SUTTON – BOROUGH WIDE (2017)

FLOOD RISK INVESTIGATION

PREPARED FOR LONDON BOROUGH OF SUTTON

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EXECUTIVE SUMMARY

This borough wide flood risk investigation was triggered due to the significant flooding that took place on the 2nd June 2017 which resulted in 28 sites experiencing flooding, with 22 of those sites experiencing internal property flooding or flooding within the curtilage of the property. A Section 19 investigation was carried out in response to the flood event.

The data collection and investigation exercises established that the sites were potentially at risk from surface water flooding, sewer flooding, and groundwater flooding to a lesser extent. To better understand the potential causes of flooding at a borough wide scale, the hydrological catchment areas were defined. Based on a review of the wider catchment area, six catchments were defined for the 28 sites that reported flooded during the June 2017 event. In order to define the high risk areas, the flood mechanisms within the six hydrological catchments were reviewed. Based on this review the sites were grouped into six hotspot areas. Each hotspot represents a localised area or group of properties that lie at a topographical low point within a catchment area. This means that during a heavy rainfall event, surface water will naturally drain towards these areas. This may lead to excess ponding along roads within each hotspot as the local sewer network may not have enough capacity to manage excess surface water.

The flood risk at the sites were exacerbated due to several factors, including changes in topography and potentially poor maintenance of existing sewer assets. The Risk Management Authorities (RMAs) who are responsible for managing the potential risks posed by flooding to the sites are the London Borough of Sutton (Sutton) who manage flood risk from surface water, ordinary watercourse and groundwater sources, Thames Water Utilities Limited (TWUL) who manage public surface water and foul or combined sewer systems, and Transport for London (TfL) who manage highway drainage assets along TfL adopted roads. Following the flooding incidents, Sutton communicated with residents impacted by flooding and carried out numerous site visits to investigate the flood risk sources. Sutton also carried out various activities in response to the June 2017 flood event, including:

- Cleaning blocked gullies in affected areas.
- Installing new gullies.
- Conducting a modelling study for Critical Drainage Area (CDA) 31 which is located towards the south east region of Sutton.
- Carrying out Section 19 flood risk investigations.

The main recommendations for the six property hotspot locations are as follows:

Demesne Road: TWUL should conduct a detailed investigation of the foul water manhole and network along Demesne Road near the railway line to confirm the reason why the manhole surcharged. Sutton should investigate the soakaway on Ross Road to determine its condition and if maintenance or a repair of the asset is required.

London Road and Riverside Close: Sutton to reinvestigate the raised table road hump at the entrance of Riverside Close to determine if improvements can be made to reduce the risk of surface water entering the lower lying properties and highway without increasing the risks to London Road.

Carshalton High Street: TWUL in partnership with TfL should conduct a detailed investigation of the surface water network along the High Street, with an emphasis on the capacity of the section with a single 450mm pipe.

Stanley Park Road and Warnham Court Road: Sewer pipe sections identified as damaged in the 2020 CCTV survey should be investigated by TWUL and appropriate measures taken.

Oxford Road: TWUL should conduct a detailed investigation of assets along Harrow Road and the surface water chamber near the property which experienced flooding on Oxford Road. TWUL should also clear and regularly maintain the surface water chamber at the property which experienced flooding on Oxford Road of any silt and debris to ensure no blockages.

Oaks Avenue: Sutton to conduct a geotechnical assessment and/or basement impact assessment (if required). These assessments should include mitigation measures to reduce the risk of potential groundwater influenced flooding to the site.

The general recommendations for all 28 sites that reportedly experienced flooding during the June 2017 event are as follows:

- Sutton to collaborate with the Environment Agency (EA) to further investigate the June 2017 flood event. Further analysis should be carried out on the recorded rainfall gauge data to confirm the flood event's return period.
- TWUL should investigate and resolve blocked assets which potentially exacerbated or led to sewer flooding for the affected sites.
- Sutton should provide regular maintenance of the gullies and street cleansing for the sites affected by sewer flooding.
- Sutton to collaborate with TWUL to review the sewer network capacity to see if any additional sewer features could alleviate flooding within the network.
- Sutton to collaborate with the affected local residences to explore property level protection.
- Sutton to collaborate with TWUL and residents affected by the June 2017 events to explore potential retrofit SuDS opportunities to increase the catchment's resilience to flood risk.

- Sutton to collaborate with TWUL and the EA as part of the Drainage and Wastewater Management Plan process.

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FIGURES AND TABLES

ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
CDA	Critical Drainage Area
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
FWMA	Flood and Water Management Act 2010
GIS	Geographic Information System
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
PPG	Planning Practice Guidance
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
Sutton	London Borough of Sutton
TBR	Tipping Bucket Raingauge
TfL	Transport for London
TWUL	Thames Water Utilities Limited

1 INTRODUCTION

1.1 Background Policy and Information

As a unitary authority, the London Borough of Sutton (Sutton) is a Lead Local Flood Authority (LLFA). LLFAs are defined as a Risk Management Authority (RMA) under Section 6, Part 1, Chapter 29 of the Flood and Water Management Act (FWMA) 2010. They are one of several parties who are responsible for managing the risk posed by flooding. Other RMAs as defined by the FWMA 2010 are:

- the Environment Agency (EA)
- a district council for an area for which there is no unitary authority
- an internal drainage board
- a water company, and
- a highway authority.

As part of their role as an LLFA and an RMA under Section 19, Part 1 of the Act, Sutton is required to act when they become aware of flooding in the area. The FWMA 2010 states that:

> *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.*

For all flood investigations carried out under Section 19 of the FWMA 2010, Sutton must:

a. publish the results of its investigation, and

b. notify any relevant *risk management authorities*

Significant flooding incidents may trigger Sutton to conduct a Section 19 investigation. When Sutton are made aware of a flooding incident, a Section 19 is then triggered if one of the following threshold criteria referenced in the Sutton Local Flood Risk Management Strategy is met:

- If internal flooding of one property has been experienced on more than one occasion
- Where internal flooding of five or more properties has been experienced during a single flood incident
- Where critical infrastructure has been affected by flooding more than once within a 12 month period

Sutton can investigate other flood incidents if it deems necessary, even if the Section 19 threshold criteria are not met. The flooding which occurred in June 2017 was a significant flood incident which resulted in 28 reported sites experiencing flooding. Of the 28 sites, 22 of those either experienced internal property

flooding or flooding within the curtilage of the property. The flooding of these sites triggered Sutton to conduct a Section 19 investigation.

There are 28 different sites that are known to have experienced flooding because of the June 2017 flood event (see

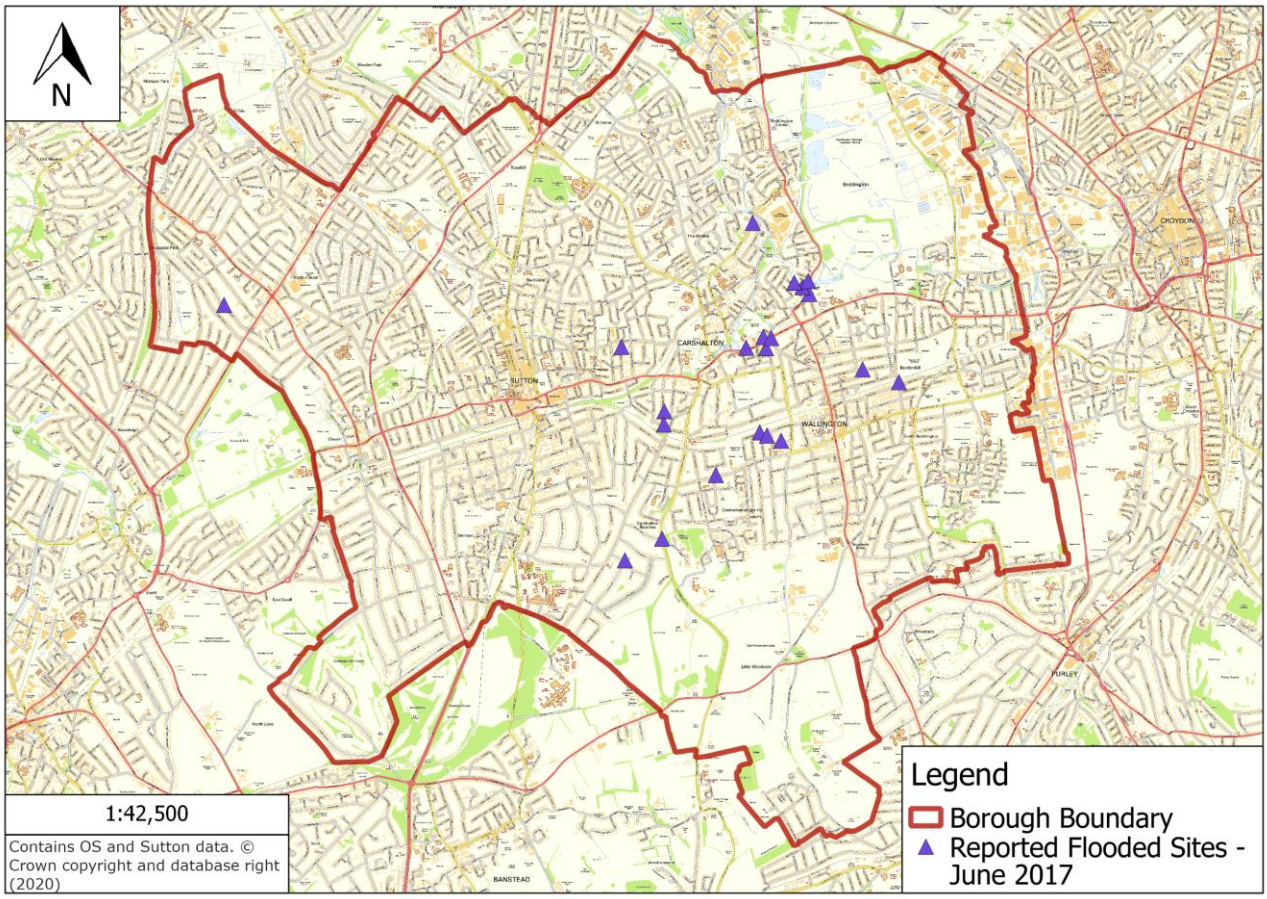

Figure **1-1**). These properties are found in the following locations:

- **Carshalton** – a town located in the east of the London Borough of Sutton. Of the 28 sites reported to have experienced flooding, 19 are in Carshalton.
- **Wallington** – a town located in the east of the London Borough of Sutton, to the east of Carshalton. Of the 28 sites reported to have experienced flooding, eight are in Wallington.
- **Worcester Park** – a town located in the west of the London Borough of Sutton. Of the 28 properties reported to have experienced flooding, one is in Worcester Park.

For further information on flooding throughout the borough and the responsible RMAs, see *Chapter 2* and *Chapter 4,* respectively. For specific property information see *Chapter 5* to *Chapter 10*.

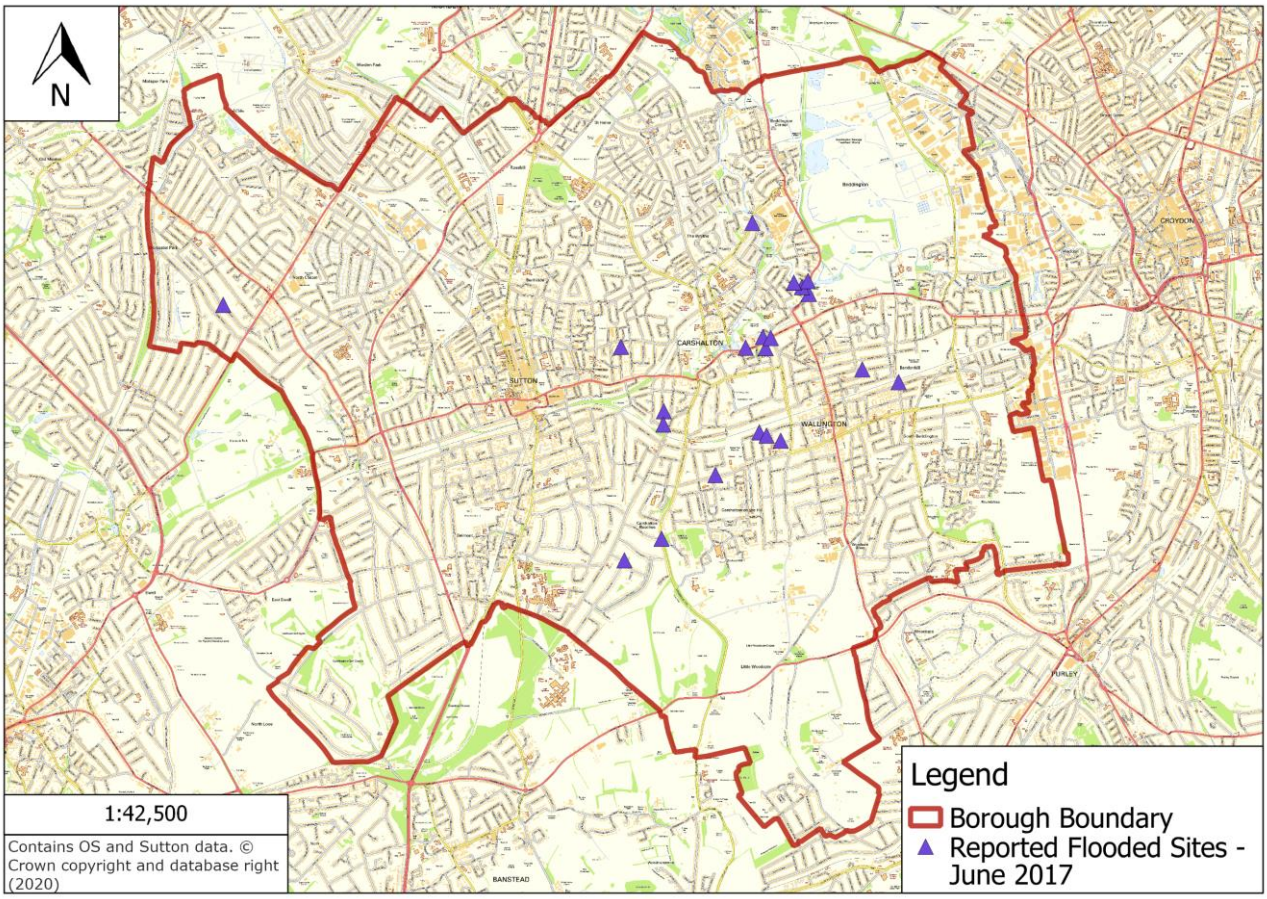

Figure 1-1. Location of the sites reported to have flood during the June 2017 flood event

1.2 Methodology

A method was developed and followed to facilitate the flood investigation. The first step was a data collection exercise to identify the type of data that was required to inform the flood investigation. A search on social media platforms was undertaken to verify the analysis conducted as part of the flood investigation. The data obtained as part of the exercise is listed in *Table 1-1*.

Table 1-1. Data sources

Data	Source
Assets significant to flood risk	EA / Sutton / Thames Water Utilities Limited (TWUL)
Flood Investigation Forms	Sutton
Geology information	British Geological Survey
Ground water information	EA
Historic flood records	Sutton
LiDAR (Light Detection and Ranging topographical data)	EA
Photos of the flooded sites	Sutton
Rainfall data for historic events and topography	EA
Sewer network	TWUL / Sutton
Surface water, fluvial and artificial flood maps	EA
Watercourse locations	EA / Sutton

The data requested from Sutton included historic flood records, assets significant to flood risk and incident specific data (i.e. photos and reports). The data was collected and analysed as part of a desktop study to identify the flood mechanisms for the local area. The available historical, topographical, drainage, geological and land use data was used to explore all potential flood risk sources throughout the borough. The data was also used to establish the hydrological catchment and the area's primary overland flow route(s), showing where water flows in relation to the flooded sites. The different RMAs were then identified alongside their responsibilities for the different flood risks posed to properties throughout the borough. Further information on this can be found in *Chapter 4*.

Finally, the results of the investigation were compiled and are delivered in this report. Recommendations on flood risk mitigation and potential next steps are provided in *Chapter 11.2*.

2 FLOOD INCIDENT DETAILS

On the 2nd June 2017, a torrential rainfall incident occurred across the London Borough of Sutton. Rain gauge data taken from the Purley Oaks rainfall gauge show that rainfall peaked at 15:45. The How Green Reservoir and Cheam rainfall gauges show that rainfall peaked at 15:00 and 14:45 respectively (see *Chapter 3* for further information). The consequence of the severe rainfall event led to several properties across the borough experiencing flooding. Several flood incidences that occurred during the rainfall event were reported by residents within the borough. A sample of the reported flood incidences at several properties within the borough is shown in *Table 2-1*. *Figure 2-1* to *Figure 2-8* depict flooding that occurred across the various properties during the June 2017 event. The remaining sites which reported flooding during the June 2017 event have been grouped into "property hotspots". The flood incident details and flood risk analysis within each property hotspot can be found in *Chapter 5* to *Chapter 10* of this report.

Table 2-1. Reported Flood Incidents

Site	Reported Flood Incidence
Osmond Gardens	No information on the flood incident.
St Mary Avenue	Internal flooding to house. Surrounding area slopes towards the property and the sewer network was overcapacity, causing local gullies to surcharge.
Wallington Bridge	Water surcharging from the manhole on the footway resulted in flooding of the highway.
Beddington Gardens	No information on the flood incident.
Northwood Road	Water was close to entering the property.
Anglesey Court Road	No information on the flood incident.
Beeches Walk	Flood water came close to entering properties.
High Street Carshalton	Flood water came from the car park and entered the property through the door. Flood water resided in the kitchen and basement.
Nightingale Road	The drains along Nightingale Road were blocked (on the opposite side of the road to the property) and subsequently resulted in internal flooding.
West Way	No information on the flood incident.
Carshalton Grove	No information on the flood incident.

Figure 2-1. Flood water entering the front of property at Osmond Garden - © Resident, 2017

Figure 2-2. Flood water entering the outside the garage of property at Osmond Garden - © Resident, 2017

Figure 2-3. Water surcharging from manhole on the footway which resulted in flooding of the highway underneath Wallington Bridge - © Resident, 2017

Figure 2-4 Flooding across properties along Beddington Gardens - © Resident, 2017

Figure 2-5 Flood water entering property on Northwood Road - © Resident, 2017

Figure 2-6 Basement flooding at property on Carshalton High Street - © Resident, 2017

Figure 2-7. Flooding at property on Nightingale Road - © Resident, 2017

Figure 2-8. Flooding at Carshalton Grove - © Resident, 2017

3 FLOOD MECHANISMS

3.1 Source of Flooding

3.1.1 Hydrological catchment

To better understand the potential causes of flooding at a borough wide scale, the hydrological catchment areas were defined. A catchment is an area of land where rainfall falls and drains towards the same waterbody, flow path or topographical low point. The hydrological catchments were defined by an analysis of the wider area's topography. Light Detection and Ranging (LiDAR) data was used to define the catchment, a surveying method that measures distance to a target by using light and sensors to make 3-D representations of target areas.

Based on a review of the wider catchment area, six catchments were defined for the 28 sites that reportedly experienced flooding during the June 2017 event. Of these 28 sites:

- 22 sites are residential or commercial properties that experienced internal flooding or flooding within the curtilage of the property.
- Five sites are residential properties that experienced highway flooding immediately outside the site.
- One site includes a highway underpass which experienced significant flooding.

