farm cleansed, all free flowing.	14/08/2018
The Willows	Gullies inspected, all free flowing	30/05/2018
Teynham		
Conyer Road	Gullies cleansed between Stone Chimney Farm and Banks Farm, all free flowing.	11/07/2018
Conyer Road	Gullies cleansed, all free flowing.	06/09/2018
Harrys Road	Gullies cleansed, all free flowing.	11/07/2018
London Road	Gullies cleansed outside The George Pub, all free flowing	10/08/2018

London Road	Gullies cleansed, all free flowing.	24/09/2018
London Road	Gully outside 129F cleansed, free flowing.	12/12/2018
Roper Road	Gullies cleanse, all free flowing. 1 gully had parked car.	06/09/2018
Roundel Close	Gully cleansed, free flowing.	12/10/2018
Station Road	Gullies cleansed between Lower Road to London Road, all free flowing.	19/12/2018
Borden		
Munsgore Lane	Gullies inspected, all free flowing	12/06/2018
Faversham		
Graveney Road	Gullies cleansed, all free flowing.	20/08/2018
Kingsnorth Road	All gullies cleansed, all free flowing.	25/06/2018
Mount Field	Gullies cleansed, no issues reported.	03/07/2018
Oare Road	Gullies cleansed, CCTV required.	28/06/2018
Ospringe Street	Gully outside The Ship Inn cleansed, requires CCTV	07/12/2018
Preston Street	Gullies cleansed, all free flowing. One jammed lid.	08/06/2018
Seager Road	Gullies cleansed at junction with Oare Road, free flowing.	28/06/2018
South Road	Gullies cleansed, catch pits require cleansing.	07/12/2018
Tanners Street	Gullies cleansed, all free flowing. One parked car over gully.	03/07/2018
Upper St Anns Road	Gullies cleansed, all free flowing.	04/12/2018
Whitstable Road	Gullies cleansed, all free flowing.	17/08/2018
Bapchild		
The Street	Gullies cleansed all free flowing.	10/10/2018
Panteny Lane	Gullies near NSL signs cleansed.	14/11/2018
Bredgar		
Gore Road	Gullies cleansed outside Bush House, all free flowing.	22/06/2018
Oad Street	Gully cleansed, free flowing.	10/08/2018
Silver Street	Gullies cleansed outside Holly Cottage, all free flowing.	02/07/2018
Gore Road	Ditch cleared.	08/08/2018
The Street	Gully cleansed, free flowing.	19/09/2018
Vigo Lane	Gullies outside Vigo farm cleansed, all free flowing.	28/09/2018
Swanton Street	Gullies cleansed and free flowing.	06/08/2018
Swanton Street	Soakaway cleansed.	03/12/2018

Please note that repeat visits to the same road are often due to parked cars or other obstructions preventing gully cleansing on the first visit.

KCC's highway drainage maintenance policy is that roadside drains on main roads, are cleaned annually, drains on minor roads are attended on a targeted basis in response to reports of blockages or flooding. To report flooding please use the highway fault reporting tool, found here:

http://webapps.kent.gov.uk/KCC.KHSFaultsGIS.Web.Sites.Public/ReportAFault.aspx, or call 03000 41 81 81 (0300 41 91 91 for out of hours reports).

4.2 Iwade

Following the flooding, KCC found that a flow gauge has not been installed on the outfall from the Wienerberger site, which was a requirement of the planning permission. KCC, who is the planning authority in this instance, has raised with the site operators and a flow gauge was installed in October 2018.

KCC also investigated the flooding at Meadow Brown View and have found that the developer has failed to discharge a planning condition for the installation of a drainage channel to intercept overland flow from the adjacent fields. The breach of the planning permission has been passed to Swale Borough Council as the Local Planning Authority.

KCC is working with the National Flood Forum (NFF)to establish and support Flood Action Groups (FAGs) in flood vulnerable communities. The NFF have worked with the residents of Iwade to establish a FAG there who will work with the risk management authorities in Kent to understand the flood risks and to identify feasible measures to mitigate the risks.

4.3 Sittingbourne

Following the flooding, KCC have carried out an inspection of the drainage system at Canterbury Road and undertaken cleansing to remove silt build up. These investigations shave shown that the soakaways that drain this system are no longer fully operational and need to be refurbished. KCC is liaising with contractors to undertake this work.

KCC will also investigate options for further managing surface water flooding within the greenspace at Snipeshill to reduce flood risk further.

4.4 Teynham

Network Rail are aware that the culvert under the railway line near the Lower Road is in need of repair.

4.5 Doddington

Kent County Council and the River Stour Countryside Management Partnership will work with the community and landowners of Doddington to explore options for using Natural flood management (NFM) to manage run-off. NFM is the alteration, restoration or use of landscape features, to manage flood risk. It is typically used in small and steep catchments, where slowing run-off is key to reducing flood risk to downstream communities.

A community workshop has been held to understand the key issues and identify opportunities for projects using local knowledge. Feasible options will be taken forward subject to the willingness to deliver measures and the availability of appropriate resources

4.6 Lynsted

Southern Water will investigate options to reduce the risk of flooding to the pumping station at Lynsted.

KCC and the River Stour Countryside Management Partnership will work with the community and landowners in Lynsted to explore options for using Natural flood management (NFM) to manage run-off. NFM is the alteration, restoration or use of landscape features, to manage

flood risk. It is typically used in small and steep catchments, where slowing run-off is key to reducing flood risk to downstream communities

4.7 Bapchild

The owner of the watercourse at the rear of the Fox and Goose public house has recently changed and the details have yet to be updated. Once they are know they will be asked to undertake maintenance of the watercourse.

4.8 Tunstall

KCC will carry out a drainage improvement scheme at the junction of Tunstall Road and Woodstock Road to reduce the flow of water onto Tunstall Road. They will also carry out localised improvements to the drainage system at the low point on the road. Further gully cleansing will be carried out following these works.

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5 Conclusions and Recommendations

The flooding that occurred on 29 May 2018 across Swale was the result of an intensive rainstorm when between 50 mm and 75 mm of rain fell over approximately a three-hour period. The extremity of the storm varied across the area affected, from 1 in 55 years in Sittingbourne to over 1 in 115 years at Doddington.

The intense rainfall led to rapid run-off which overwhelmed the local drainage and watercourses leading to flooding of properties and highways. Storms of this severity are likely to overwhelm drainage which is not designed for rainfall of this intensity.

The event that occurred on 29 May 2018 was very severe and it is unlikely flooding from a similar event could be prevented entirely. However, there may be measures that can be undertaken that could reduce the severity of the flooding and mitigate flooding from smaller rain storms to reduce the risk to communities.

Some of the opportunities that have been identified as part of this investigation are outlined below:

1. The Environment Agency in partnership with KCC and the local community will explore the opportunity for flood risk management in Iwade.

2. KCC will explore the options for improving the surface water drainage around Canterbury Road and the Greenways, Sittingbourne.

3. KCC and the Countryside Management Partnerships will work with the local community and local landowners within the Doddington and Lynsted to explore opportunities for natural flood management to intercept over land flows.

4. KCC will investigate defects in the highway drainage network.

5. Residents should continue to report blocked highways gullies and defects via the Kent County Council website (http://webapps.kent.gov.uk/KCC.KHSFaultsGIS.Web.Sites.Public/ReportAFault.aspx)

6. Southern Water will investigate options for protection of the pumping station at Lynsted.