Information on the sites which fall within the six catchment areas are detailed in *Figure 3-1* and *Table 3-1* below.

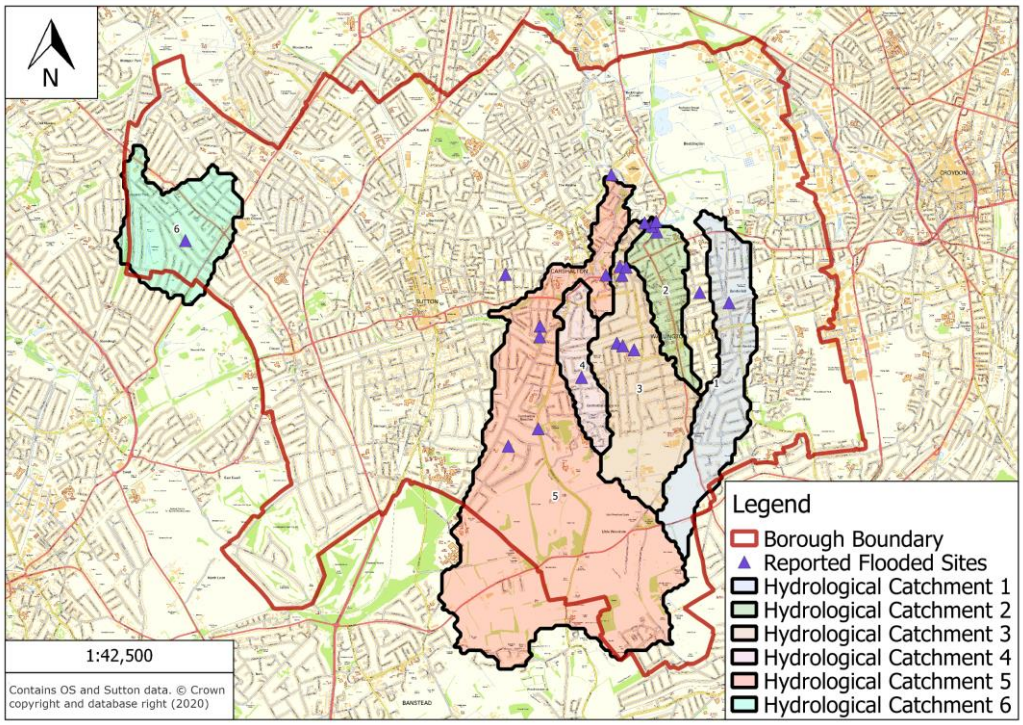

Figure 3-1. June 2017 Flood Event Hydrological Catchments

Table 3-1. Summary of Sites within the hydrological cathcments

Catchment	Sites
1	Demesne Road (three properties) Osmond Gardens (one property)*
2	London Road (one property) Riverside Close (one property) St Mary Avenue (one property) Wallington Bridge (infrastructure/highway flooding)
3	High Street, Carshalton (three properties) Beddington Gardens (two properties) Northwood Road (one property) Anglesey Court Road (one property/highway flooding)
4	Stanley Park Road, (three properties/highway flooding) Warnham Court Road (one property/highway flooding)
5	Oxford Road (two properties) Beeches Walk (one property) High Street, Carshalton (one property) Nightingale Road (one property) West Way (one property) Carshalton Grove (two properties)**
6	Oaks Avenue, Worcester Park (one property)

*Property on Osmond Gardens lies approximately 140m northwest of catchment 1
**Property on Carshalton Grove lies approximately 325m northwest of catchment 5

3.2 Hotspots of flooded locations

To define the property hotspots that would be analysed in detail, the flood mechanisms within the six hydrological catchments were reviewed. Based on this review sites have been grouped into six hotspots (see *Figure 3-2*). Each hotspot represents a localised area or group of properties that lie at a topographical low point within a catchment area. This means that during a heavy rainfall event, surface water will naturally drain towards these areas. This may lead to excess ponding along roads within each hotspot should the local sewer network not have enough capacity to manage excess surface water. Therefore, the sites within an identified hotspot may be at a greater risk of flooding compared to other areas within the same hydrological catchment. The flood mechanisms for each hotspot varies. A detailed analysis of the flood mechanisms for each identified hotspot can be found in *Chapter 5* to *Chapter 10* of this report. Each chapter includes information about the actions undertaken by relevant RMAs before, during or after the June 2017 flood event. An assessment of the flooding incident(s) has been made with recommendations that include inputs from the relevant RMAs.

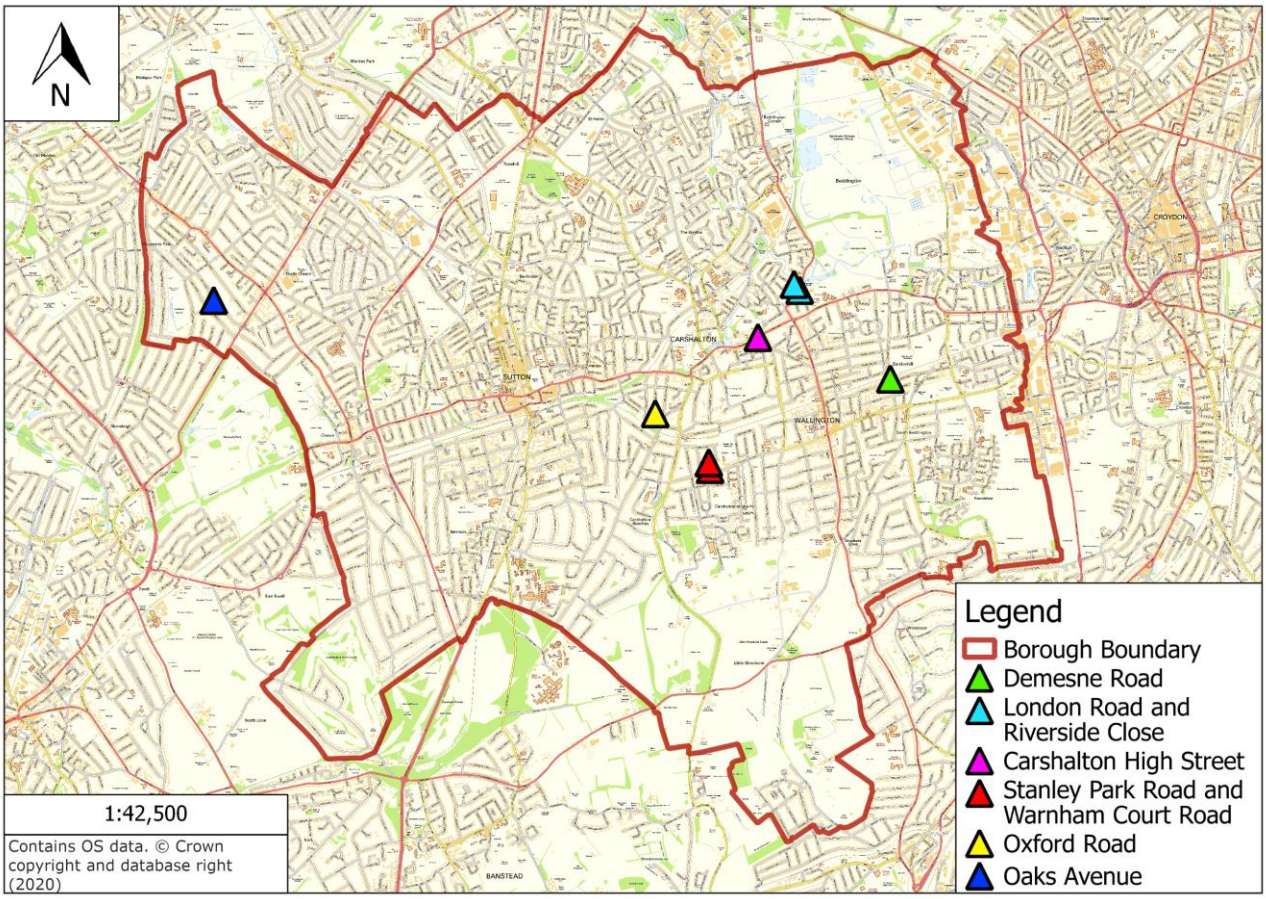

Figure 3-2. June 2017 flood event hotspots

3.3 Rain gauge data

Rainfall data from three different rainfall gauge sites were used to assess the reported rainfall event which resulted in flooding at the sites. *Table 3-2* and *Table 3-3* provide a summary of the rainfall gauges in relation to the six catchments. The rainfall gauges where chosen based on the closest distance to the furthest site within each hydrological catchment.

Table 3-2. Summary of the rain gauges

Catchment	Rainfall Gauge Chosen	Within Borough Boundary?	Distance to furthest site
1	Purley Oaks TBR	No	4km north west
2	Purley Oaks TBR	No	5km north west
3	Purley Oaks TBR	No	6km north west
4	How Green Reservoir	No	5km north west
5	How Green Reservoir	No	8km north west
6	Cheam PS	Yes	1.6km north west

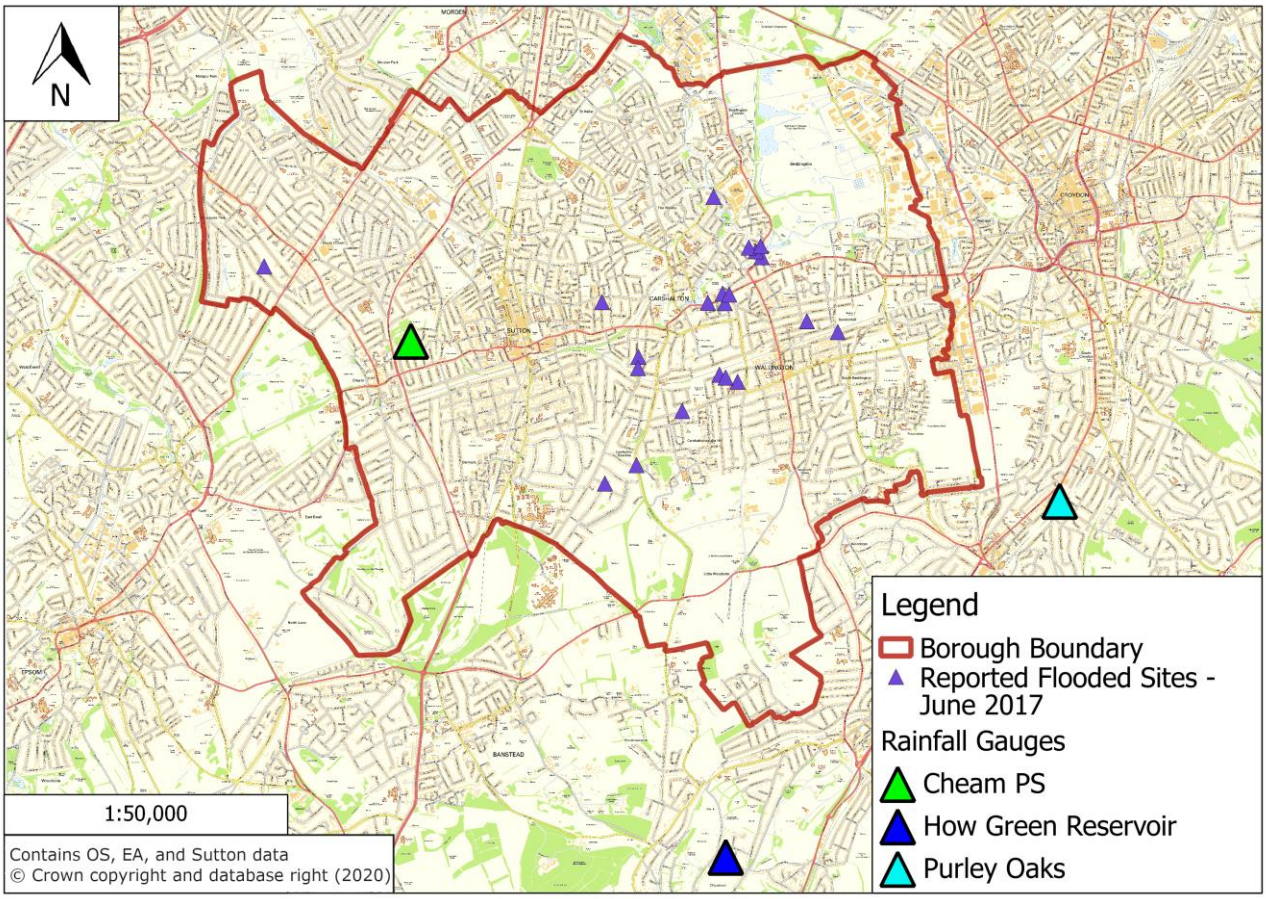

Figure 3-3. Approximate locations of the local rainfall gauge sites

The data analysed from the rainfall gauges shows the variation in rainfall over a 48 hour period for the rainfall event. The measurements recorded at the rain gauge sites are captured in a Tipping Bucket Raingauge (TBR). The data recorded provides accumulated totals for each 15-minute period. *Table 3-3* provides a summary of the rainfall event investigated as part of this study. Rainfall event specific details on rainfall variation are shown in *Figure 3-4* to *Figure 3-6* below.

Table 3-3. Summary of the Rainfall Events

Rainfall Gauge	Rainfall Event	Significant Rainfall Period	Recorded Peak (mm)	Peak Time
Purley Oaks	June 2017	00:00 to 16:45 BST on 2nd June	5.40	15:45
How Green Reservoir	June 2017	00:00 to 18:30 BST on 2nd June	7.3	15:00
Cheam PS	June 2017	00:00 to 18:30 BST on 2nd June	1.40	14:45

The data for June 2017 event indicates that the peak rainfall return period approximates to a 1 in 5 year event (20% probability of a rainfall of that intensity occurring in a given year). Anecdotal evidence would suggest that based on the identified flood risk sources and the nature of flooding that occurred (see *Chapter 2*), it is possible that the flood event is greater than a 1 in 5 year event. The rain gauges are within the closest proximity to the hotspots therefore are the most suitable to approximate the rainfall return period in relation to the closest hotspots.

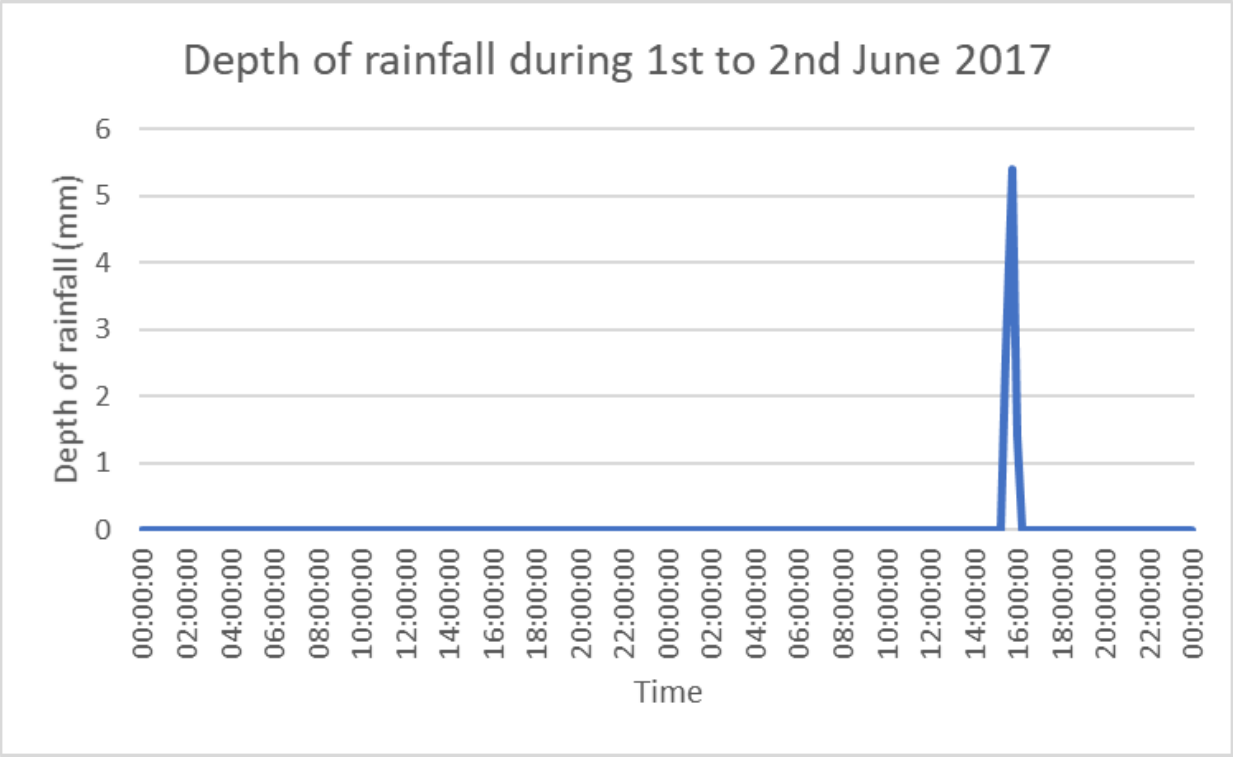

Figure 3-4. Depth of rainfall for June 2017 event (Purely Oaks TBR)

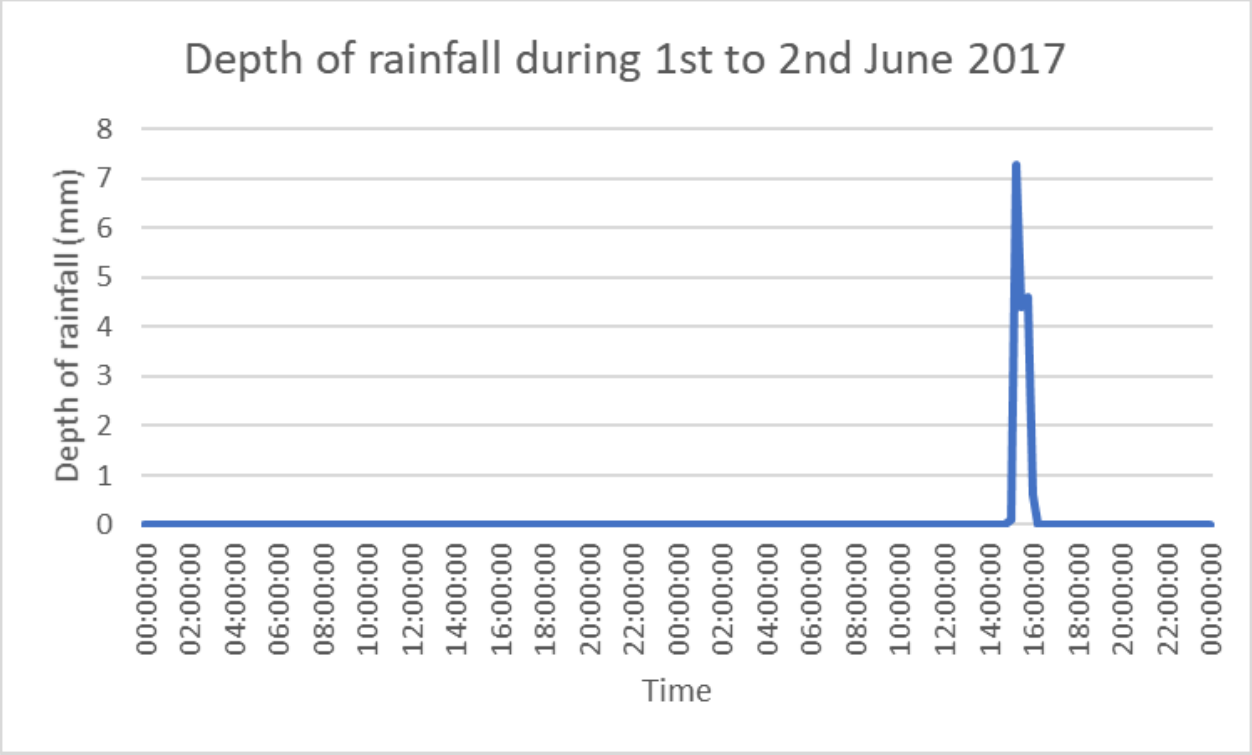

Figure 3-5. Depth of rainfall for June 2017 event (How Green Reservoir)

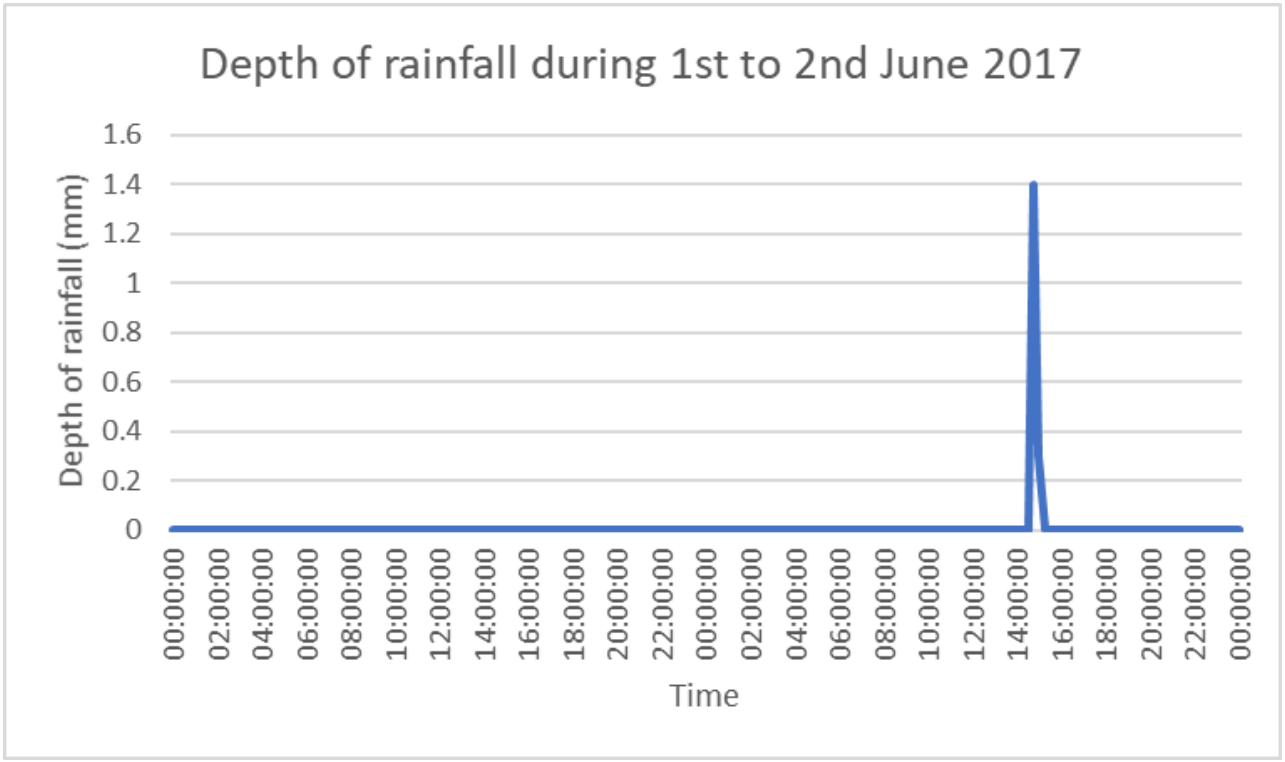

Figure 3-6. Depth of rainfall for June 2017 event (Cheam PS)

Table 3-4. Recorded Rainfall Peaks and Return Period per Catchment

Catchment	Recorded Peak (mm)	Approximate Return Period
1	5.40	1 in 5 year event
2	5.40	1 in 5 year event
3	5.40	1 in 5 year event
4	7.3	1 in 5 year event
5	7.3	1 in 5 year event
6	1.40	1 in 5 year event

The TBR results for the 2017 events have been labelled as “good and complete” by the EA. This means that the TBR gauge was operational during the event to accurately record rainfall depth. Further information on the method for estimating the rainfall return periods can be found in *Appendix A*.

4 Risk Management Authorities

There are several RMAs who are responsible for managing the potential risks posed by flooding, depending on the flood sources. *Table 4-1* lists them at a borough level, with further information provided in *Chapter 4.1* to *Chapter 4.5*

Table 4-1. Borough level Risk Management Authorities

Risk Management Authorities	Authority	Risk management responsibilities
EA	EA	Main rivers, the sea, and reservoirs
LLFA	Sutton	Surface water, ordinary watercourses, and groundwater
Water and Sewerage Company	TWUL	Surface water and foul / combined sewer systems
Highway Authority	Sutton	Highway drainage
Highway Authority	TfL	Highway drainage

4.1 Environment Agency

4.1.1 Responsibilities

The EA are the lead RMA in managing flood risk from designated main rivers, the sea, and reservoirs. They have a range of different powers and responsibilities including surveying, maintenance and improvement works to main rivers and the sea relating to flood and coastal erosion risk management. The EA plays a key role in advising planning authorities on the implications that proposed developments may have on flood risk, providing and operating flood warning systems, and improving the environment. The EA also monitor groundwater and supply the LLFA information in the form of monitored groundwater levels.

The identified flood risk sources for the sites are not from fluvial, tidal, or coastal sources. The EA therefore do not have direct responsibilities as an RMA to manage flood risk for the sites.

4.1.2 Response and actions

As an RMA that does not have direct responsibilities for managing surface water or sewer flood risk, the EA have not carried out any actions in response to flood risk at these sites.

4.2 London Borough of Sutton

4.2.1 Responsibilities

Sutton has different RMA roles as an LLFA, a Highway Authority and a landowner. As a unitary authority LLFA, Sutton has the lead responsibility for managing flood risk from surface water, ordinary watercourse, and groundwater sources. They are responsible for:

- Developing, applying, maintaining, and monitoring local flood risk management strategies.
- Maintaining a register of structures and features that have a significant effect on flood risk.

- Regulating works within the proximity of ordinary watercourses (consenting and enforcement)
- Preparing and maintaining preliminary flood risk assessments, flood hazard maps, flood risk maps and flood risk management plans.
- Reviewing and consulting on surface water drainage proposals for major planning developments.
- Undertaking Section 19 flood risk investigations as per the FWMA 2010.

Other RMAs have a duty to cooperate with LLFAs where necessary to undertake the above responsibilities. Sutton can also carry out work to help alleviate surface water, groundwater, and ordinary watercourse flooding in collaboration with other RMAs. Under the powers granted to them, Sutton can make by-laws to ensure that flood risk management work is effective.

As a Highway Authority, Sutton are responsible for providing and managing highway drainage that is not managed by Transport for London (TfL) or Highways England. They must ensure that drains, including kerbs, road gullies and ditches, and the pipe network, which is connected to sewers, are maintained. They have a responsibility to manage highway runoff on and from highways, reducing the wider flood risk that may be presented from highways.

As a landowner, Sutton have a responsibility to safeguard their own land and property against flooding. Common law requires all landowners that they do not increase the risk of flooding to a neighbouring property through carrying out tasks such as drain clearing and maintaining any existing flood defences.

4.2.2 Response and actions

Following the flooding incidents, Sutton communicated with affected residents and carried out numerous site visits to investigate the flood risk sources. Site visits were carried out to the following locations:

- High Street, Carshalton
- St Mary Avenue, Wallington
- Riverside Close, Wallington
- Oxford Road, Carshalton
- Highway adjacent to Stanley Park Road
- West Way, Carshalton
- Osmond Gardens, Wallington
- Nightingale Road, Carshalton
- Oaks Avenue, Worcester Park

Highways Inspectors were engaged to clean blocked gullies in affected areas. A new gully has been installed along West Way, Carshalton, as the previous drainage was ineffective at preventing flooding to the property. New gully chutes were also installed along St Mary Avenue in 2017, though it was confirmed that the system was still overloading following installation.

Sutton has previously conducted investigation work including a modelling study for Critical Drainage Area (CDA) 31, a Section 19 investigation for Carshalton Grove, and investigative work as part of this borough wide Section 19 investigation. The response and actions taken by Sutton for the identified hotspots are detailed in *Chapter 5* to *Chapter 10*.

4.3 Thames Water Utilities Limited

4.3.1 Responsibilities

TWUL is the water and sewerage company responsible for managing public surface water and foul or combined sewer systems. They are responsible for any maintenance and repair work on their drainage assets.

When wet winters and high groundwater occurs, TWUL investigate where the water may be forcing its way in into the sewer network. TWUL use CCTV, Impermeable Area Surveys, flow monitors, and manhole surveys to identify problem areas. TWUL may also investigate potential flood impacts if a report has been submitted to highlight internal property flooding. In each of their Asset Management Periods (which operates on a five-yearly cycle), investment is put into TWUL's business plan for flood alleviation. The location of flood alleviation schemes are prioritised based on frequency and severity of flooding, as well as environmental and customer impact.

Several of the sites have been identified as flooding which may be have been caused or exacerbated due to TWUL assets. TWUL have direct responsibilities as an RMA to manage sewer related flood risks at these sites.

4.3.2 Response and actions

TWUL carried out a CCTV survey at St Mary Avenue in October 2017 which confirmed there were no defects or blockages found in the network. TWUL informed the resident that the outfall in the river became submerged during the flood incident, causing water to get backed up in the sewer. The response and actions taken by TWUL for the identified hotspots are detailed in *Chapter 5* to *Chapter 10*.

TWUL met with Sutton for the first workshop of the Drainage and Wastewater Management Plan (DWMP) process in November 2020. The DWMP aims to prioritise interventions for areas which have

the biggest drainage and wastewater management issues. The optioneering process will begin in 2021 and optimising the programme for cost beneficial schemes will commence in 2022.

4.4 Landowners

4.4.1 Responsibilities

Landowners have the primary responsibility of safeguarding their own land and property against flooding. Under common law they are also required to ensure that they do not take action to their property in a way that increases the risk of flooding to a neighbouring property. Common law also enables landowners to take reasonable measures to protect their property from flooding, provided the measures do not cause harm to others. Riparian landowners are responsible for ensuring that any structure(s) on their land linked to the neighbouring watercourse is kept clear of debris.

4.4.2 Response and actions

The highways affected by the flooding are adopted by Sutton. The response and actions taken by Sutton are outlined in *Chapter 4.2.2*. Private landowners reported anecdotal evidence to Sutton Council based on flooding to their properties for the June 2017 flood event.

4.5 Transport for London

4.5.1 Responsibilities

TfL are responsible for managing the drainage of surface water on adopted roads along red routes. They must ensure that drains, including kerbs, road gullies and ditches, and the pipe network, which is connected to sewers, are maintained. TfL should be contacted by Sutton to request assistance in dealing with flooding to or from their assets.

4.5.2 Response and Actions

The response and actions taken by TfL for the hotspot areas which feature their adopted roads are detailed in *Chapter 5* to *Chapter 10*.

4.6 Category One Responders

4.6.1 Responsibilities

Blue light emergency services are categorised as Category One Responders under the Civil Contingencies Act (2004). They are organisations at the core of responding to most emergencies. Services such as the Metropolitan Police Service and the London Fire Brigade are the most relevant responders with regards to flood incidents within the borough.

4.6.2 Response and Actions

Blue light emergency services were involved in managing flood risk during the June 2017 flood event. The response and actions taken by the blue light emergency services for the hotspot areas are detailed in *Chapter 5* to *Chapter 10*.

5 HOTSPOT 1 – DEMESNE ROAD

Demesne Road lies within Wallington, in the north east of the borough. Demesne Road also lies within CDA 31.

5.1 Location-wide flood incident(s)

Due to the heavy downpour in the afternoon of June 2nd, 2017, three properties on Demesne Road experienced flooding. A homeowner account of the flooding reported that sandbags were put in place to prevent water from entering their house. However, the amount of water was deep enough to knock down the sandbags which then led to their garage to flood. The homeowner also witnessed raw sewage coming up from the drain in their rear garden which they believed was caused by a backup of foul water at their neighbours' property. Residents reported that the highway drains were clear of any debris. This suggests that drains were clear of blockages and were overwhelmed by the volume of water during the flood event.

5.2 Local drainage network

There are surface water sewers on both sides of Demesne Road. One surface water sewer network flow in a northerly direction from the south of Demesne Road (starting from Stafford Road), with interchanging diameters of 450mm and 600mm before discharging into a 600mm diameter surface water sewer at the junction with Croydon Road. The 600mm diameter surface water sewer runs from Croydon Road onto the adjacent Church Road and continues to flow in a north westerly direction. The 600mm section finally discharges into the River Wandle approximately 1.2km north of the sites along Demesne Road. The second surface water sewer network is a 450mm diameter pipe which flows in a northerly direction from the south of Demesne Road. The surface water sewer is diverted onto Montague Road then diverted onto Rectory Lane. The surface water sewer continues to flow along Rectory Lane in a northerly direction and discharges into a 600mm diameter surface water sewer at the junction with Croydon Road. The surface water sewer continues to flow in a north western direction before discharging into the River Wandle approximately 1.3km north west of the sites along Demesne Road. There is also a separate foul sewer network, flowing from south to north. The diameter of the foul water pipe along Demesne Road is 300mm. This is shown in


N
MORTON GARDENS
THE BRIDLE WAY
Bandon Hill Cemetery
Bandonhill
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THARP ROAD
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ROSE ROAD
CAREW ROAD
ST MICHAEL'S RD
CLARENDON ROAD
ROSSWOOD ROAD
ELGIN ROAD
Pol Sta
PW
PW
Sch
CHARLOTTE ROAD
HINTON ROAD
1:4,000
Contains OS, TWUL, and Sutton data © Crown copyright and database right (2020)
Legend
Demesne Road
Soakaways
TWUL Sewer Network
Surface Water

Figure **5-2**.

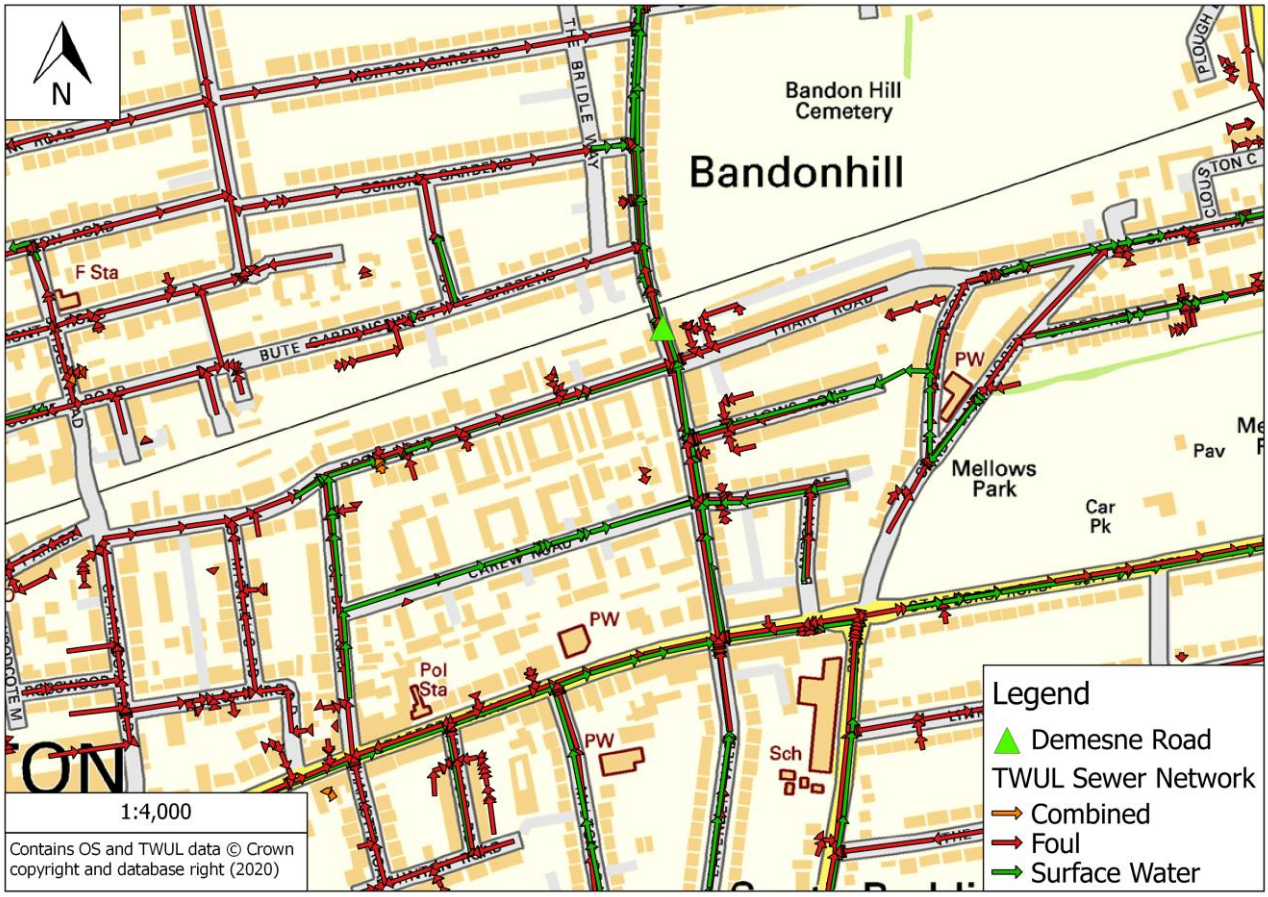

Figure 5-1. Local sewer network – Demesne Road

There are numerous soakaways within the vicinity of Demesne Road. The nearest soakaway is located at the junction between Ross Road and Demesne Road. The soakaway has been labelled as being in 'poor' condition. This suggests the soakaway may not be as effective as it could be at discharging surface water via infiltration into the underlying chalk geology. Further information on the location of soakaways in the local area are shown in *Figure 5-4*.

Figure 5-2. Surface water sewer network and soakaways – Demesne Road

5.3 Local flood mechanism

Analysis of the area using a Geographic Information System (GIS) provided several outputs, including defined hydrological catchments and primary flow paths (shown as 'Hydrological Catchment Stream' in *Figure 5-3*). LiDAR data shows that Demesne Road lies at a topographical low point within the hydrological catchment. This means that surface water within the defined catchment will naturally flow towards the area and pond across Demesne Road. Therefore, properties along Demesne Road (south of the railway line) are considered to be located within a flood hotspot.

The primary flow paths are the main overland flow route for surface water in the defined catchment. The main overland flow route for the catchment area flows in a north westerly direction towards Croydon Road which lies further north of the sites. The overland flow path then outfalls into the River Wandle just south of Beddington Park.

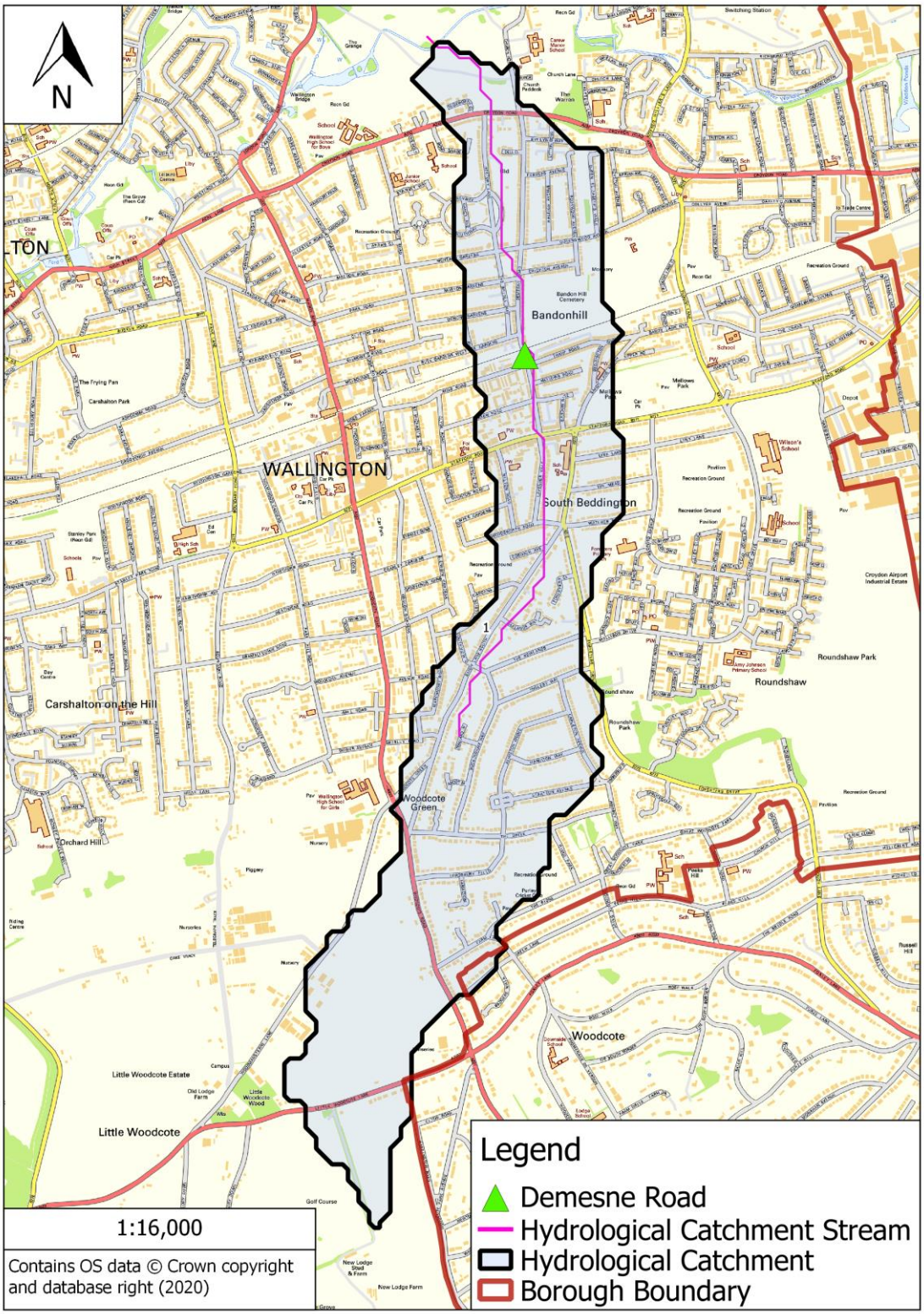

Figure 5-3. Hydrological catchment and catchment stream – Demesne Road

5.4 Local Flood Risk

5.4.1 Surface water flood risk

Surface water flooding arises due to the accumulation of water at ground level following prolonged or intense rainfall. When rainwater does not drain away through the constructed drainage systems, or soak into the ground, it flows over the ground surface, leading to the risk of flooding in the surrounding areas. Anecdotal evidence from residents have confirmed that Demesne Road has repeatedly experienced surface water flooding in the past although the exact dates of the flood events were not confirmed.

A review of the EA's Risk of Flooding from Surface Water (RoFSW) data shows that surface water is predicted to flow towards Demesne Road. The mapping also shows that Demesne Road is at risk from the 1 in 30 year, 1 in 100 year, and 1 in 1000 year rainfall events (see *Figure 5-4*). The predicted surface water extent for the 1 in 100 year and 1 in 1000 year events encroaches onto the impacted properties along Demesne Road with flood depths ranging from 0.15m - 0.9m maximum. Therefore, Demesne Road and the adjoining properties are at high risk of surface water flooding.

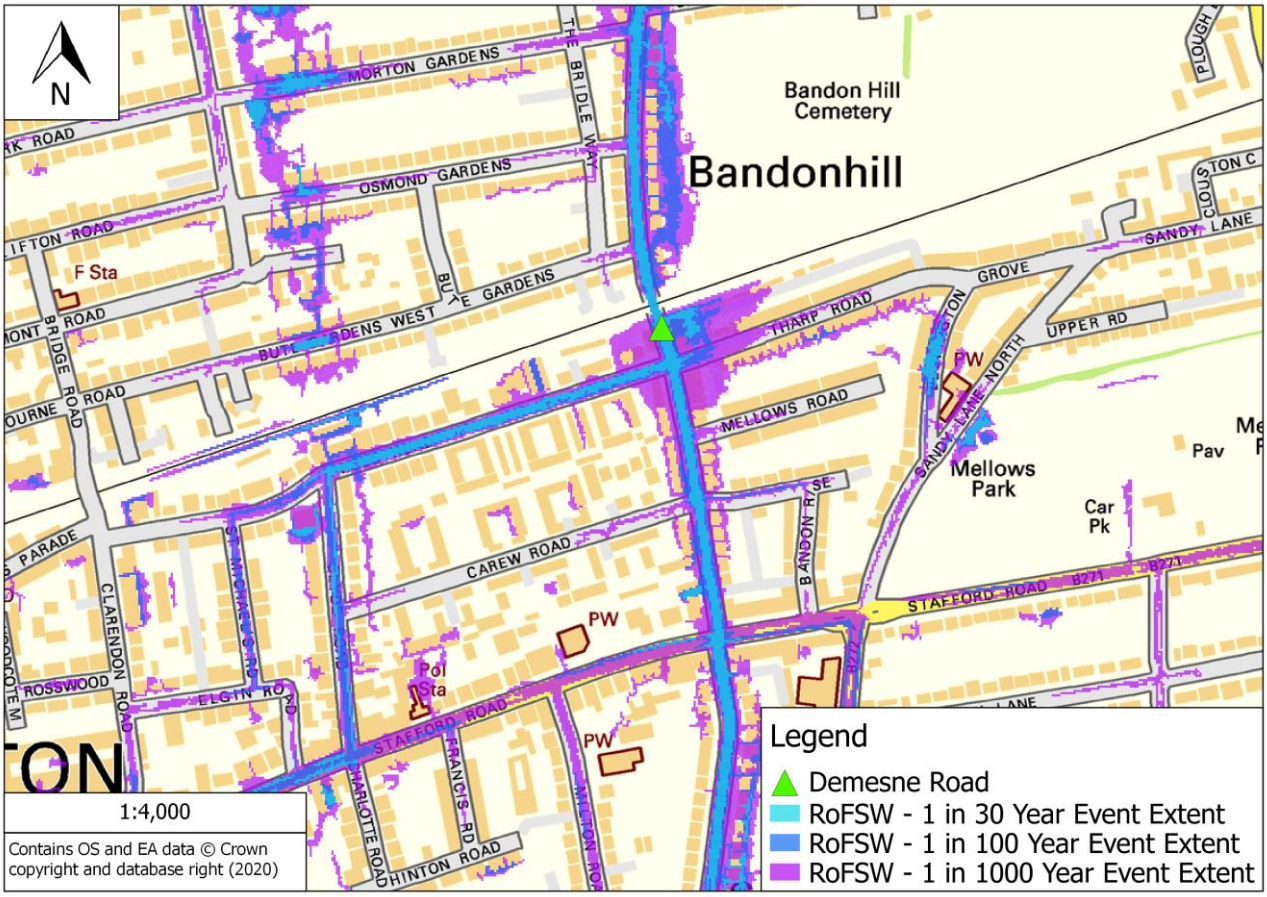

Figure 5-4. Risk of flooding from surface water – Demesne Road

5.4.2 Ordinary Watercourse flood risk

Ordinary watercourses are rivers, ditches and streams that are not designated as 'main rivers' by the EA. Significant rainfall events cause increased peak flows into the watercourses which may exceed the capacity of the channels and lead to surface water flooding over ground.

Flooding from ordinary watercourses is included within the EA's RoFSW map. A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of Demesne Road. Therefore, Demesne Road is not at risk of flooding from ordinary watercourses.

5.4.3 Fluvial Flood Risk

Similarly, to flooding from ordinary watercourses, fluvial flooding can arise as a result of heavy or excessive rainfall causing watercourses to exceed their hydraulic capacity. This source of flooding comes from watercourses that are designated as a main river by the EA.

According to the EA's Flood Map for Planning Demesne Road is situated in Flood Zone 1 and therefore not at risk of fluvial flooding.

5.4.4 Groundwater Flood Risk

Groundwater flooding can occur due to the below-ground water table rising in response to significant periods of rainfall. Flooding will then occur at the surface where rainfall is no longer able to infiltrate into the ground. In extreme circumstances, water can emerge through the ground and cause flooding. The effects can be further exacerbated based on an area's ground composition and the presence of aquifers.

Demesne Road lies within the '>=50% <75%' and '>-75%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 5-5*). However, there were no reports of basement or subsurface level flooding during the June 2017 event, flooding which could have been caused by a high groundwater table. Based on the lack of such reports, it is not believed that this flood incident can be attributed to groundwater flood sources.

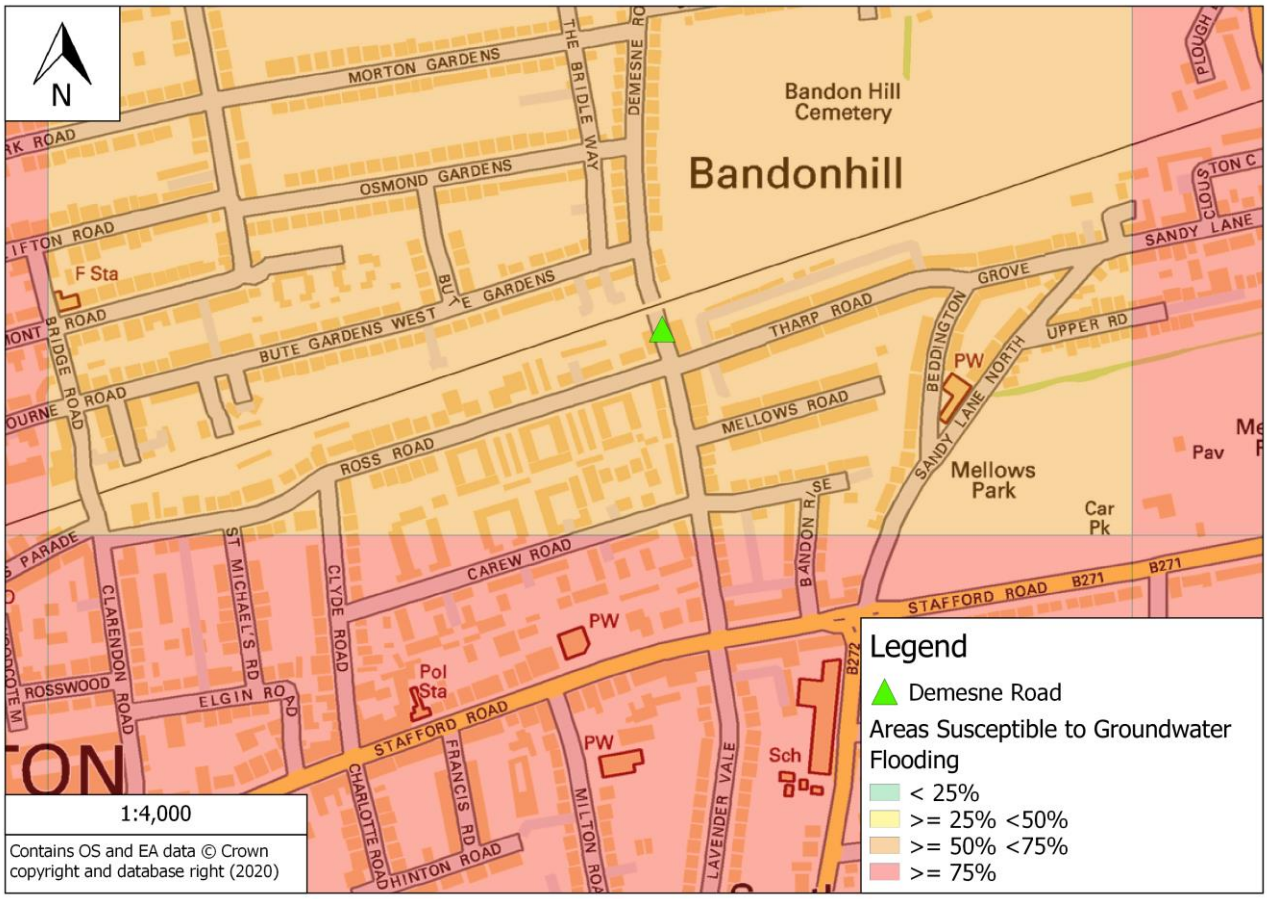

Figure 5-5. Areas susceptible to groundwater flooding – Demesne Road

5.4.5 Sewer Flood Risk

Sewer flooding occurs when the hydraulic capacity of a given sewer system is exceeded by the inflow of water from a significant rainfall event. Drains and sewers can also become full when a blockage occurs downstream in the sewer system. This can cause water to back up in a sewer system and cause flooding.

As stated in *Chapter 2*, resident reports indicate that the surface water drains were overwhelmed due to the volume of surface water during the rainfall event. The surface water drains may not have had enough capacity to deal with the heavy rainfall, therefore surface water may have surcharged from the drains and spilled out onto the road and flooded the nearby properties. Residents also reported that the sewer at a neighbouring property on Demesne Road near the railway line backed up with raw sewage and therefore several properties in the area were flooded with sewerage overflow. Based on this information, it is believed that this flooding incident can be attributed to sewer flood sources.

5.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Demesne Road sits outside of the predicted reservoir flooding extent. Therefore, Demesne Road is not at predicted risk of flooding from other sources.

5.5 Actions taken by relevant RMAs (and other stakeholders affected)

Table 5-1: Risk Management Authorities - Actions

Authority	Authority Response to Flooding
Sutton	***Before*** No known actions were taken by Sutton before the flood event. ***During*** No known actions were taken by Sutton during the flood event. ***After*** Sutton Council have been in contact with TWUL since 2017 regarding a blocked sewer outfall in Beddington Park. The outfall is blocked by tree roots from a protected tree, making it difficult for TWUL to clear the blockage. It was identified that the blocked sewer may possibly be causing water to back up, potentially causing flooding further upstream along the sewer system. Letters were sent to residents to facilitate communication with those who were impacted by the flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Sutton Council contacted Metis Consultants to conduct a modelling exercise on this area (CDA 31) to increase understanding of local flood risk. The modelling exercise was also conducted with a view to assessing the suitability of flood alleviation options in the area. Sutton Council cleared the soakaways along Ross Road after the June flood event on 06/09/18. Sutton met with TWUL in 2020 to have further discussions regarding the problem posed by the tree root blocking the outfall in Beddington Park. The meeting also sought to identify potential solutions.

TWUL	***Before*** No known actions were taken by TWUL before the flood event. ***During*** No known actions were taken by TWUL during the flood event. ***After*** Thames Water have proposed a flood alleviation scheme at Demesne Road. The scheme would include the construction of a FLIP (Flood Improvement Process) to protect specific properties along Demesne Road. The solution, which includes a small package pumping station and a raised brick wall at the rear of certain properties, will reduce the risk of flooding to the rear gardens caused by flow backing up from the main foul sewer. If Thames Water go ahead with the scheme, they are aiming to start construction in April 2021. Thames Water have identified that sewer cleaning may also solve the problem.

5.6 Recommendations

- TWUL should conduct a detailed investigation of the foul water manhole and network along Demesne Road near the railway line to confirm the reason why the manhole surcharged.
- Sutton and TWUL to collaborate to keep undertaking regular maintenance of the gullies and sewer networks to avoid blockages.
- Sutton to investigate the soakaway on Ross Road to determine its condition and if maintenance or a repair of the asset is required.
- Sutton to investigate if the installation of new gullies or swales in the vicinity of Demesne Road is feasible to cope with future flood events.
- Sutton Council to collaborate with the affected local residences to explore property level protection.
- Sutton should arrange to meet with TWUL and resident to discuss further flood risk issues.
- Sutton and TWUL should investigate mitigation measures such as sustainable drainage systems (SuDS) which can be incorporated on the site to reduce the risk of flooding.

6 HOTSPOT 2 – LONDON ROAD AND RIVERSIDE CLOSE

London Road and Riverside close lies within Wallington, in the north east part of the borough. London Road and Riverside close also lie within CDA 32.

6.1 Location-wide flood incident(s)

The heavy downpour in the afternoon of June 2nd, 2017 caused properties on Riverside Close and London Road to experience flooding. Anecdotal evidence in the form of a video recording shows that London Road was heavily flooded during the rainfall event, with flood depths rising above the tyres of cars driving through London Road during the event. A homeowner account confirmed that their garden was flooded along with parts of their house. The resident reported that water came off London Road, and avoided the road hump at the entrance to Riverside Close. The resident believed that the road hump was initially built to stop flooding however residents still experienced flooding during the rainfall event. Sutton Parks/highway have confirmed the culvert that runs from the pond under Derek Avenue is blocked with silt and tree roots. This leads to water backing up in the culvert and then overflows through gullies and floods London Road. The blockage of the culvert may have had a significant impact to flooding on London Road and Riverside Close.

6.2 Local drainage network

There are two surface water sewers serving London Road and one surface water sewer serving Riverside Close.

One surface water sewer on London Road flows in a north easterly direction from the south of London Road (starting from the junction between London Road and Acre Lane). The pipe diameter of the sewer run interchanges between 450mm and 600mm along the stretch and discharges into River Wandle which lies immediately north east of London Road. There is a 230mm surface water pipe which is connected to the interchanging surface water pipe at the junction with Butter Hill Road. The second is a 600mm diameter surface water sewer pipe which flows in a north easterly direction and is connected to a waterbody which lies adjacent to London Road. The 600mm surface water pipe then discharges into a waterbody which lies at the junction between London Road, Riverside Close and Derek Avenue. There is also a 600mm surface water pipe which lies along Riverside Close which flows in a north westerly direction and outfalls into an ordinary watercourse adjacent to Riverside Close. There are two 150mm foul sewers which serve Riverside Close and both flow in a south easterly direction. The two foul sewers then discharge into the foul sewer network on London Road. See *Figure 6-1* for the local sewer network.

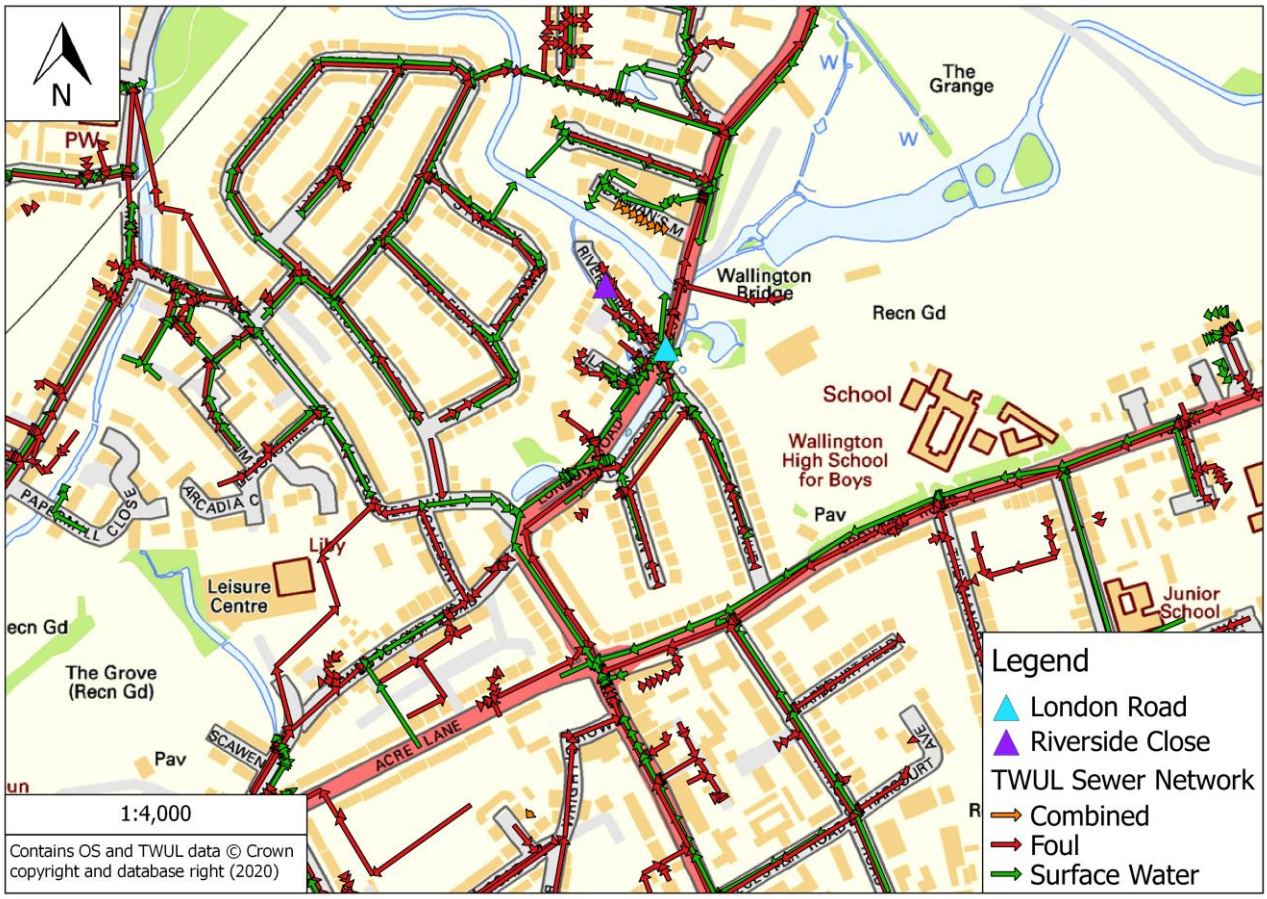

Figure 6-1. Local sewer network – London Road and Riverside Close

There are numerous soakaways in the wider vicinity of London Road and Riverside Close. The nearest is a 2.5m deep concrete lined soakaway located by Vellum Drive, approximately 360m north west of both roads. The soakaway has been labelled as being in 'good' condition. This is shown in *Figure 6-2*.

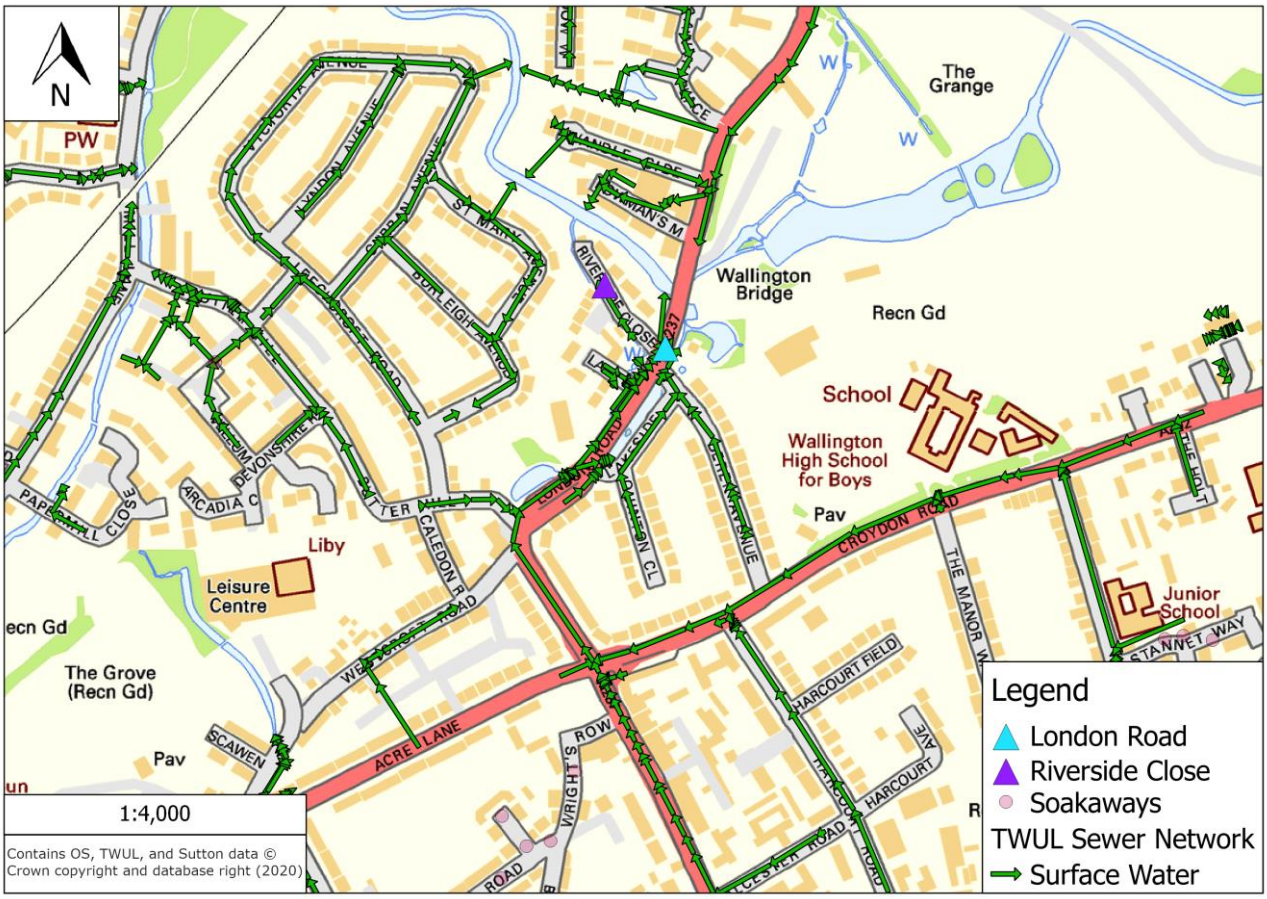

Figure 6-2. Surface water sewer network and soakaways – London Road and Riverside Close

6.3 Local flood mechanism

Analysis of the area using a GIS provided several outputs, including defined hydrological catchments and primary flow paths (shown as 'Hydrological Catchment Stream' in *Figure 6-3*). LiDAR data shows that Riverside Close lies within a topographical low point within the hydrological catchment. This means that surface water within the defined catchment will naturally drain along London Road and towards Riverside Close. Therefore, the properties along Riverside Close are considered to be located within a flood hotspot.

The primary flow paths are the main overland flow route for surface water in the defined catchment. The main overland flow route for the catchment area flows in a northernly direction towards Riverside Close. The overland flow path then outfalls into the River Wandle just north of River Side Close.

Figure 6-3. Hydrological catchment and catchment stream – London Road and Riverside Close

6.4 Local Flood Risk

6.4.1 Surface water flood risk

A review of the EA's Risk of Flooding from Surface Water (RoFSW) data shows that surface water is predicted to drain towards London Road and eventually spills onto Riverside Close. The mapping also shows that London Road and Riverside Close are both at risk from the 1 in 30 year, 1 in 100 year, and 1 in 1000year rainfall events (see *Figure 6-4*). The predicted surface water extent for the 1 in 1000 year events encroaches onto the impacted property on London Road, with flood depths ranging from 0.15m- 0.9m maximum. The predicted surface water extent for the 1 in 1000 year event also encroaches onto an impacted property on Riverside Close with flood depths ranging from 0.15 – 0.30m maximum. Therefore, Riverside Close and Manor Cottage are at high risk of surface water flooding.

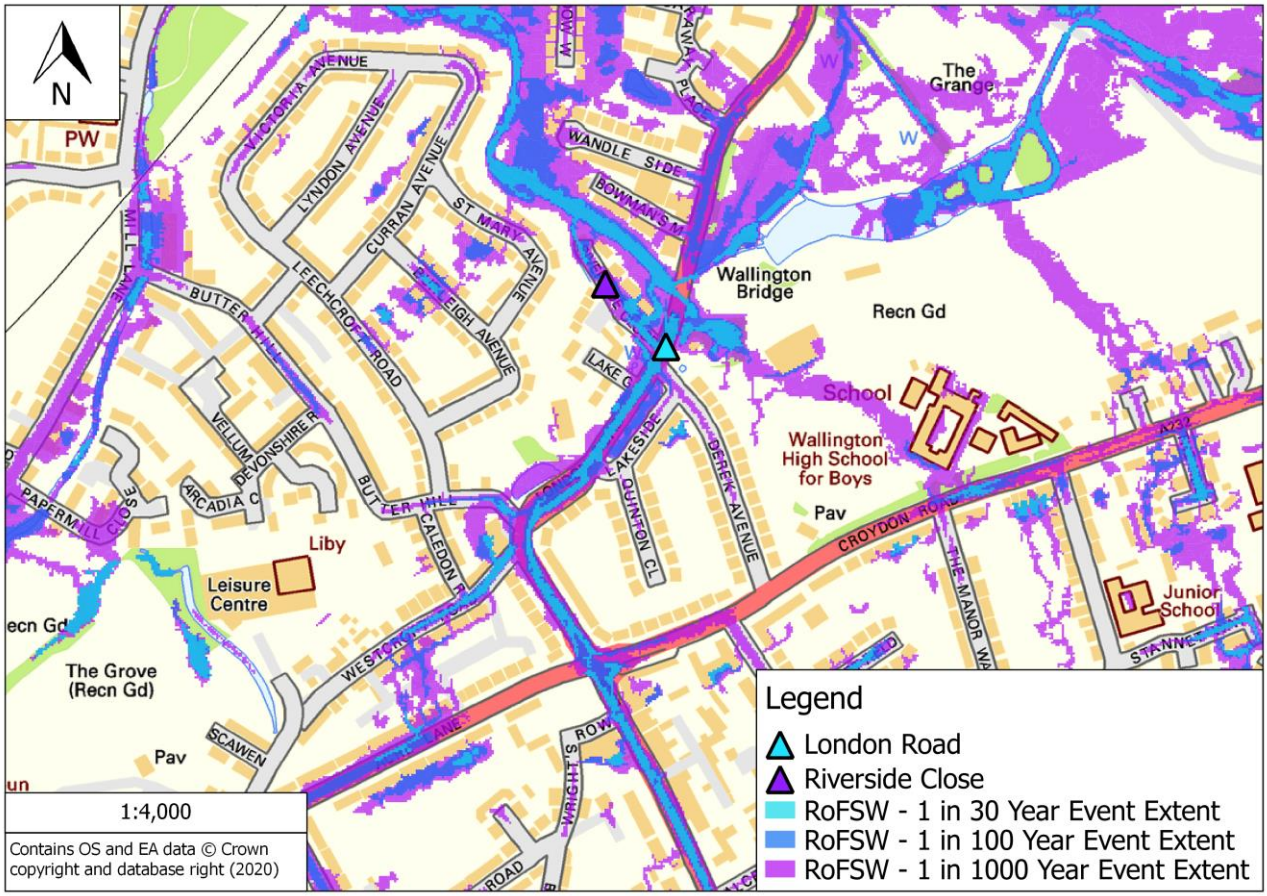

Figure 6-4. Risk of flooding from surface water – London Road and Riverside Close

6.4.2 Ordinary Watercourse flood risk

There are ordinary watercourses which serve as tributaries of the River Wandle that fall within the hydrological catchment (see *Figure 6-5*). A review of the EA Detailed River Network data confirms that there is an ordinary watercourse which lies approximately 11m north of the impacted property on London Road. The ordinary watercourse is a tributary of the River Wandle and flows in a north westerly

direction before discharging into the River Wandle, approximately 40m north west of the impacted property on London Road. A review of the EA RoFSW map shows that water is predicted to overtop the ordinary watercourse's banks during the during the 1 in 1000 year event. This flood source is predicted to partially flow in a southern direction before encroaching onto the impacted property on London Road. There is also a minor ordinary watercourse which connects to the TWUL surface water sewer network alongside Riverside Close approximately 80m south west of the site. Based on this information, both sites are at risk from flooding ordinary watercourses.

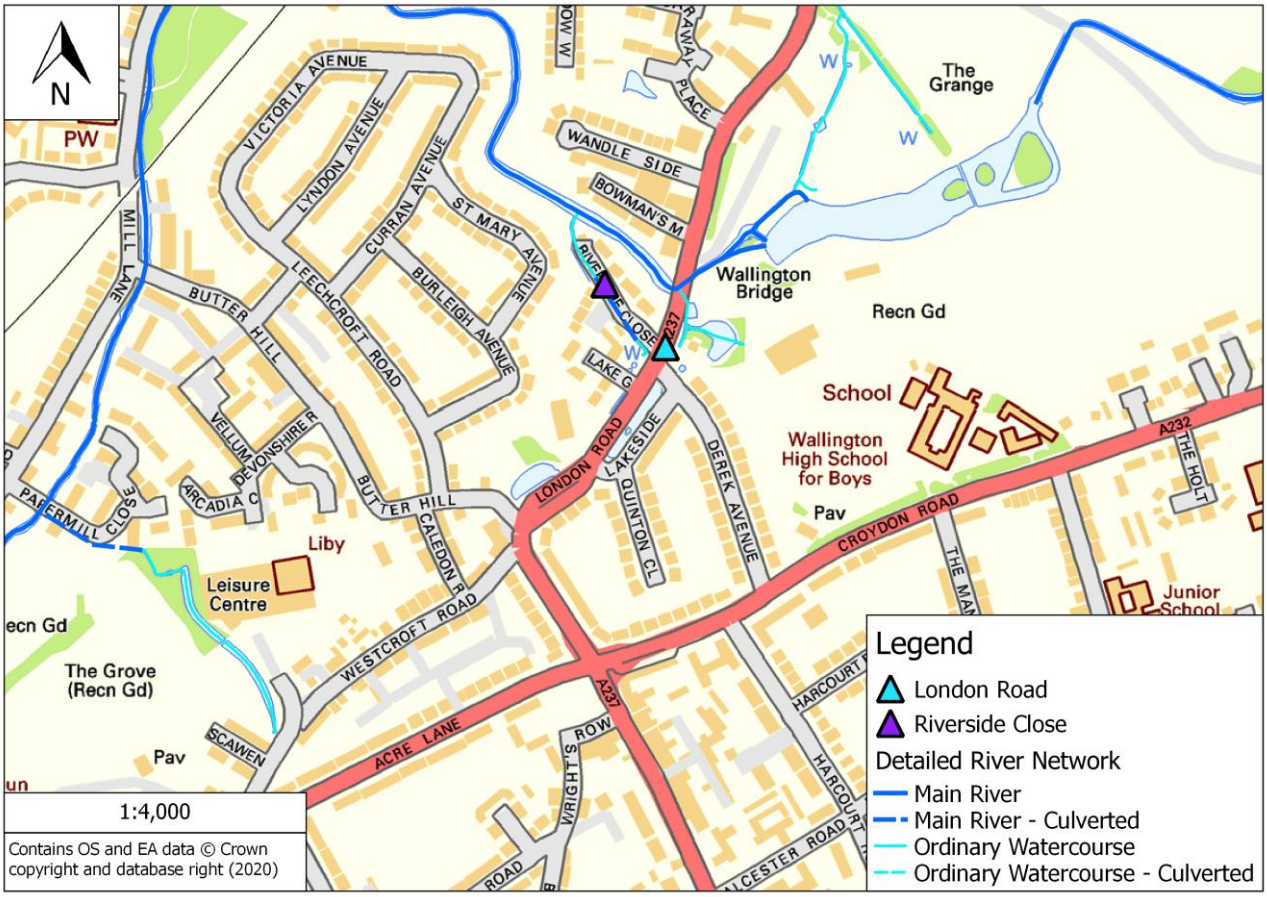

Figure 6-5. Detailed River Network – London Road and Riverside Close

6.4.3 Fluvial Flood Risk

Similarly, to flooding from ordinary watercourses, fluvial flooding can arise as a result of heavy or excessive rainfall causing watercourses to exceed their hydraulic capacity. This source of flooding comes from watercourses that are designated as a main river by the EA.

According to the EA's Flood Map for Planning, Riverside Close and London are both situated in Flood Zone 1 and therefore not at risk of fluvial flooding.

6.4.4 Groundwater Flood Risk

The London Road and Riverside Close hotspot lies within the '>=75%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 6-6*). However, there were no reports of basement or subsurface flooding for both sites during the June 2017 event, flooding which could have been caused by a high groundwater table. Based on the lack of such reports, it is not believed that this flood incident can be attributed to groundwater flood sources.

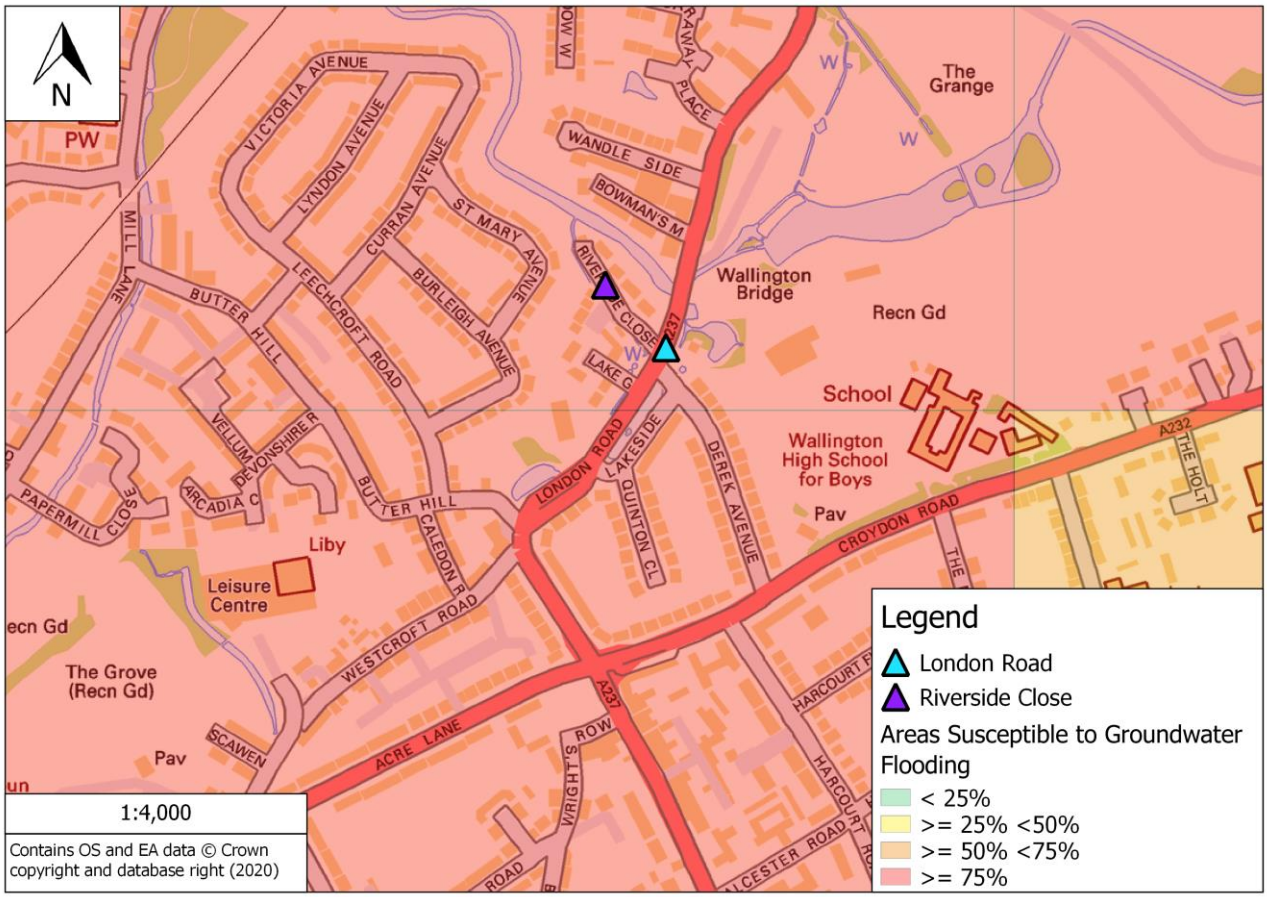

Figure 6-6. Areas susceptible to groundwater flooding – London Road and Riverside Close

6.4.5 Sewer Flood Risk

There is no historical evidence of surcharging manholes or gullies, and no records of sewer flooding in the vicinity of the site. Based on this information, it is believed that this flooding incident cannot be attributed to sewer flood sources.

6.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that London Road and Riverside Close both sits outside of the predicted reservoir flooding extent. Therefore, the London Road and Riverside Close hotspot is not at predicted risk of flooding from other sources.

6.5 Actions taken by relevant RMAs (and other stakeholders affected)

Table 6-1: Risk Management Authorities - Actions

Authority	Authority Response to Flooding
Sutton	***Before*** Sutton Highways redesigned the raised highway table at the junction of Riverside Close in approximately 2007 to limit the amount of surface water flowing off London Road into Riverside Close. Ditch work was also undertaken in the verge around the same time to also better protect lower lying properties on Riverside Close. ***During*** No known actions were taken by Sutton during the flood event. ***After*** Letters were sent to residents to facilitate communication with those who were impacted by the flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Sutton Parks/Highway are proposing to do some drainage works along London Road and Derek Avenue. The works would involve some silt removal and tree root removal from the culvert that runs from the pond under Derek Avenue. The proposed works should remove the culvert blockage and therefore reduce the risk of flooding along London Road and Riverside Close.
TWUL	***Before*** No known actions were taken by TWUL before the flood event. ***During*** No known actions were taken by TWUL during the flood event. ***After*** No known actions were taken by TWUL after the flood event.

6.6 Recommendations

- Sutton to investigate raising kerb levels at Riverside Close to guide surface water away from the sites if feasible.
- Sutton to reinvestigate the raised table road hump at the entrance of Riverside Close to determine if improvements can be made to reduce the risk of surface water entering the lower lying properties and highway without increasing the risks to London Road.
- Sutton Council to collaborate with the affected local residences to explore property level protection.
- Sutton to Investigate mitigation measures such as SuDS which can be incorporated on the site to reduce the risk of flooding.
- In the event of future flooding, Sutton to investigate opportunities for introducing automated traffic diversions, signage, and alarms.

7 HOTSPOT 3 – CARSHALTON HIGH STREET

Carshalton High Street is located in Carshalton, in the centre of the borough. The High Street is a TfL red route and is located in Critical Drainage Area 28 as defined in the Surface Water Management Plan for Sutton.

7.1 Location-wide flood incident(s)

The heavy downpour in the afternoon of June 2nd, 2017 caused properties on Carshalton High Street to experience flooding. Anecdotal evidence from a resident mentioned extensive internal flooding and the need to evacuate the property. According to the resident, surface water travelled along the High Street, pass several flats before entering a property further downstream, with drains unable to cope with the volume of water. A similar incident reportedly happened in 2018. Another resident reported flooding to their kitchen and basement with water coming from the car park and entering through the front door. A shop owner further along the High Street also reported flooding to their property, with surface water entering via the shop front. A large tree on the footpath is believed to have exacerbate the flooding.

7.2 Local drainage network

There is one surface water sewer serving Carshalton High Street. The surface water sewer flows along Carshalton High Street in a north easterly direction. This surface water sewer originates from Seymour Road, to the south of the hotspot , and flows in a northerly direction perpendicularly to Talbot Road and Brookside until reaching the High Street, with the pipe diameter starting at 950mm and then splitting into two 375mm pipes. Both pipes change direction on the High Street and combine with a third 375mm diameter pipe flowing in a northerly direction along Carshalton Place. All three pipes combine into a single 450mm diameter pipe that follows the High Street. At the intersection between Carshalton High Street, Acre Lane, and Westcroft Road, another surface water sewer with a 305mm diameter discharges into the 450mm diameter pipe. The 450mm pipe is split in two 450mm diameter pipes before discharging to a waterbody to the east of the Grove park.

The is a 200mm foul sewer along Carshalton High Street that flows in a north easterly direction. Two 229mm foul sewers connect to the 200mm pipe at the intersection with Carshalton Place and Rotherfield Road respectively. The foul sewer along Carshalton High Street combines with a 200mm pipe originating from Acre Lane and Park Lane before diverting to Westcroft Road. See *Figure 7-1* for the surface water and foul network in the local area.

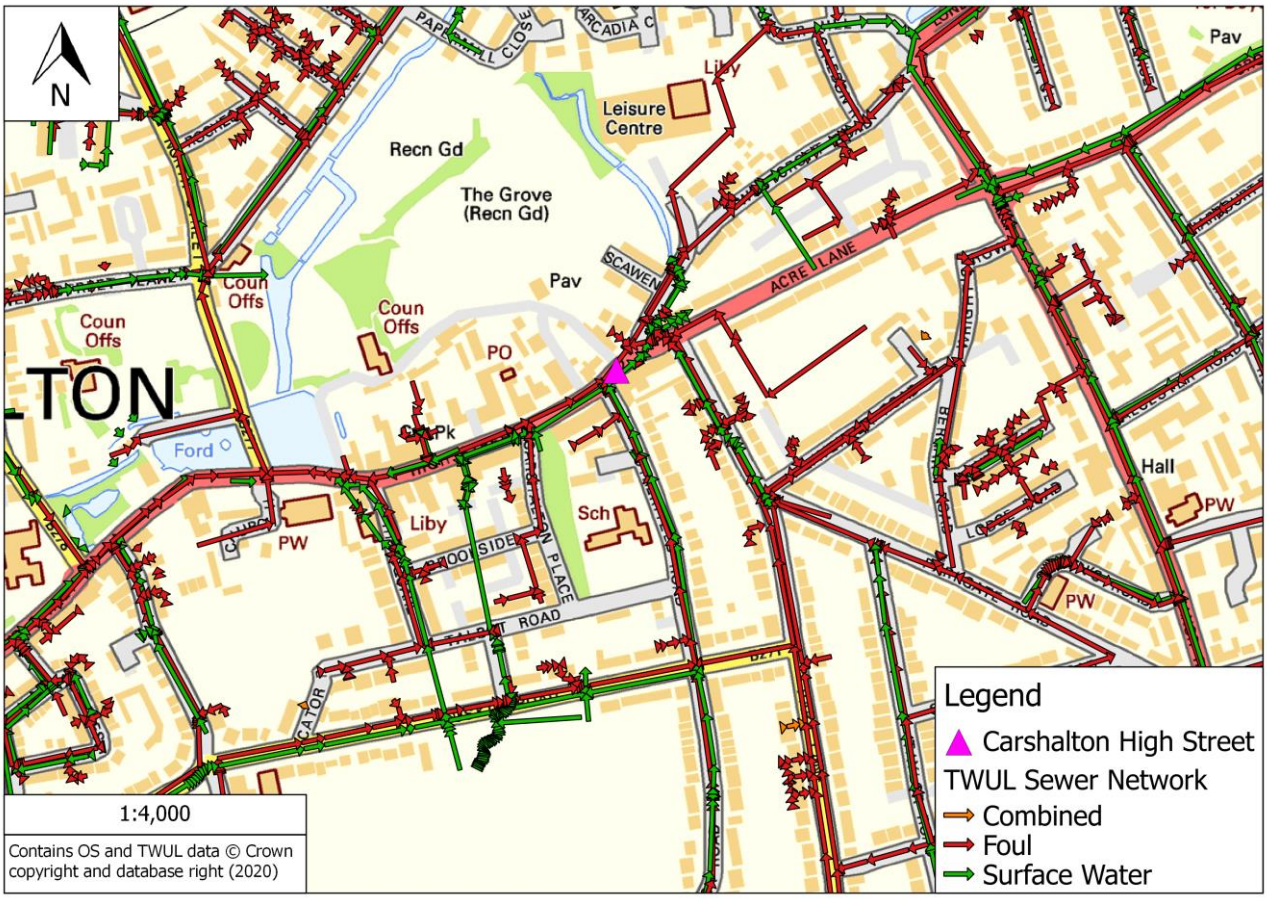

Figure 7-1. Local sewer network – Carshalton High Street

There are no known soakaways in the immediate hotspot area. There are soakaways located southeast of the hotspot along Lavender Road. Their condition ranges from 'poor' to 'fair'. Their location is shown in *Figure 7-2*.

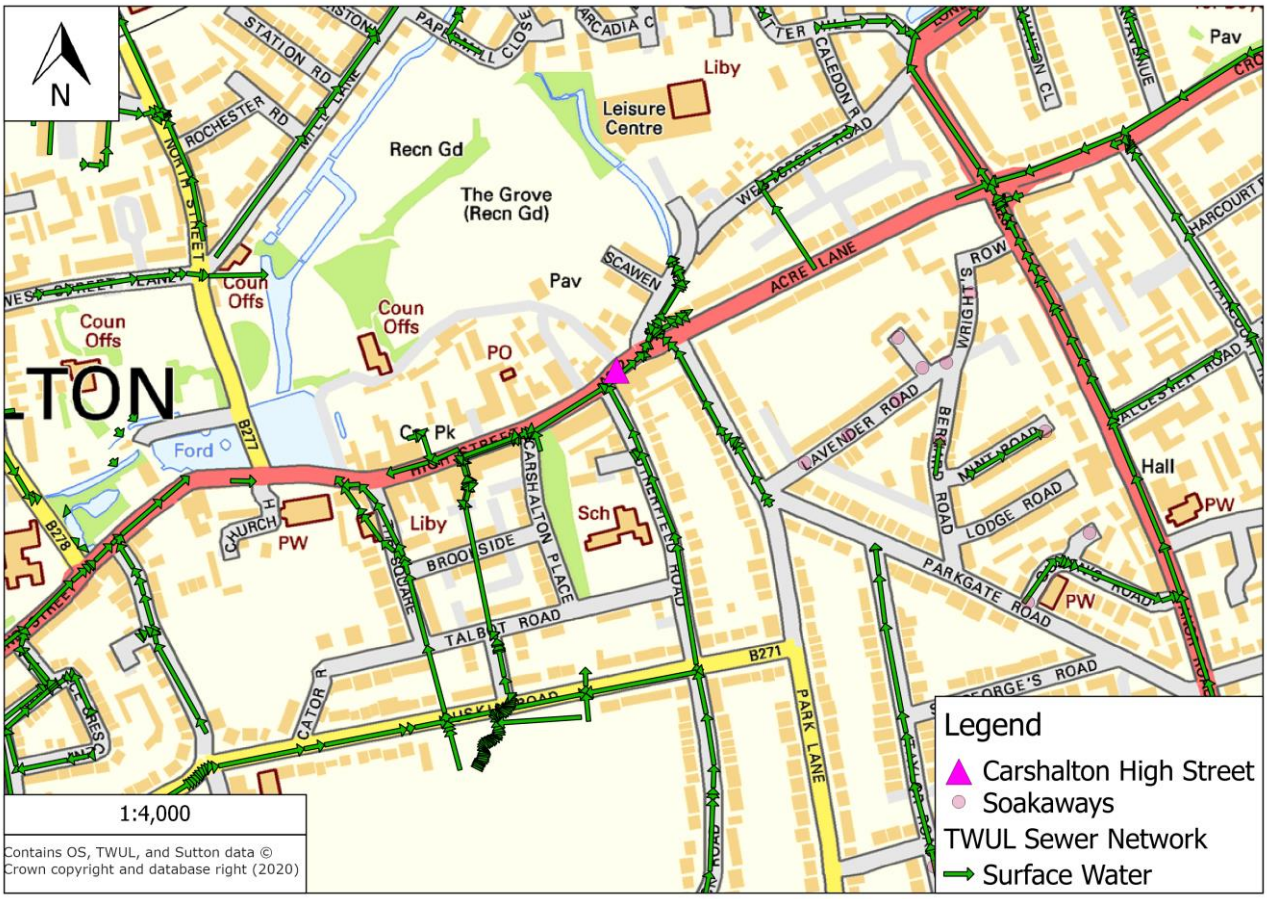

Figure 7-2. Surface water sewer network and soakaways – Carshalton High Street

7.3 Local flood mechanism

Analysis of the area using a GIS provided several outputs, including defined hydrological catchments and primary flow paths (shown as 'Hydrological Catchment Stream' in *Figure 7-3*). LiDAR data shows that Carshalton High Street lies within a topographical low point within the hydrological catchment. This means that surface water within the defined catchment will naturally drain towards Carshalton High Street. Therefore, the properties along Carshalton High Street would be considered be located within a flood hotspot.

The primary flow paths are the main overland flow route for surface water in the defined catchment. The main overland flow route for the catchment area flows in a north easterly direction towards River Wandle. The properties that reported flooding lie on the overland flow path of the catchment.

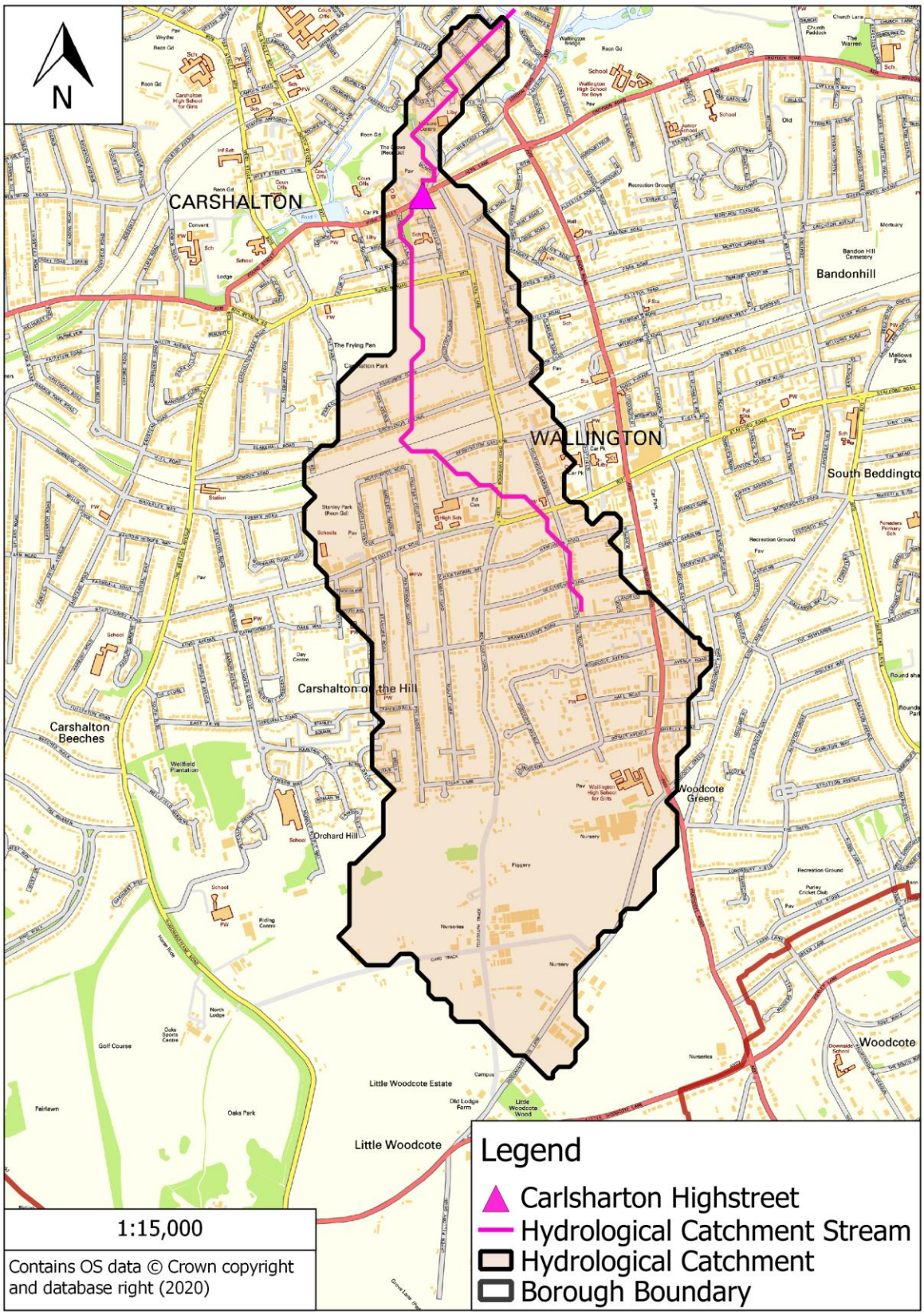

Figure 7-3. Hydrological Catchment – Carshalton High Street

7.4 Local Flood Risk

7.4.1 Surface water flood risk

A review of the EA's Risk of Flooding from Surface Water (RoFSW) data shows that surface water is predicted to drain towards Acre Lane, largely from Carshalton Place and Park Lane. The mapping also shows that Carshalton High Street is at risk from the 1 in 100 year, and 1 in 1000 year rainfall events (see *Figure 7-4*). The predicted flood depths for the 1 in 1000 year event range from 0.3m to 0.6m maximum at the transition from Carshalton High Street to Acre Lane. The predicted flood depths for the 1 in 1000 year along Carshalton High Street range from 0.3m to 0.6m maximum, with very localised flooding. Flooding is predicted to occur at the roads adjacent to the High Street during the 1 in 1000 year event, with flood depths greater than 1.2m along Carshalton Place. Therefore, Carshalton High Street is at medium risk of surface water flooding.

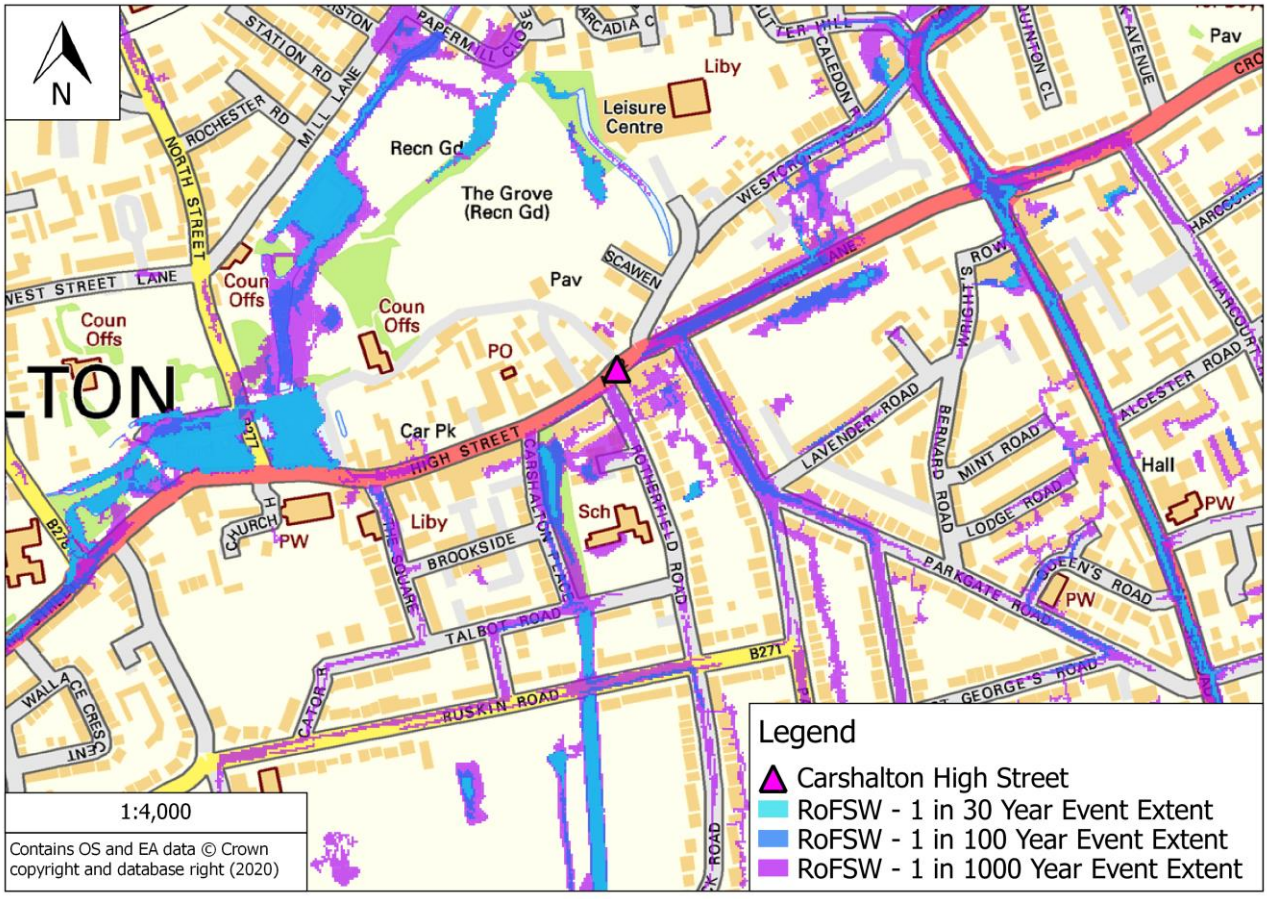

Figure 7-4. Risk of flooding from surface water – Carshalton High Street

7.4.2 Ordinary Watercourse flood risk

There is an ordinary watercourse that falls within the same hydrological catchment as the Carshalton High Street hotspot (see *Figure 7-5*). A review of the EA Detailed River Network data confirms that there is an ordinary watercourse which lies approximately 260m north east of Carshalton High Street.

The ordinary watercourse, known locally as the Westcroft Canal, is a tributary of the River Wandle and flows in a north westerly direction before discharging into the River Wandle, approximately 550m from Carshalton High Street. A review of the EA RoFSW map shows that water is not predicted to overtop the ordinary watercourse's banks during the during the 1 in 1000 year event.

An additional ordinary watercourse channel, known locally as the Grotto Canal, feeds the Westcroft Canal. According to anecdotal data from Sutton Highways staff, until the winter of 2013/14 the Grotto Canal had been dry, but since has occasionally been fed by groundwater-influenced sources and flows above ground for several months at a time. The EA are currently consulting on whether this (and the Westcroft Canal) should be added to the main river network, but due to its groundwater-influenced nature it is not currently shown in either dataset shown in *Figure 7-5*. Therefore, Carshalton High Street is considered at risk of flooding from ordinary watercourses, the risk shown in *Figure 7-4*.

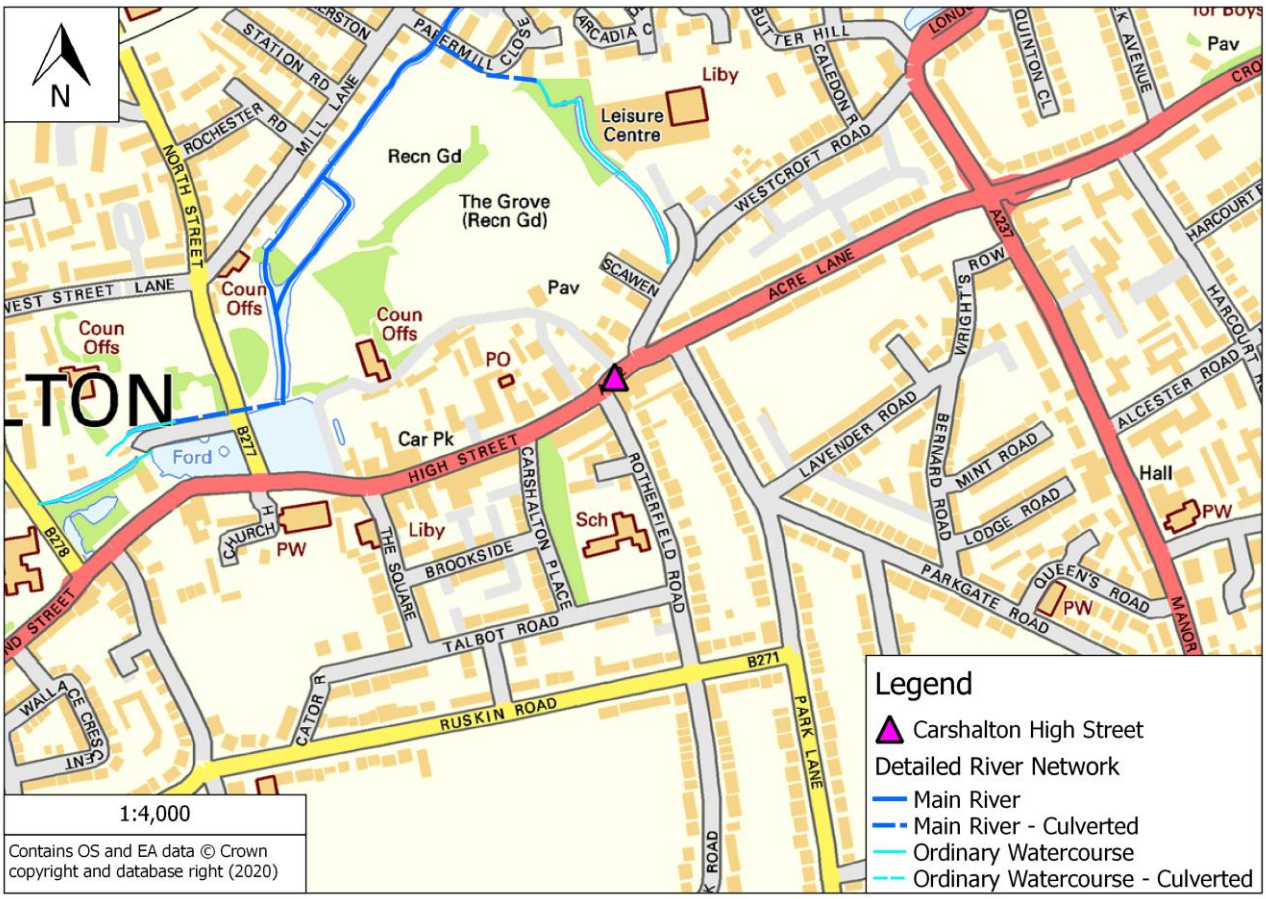

Figure 7-5. Detailed River Network – Carshalton High Street

7.4.3 Fluvial Flood Risk

Similarly, to flooding from ordinary watercourses, fluvial flooding can arise as a result of heavy or excessive rainfall causing watercourses to exceed their hydraulic capacity. This source of flooding comes from watercourses that are designated as a main river by the EA. Carshalton High Street is situated in Flood Zone 1 and therefore is not at risk of fluvial flooding.

7.4.4 Groundwater Flood Risk

The Carshalton High Street hotspot lies within the '>=75%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 7-6*). There was one report of flooding basement flooding at a property during the June 2017 event. However, flooding was reported to be caused by water entering through the front door. Due to the groundwater-influenced Grotto Canal the flood incident may have been partly attributed to groundwater flood sources, but anecdotal reports and the interlinkages between surface water runoff and local drainage systems in this area suggest groundwater was not the likely cause.

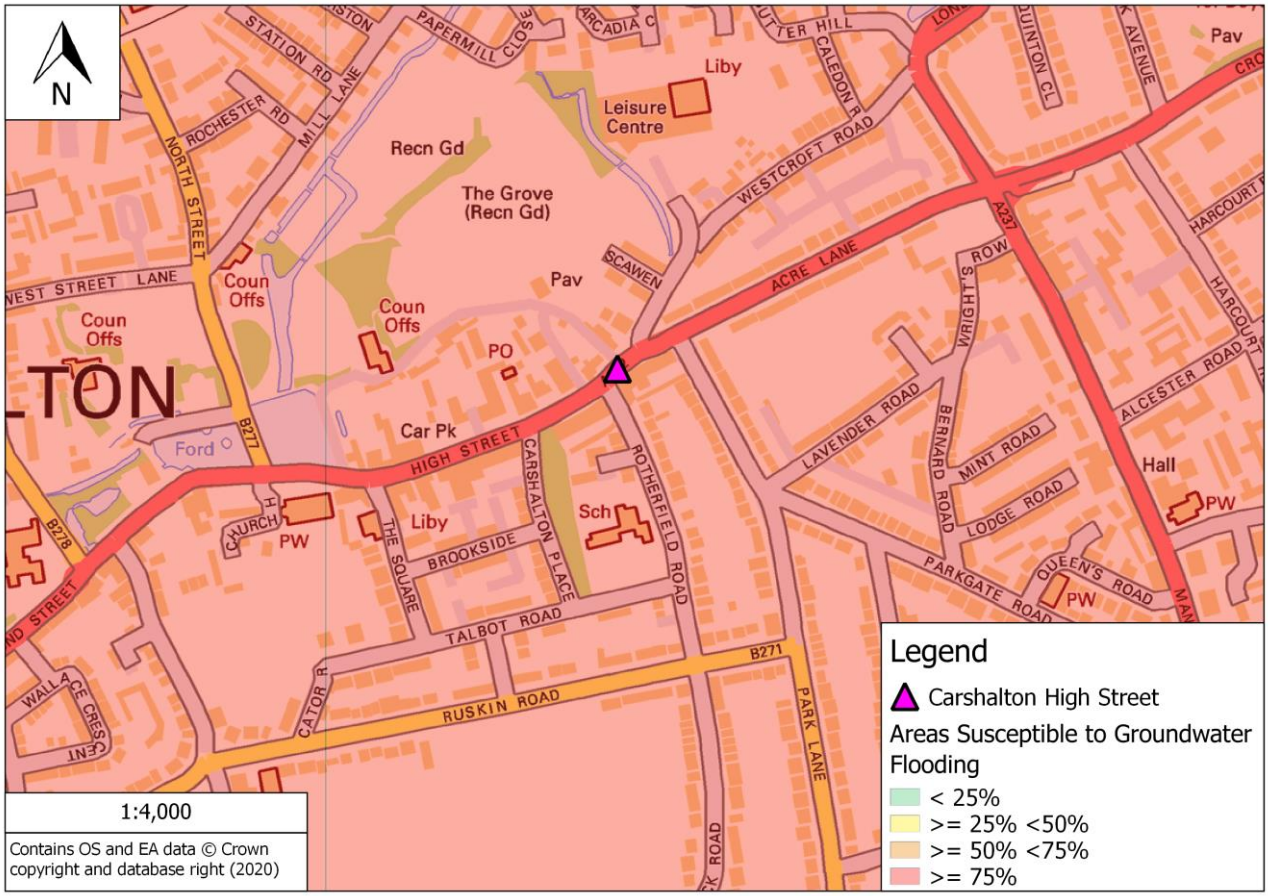

Figure 7-6. Areas susceptible to groundwater flooding – Carshalton High Street

7.4.5 Sewer Flood Risk

It was reported by residents that a drain on Carshalton High Street near one of the impacted properties was overwhelmed during the June 2017 storm event. Looking at the local drainage network, this corresponds to a section of the High Street where there is a single 450mm surface water pipe. As this pipe is the result of three 375mm diameter pipes combining, its capacity might not be sufficient to cope with surface water runoff during higher storm events. Based on this information, it is believed that this flooding incident can be attributed to sewer flood sources.

7.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Carshalton High Street sits outside of the predicted reservoir flooding extent. Therefore, Carshalton High Street is not at predicted risk of flooding from other sources.

7.5 Actions taken by relevant RMAs (and other stakeholders affected)

Table 7-1: Risk Management Authorities - Actions

Authority	Authority Response to Flooding
Sutton	***Before*** Carshalton Road lies within the CDA29/30 catchment boundary and was modelled as part of the CDA29/30 hydraulic model. ***During*** No known actions were taken by Sutton during the flood event. ***After*** Letters were sent to residents to facilitate communication with those who were impacted by the flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report.
TWUL	***Before*** No known actions were taken by TWUL before the flood event. ***During*** No known actions were taken by TWUL during the flood event. ***After*** No known actions were taken by TWUL after the flood event.
TfL	***Before*** No known actions were taken by TfL before the flood event. ***During*** No known actions were taken by TfL during the flood event.

	After 43-51 High Street Carshalton, July 2017: Following complaints of flooding to properties along High Street Carshalton near the junction of Westcroft Road, the gullies along this section were cleaned by TfL with no defects found. It was noted that the gullies were located close to vegetation and shrubs, with gully grates covered with rotting vegetation which were blocking the flow of water. 96 High Street Carshalton, November 2018: A jet and cleanse was undertaken due to constant carriageway flooding and blocked gullies adjacent to the bus stop build out. The cleansing report noted no defects and the gully was running. TfL believe that the blockage was most likely caused by litter and leaves rather than a capacity issue. 39 High Street Carshalton, February 2020: A jet and cleanse found a large build up of silt and debris within the pot. 45 Acre Lane, June 2017: A report was received that surface water entered the property at 45 Acre Lane. TfL investigated this via CCTV survey, and no defects were reported. The investigation noted that the connections from the gullies opposite 45 Acre Lane were lower than the surface water pipe, which increases the risk of silt build up. Minor repairs were required to the connecting lines to the gullies outside 45 Acre Lane, which TfL believe were damaged during a utility cable installation.
Blue Emergency Services	***Before*** No known actions were taken by Blue Emergency Services before the flood event. ***During*** The London Fire Brigade was called out to a property on the High Street as there was extensive flooding to the basement. The London Fire Brigade did not pump out any water. ***After*** Sandbags were placed by emergency services in front of the door as a temporary measure to prevent further flooding, on the initiative of the resident.

7.6 Recommendations

- TWUL, in partnership with TfL, should conduct a detailed investigation of the surface water network along the High Street, with an emphasis on the capacity of the section with a single 450mm pipe.

- TWUL, in partnership with TfL, should review their maintenance strategy for the surface water sewer network along the High Street.
- TWUL, in partnership with TfL, should investigate the impact of the large tree on surface water drainage.
- TWUL, in partnership with TfL, should investigate the drains which surcharged during the flood event to understand why they may have surcharged.
- Sutton to investigate frequency of street cleansing to prevent blocking of gullies by litter and debris.
- Sutton to investigate if the car park at the rear of one of the properties which experienced flooding is maintained properly, and if SuDS measures would be suitable to prevent future flooding.
- Sutton should arrange to meet with TfL and residents to discuss further flood risk issues.
- Sutton, in partnership with the EA, should continue to use outputs from the CDA29/30 hydraulic modelling study to better understand the interrelated drainage network of groundwater and surface water flood risk sources of the Grotto Canal and determine whether it (and the Westcroft Canal) should be defined as main rivers.

8 HOTSPOT 4 – STANLEY PARK ROAD AND WARNHAM COURT ROAD

Stanley Park Road and Warnham Court Road lie within Carshalton Beeches, in the centre of the borough.

8.1 Location-wide flood incident(s)

Due to the heavy downpour in the afternoon of June 2nd, 2017, flooding occurred on the highway by three properties on Stanley Park Road. Residents have reported the issue and explained that flooding is an ongoing issue in the local area. Reports suggest that the drain adjacent to these properties has been overwhelmed by the volume of surface water runoff on several occasions, which in turn leads to a rise in surface water pooling. Surface water subsequently breaches the kerbing and flows down the front path of the houses as these are topographically lower than street level. Residents have also pointed out that a speed hump introduced on the corner of Stanley Park and Warnham Court Road acts like a dam, worsening the issue.

8.2 Local drainage network

Figure 8-1 shows the TWUL sewer network within the local area. There are two short surface water sewer pipes along Stanley Park Road that connect at the intersection with Warnham Court Road. One pipe has a 152mm diameter and flows in an easterly direction, starting in Stanley Park Road between the intersections with Crichton Road and Balfour Road. The other pipe has a 203mm diameter and flows in a westerly direction, starting in Stanley Park Road between the intersections with Fir Tree Grove and Warnham Court Road. Both surface water pipes flow towards the junction between Stanley Park Road and Warnham Court Road and discharge into a 203mm diameter surface water sewer that flows in a northerly direction first and then in a westerly direction as it follows the curve of Warnham Road. At the bend in the road, the diameter changes from 203mm to 229mm and the pipe flows in a northerly direction until the junction with Sussex Road. A separate surface water pipe with a 152mm diameter starts from the upper section of the east branch of Warnham Court Road, flows in a northerly direction and is diverted onto Sussex Road where the diameter increases to 229mm. Both pipes combine into a single 225mm diameter surface water pipe that flows in a northerly direction and passes under the train tracks between Sussex Road and Gordon Road. The surface water sewer ultimately discharges into the Carshalton Ponds located approximately 1.2km to the north of Stanley Park Road and Warnham Court Road.

There is also a separate foul sewer network. One foul sewer flows from east to west along Stanley Park Road towards Beeches Avenue. The diameter of the pipe along Stanley Park Road is 305mm. The junction between Stanley Park Road and Warnham Road is a connection point for another foul sewer of 229mm

diameter that flows in a northerly direction, starting in Stanley Square. Within Warnham Court Road, two foul sewers flow towards Sussex Road, one on the east branch and the other on the west branch of Warnham Court Road.

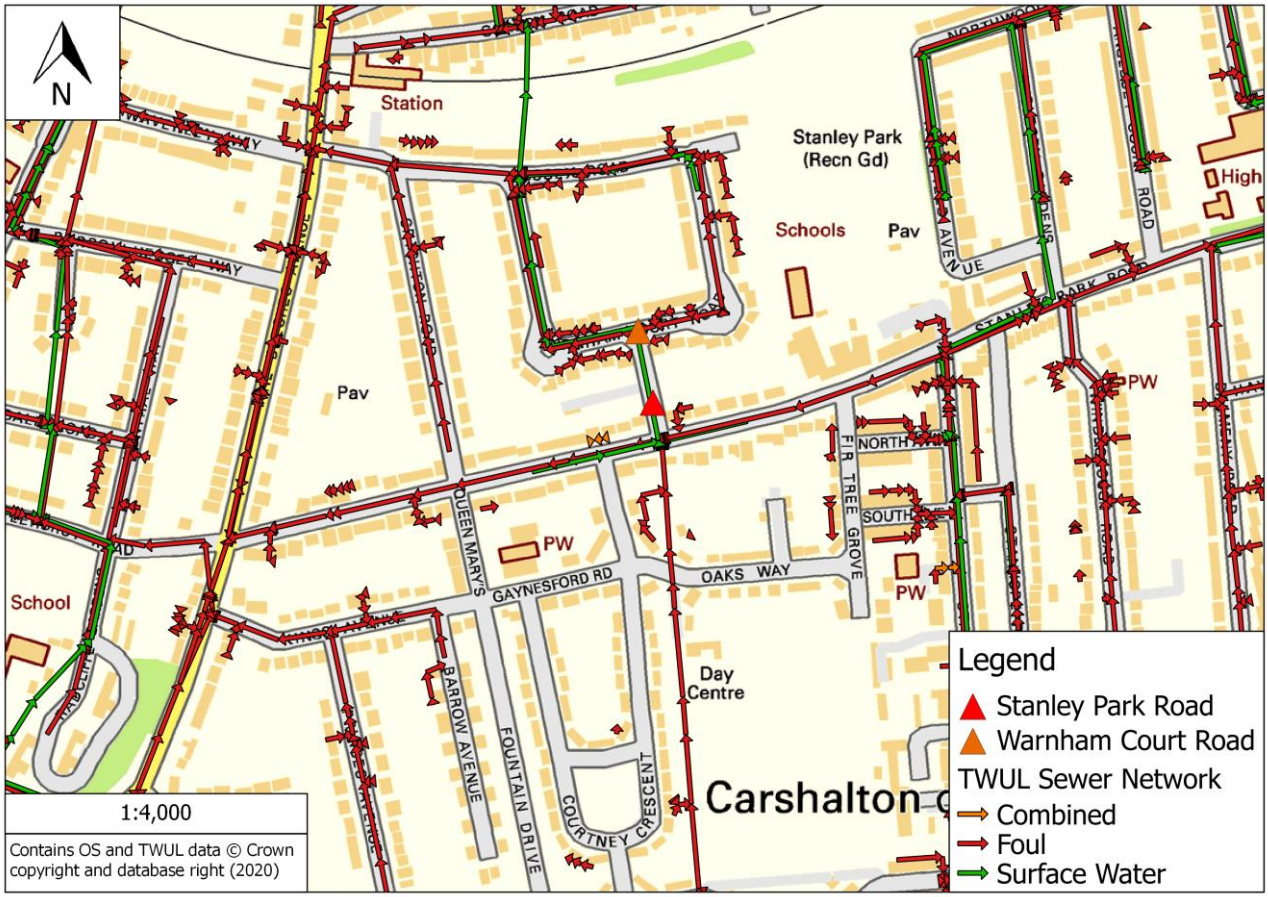

Figure 8-1. Local sewer network – Stanley Park Road and Warnham Park Road

There are also multiple soakaways in the local area due to the underlying chalk geology. Nine soakaways with diameters ranging from 1.2m to 2.3m are spread throughout both branches of Warnham Court Road. There is an additional soakaway at the intersection between Warnham Court Road and Stanley Park Road. Four soakaways with a 2m diameter are located along Sussex Road. For further information on soakaways in the local area, see

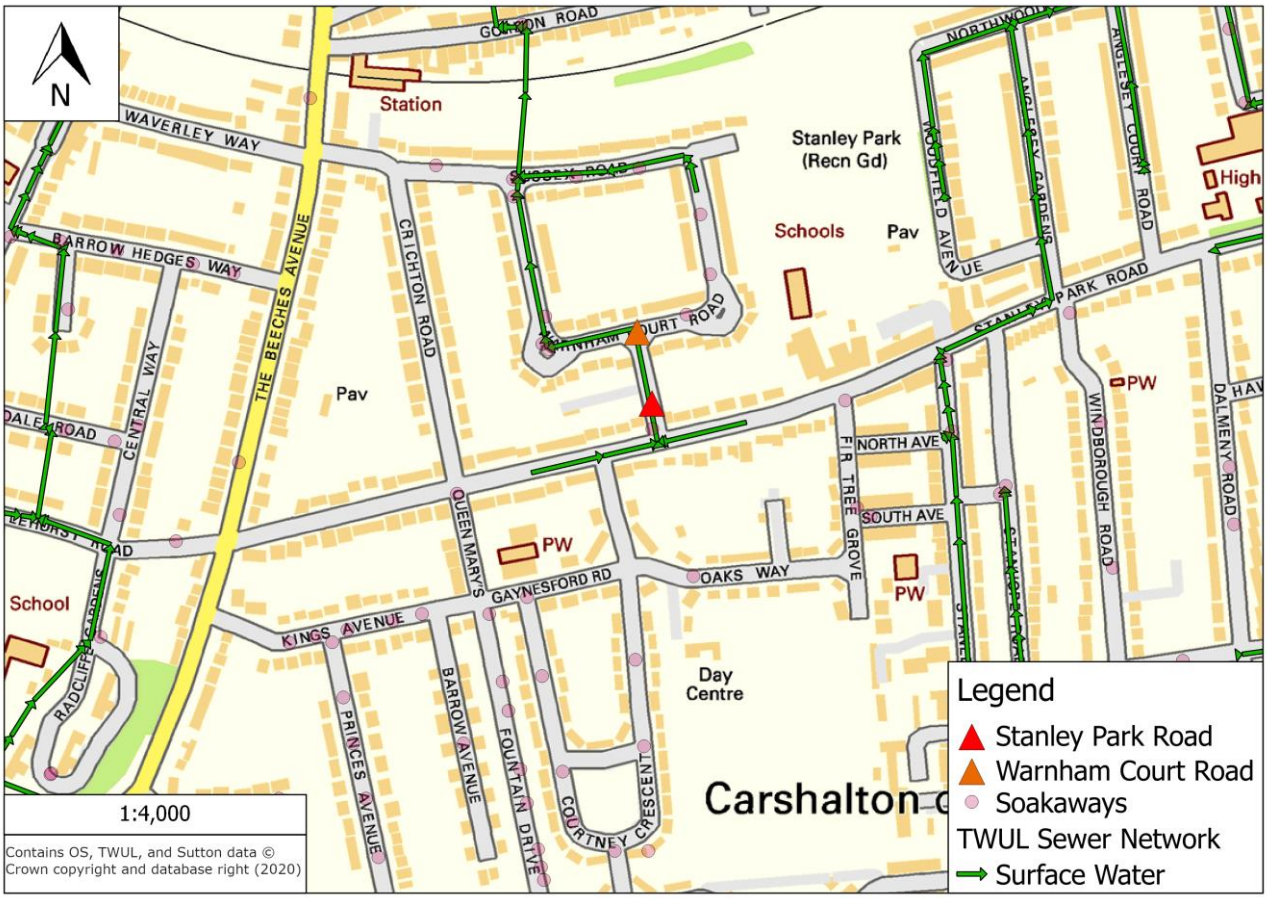
N
Station
Stanley Park (Recn Gd)
Schools
Pav
WAVERLEY WAY
BARROW HEDGES WAY
THE BEECHES AVENUE
CRICHTON ROAD
CENTRAL WAY
DALE ROAD
QUEEN MARY'S
GAYNESFORD RD
OAKS WAY
NORTH AVE
SOUTH AVE
FIR TREE GROVE
PARK ROAD
WINDBOROUGH ROAD
DALMENY ROAD
ANGLESEY COURT ROAD
PW
School
KINGS AVENUE
PRINCES AVENUE
BARROW AVENUE
FOUNTAIN DRIVE
COURTNEY CRESCENT
Day Centre
Carshalton
1:4,000
Contains OS, TWUL, and Sutton data © Crown copyright and database right (2020)
Legend
Stanley Park Road
Warnham Court Road
Soakaways
TWUL Sewer Network
Surface Water

Figure **8-2**

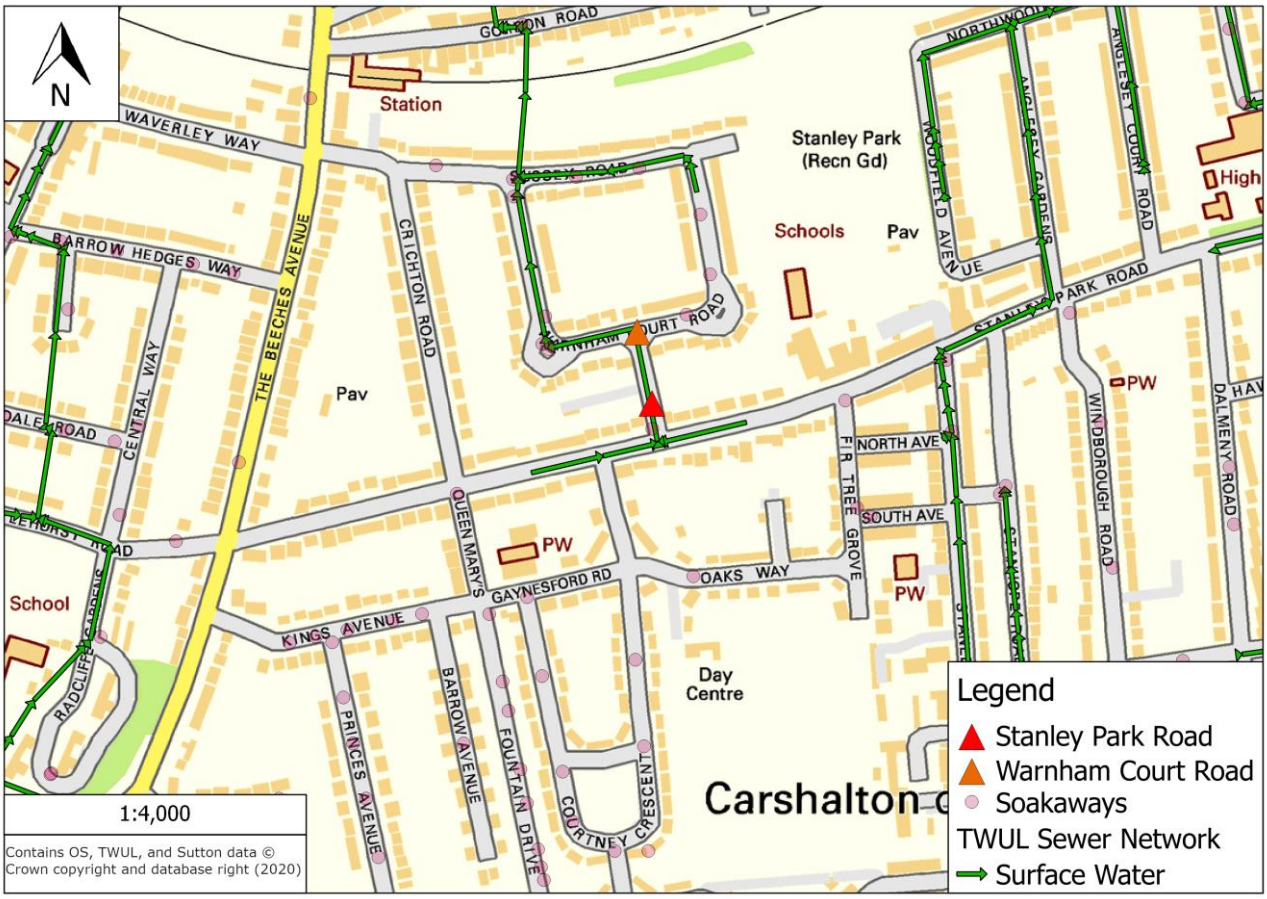

Figure 8-2. Surface water sewer network and soakaways – Stanley Park Road and Warnham Park Road

8.3 Local flood mechanism

Analysis of the area using a GIS provided several outputs, including defined hydrological catchments and primary flow paths (shown as 'Hydrological Catchment Stream' in *Figure 8-3*). LiDAR data shows that the intersection between Warnham Court Road and Stanley Park Road lies within a topographical low point within the hydrological catchment. Surface water that falls within the defined catchment to the south of this location will naturally drain in a northernly direction towards Warnham Court Road and Sussex Road.

Figure 8-3. Hydrological Catchment – Stanley Park Road and Warnham Park Road

8.4 Local Flood Risk

8.4.1 Surface water flood risk

A review of the EA's Risk of Flooding from Surface Water (RoFSW) data shows that surface water is predicted to flow towards the junction between Stanley Park Road and Warnham Court Road. Surface water also accumulates along the west branch of Warnham Court Road and to the north of Sussex Road, along the railway line. The mapping also shows that properties on the junction between Warnham Court Road and Stanley Park Road are at predicted risk of flooding from the 1 in 30 year, 1 in 100 year, and 1 in 1000 year rainfall events (see *Figure 8-4*). In the 1 in 1000 year rainfall event, the predicted flood depths range from 0.6m to 0.9m maximum for the properties by the Stanley Park Road and Warnham Court Road intersection. In the 1 in 100 year rainfall event, the maximum flood depth is between 0.3 and 0.6m. Properties on the west branch of Warnham Court Road are predicted to experience similar maximum flood depths for both the 1 in 100 year and the 1 in 1000 year rainfall events. Therefore, Warnham Court Road and the Stanley Park Road junction are at high risk of surface water flooding.

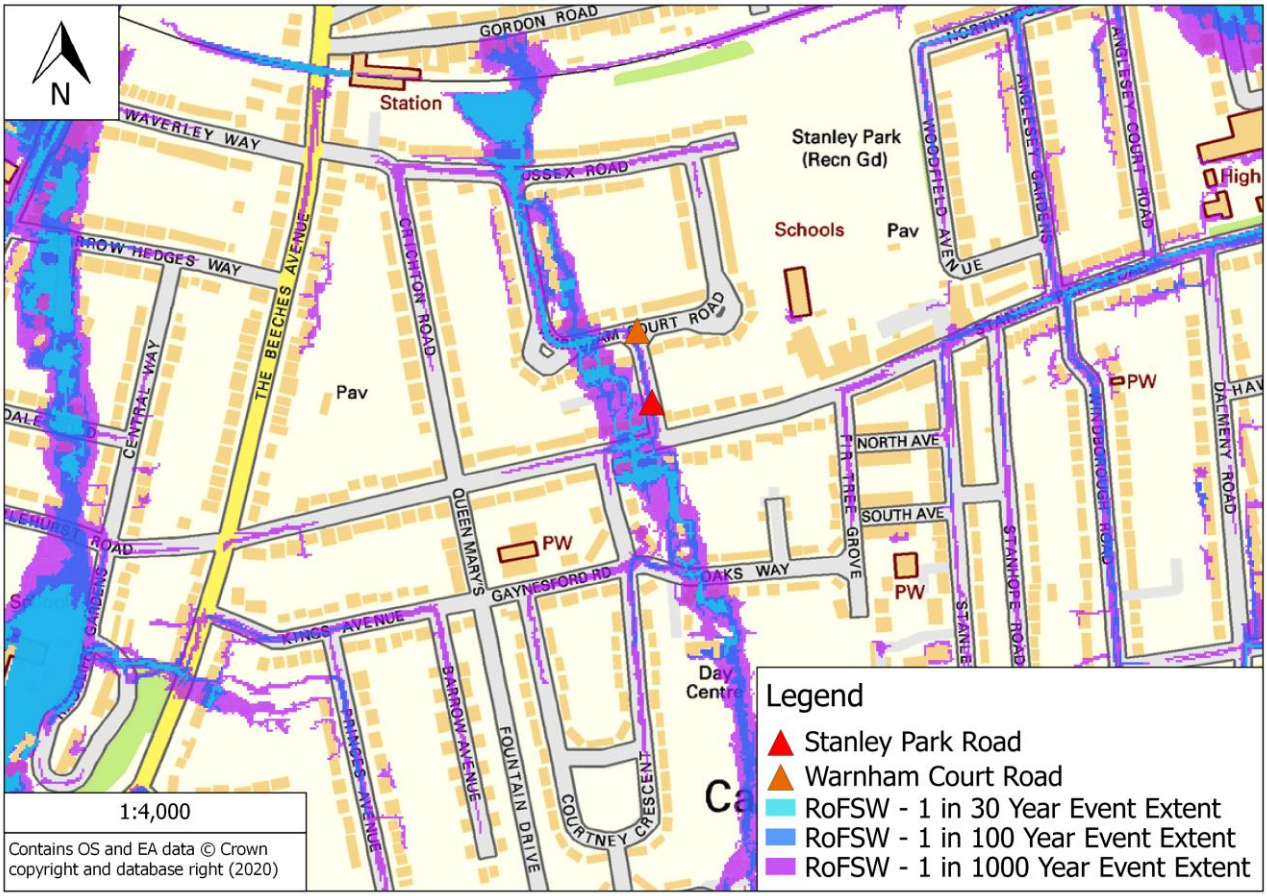

Figure 8-4. Risk of flooding from surface water – Stanley Park Road and Warnham Park Road

8.4.2 Ordinary Watercourse flood risk

Flooding from ordinary watercourses is included within the EA's RoFSW map. There is no ordinary watercourse within the vicinity of Warnham Road and Stanley Park Road. Therefore, Warnham Court Road and Stanley Park Road is not at risk of flooding from ordinary watercourses.

8.4.3 Fluvial Flood Risk

Warnham Court Road and Stanley Park Road are both situated in Flood Zone 1 and therefore are not at risk of fluvial flooding.

8.4.4 Groundwater Flood Risk

The intersection between Warnham Court Road and Stanley Park Road lies within the '>=50% <75%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 8-5*). However, there were no reports of basement or subsurface level flooding during the June 2017 event, flooding which could have been caused by a high groundwater table. Based on the lack of such reports, it is not believed that this flood incident can be attributed to groundwater flood sources.

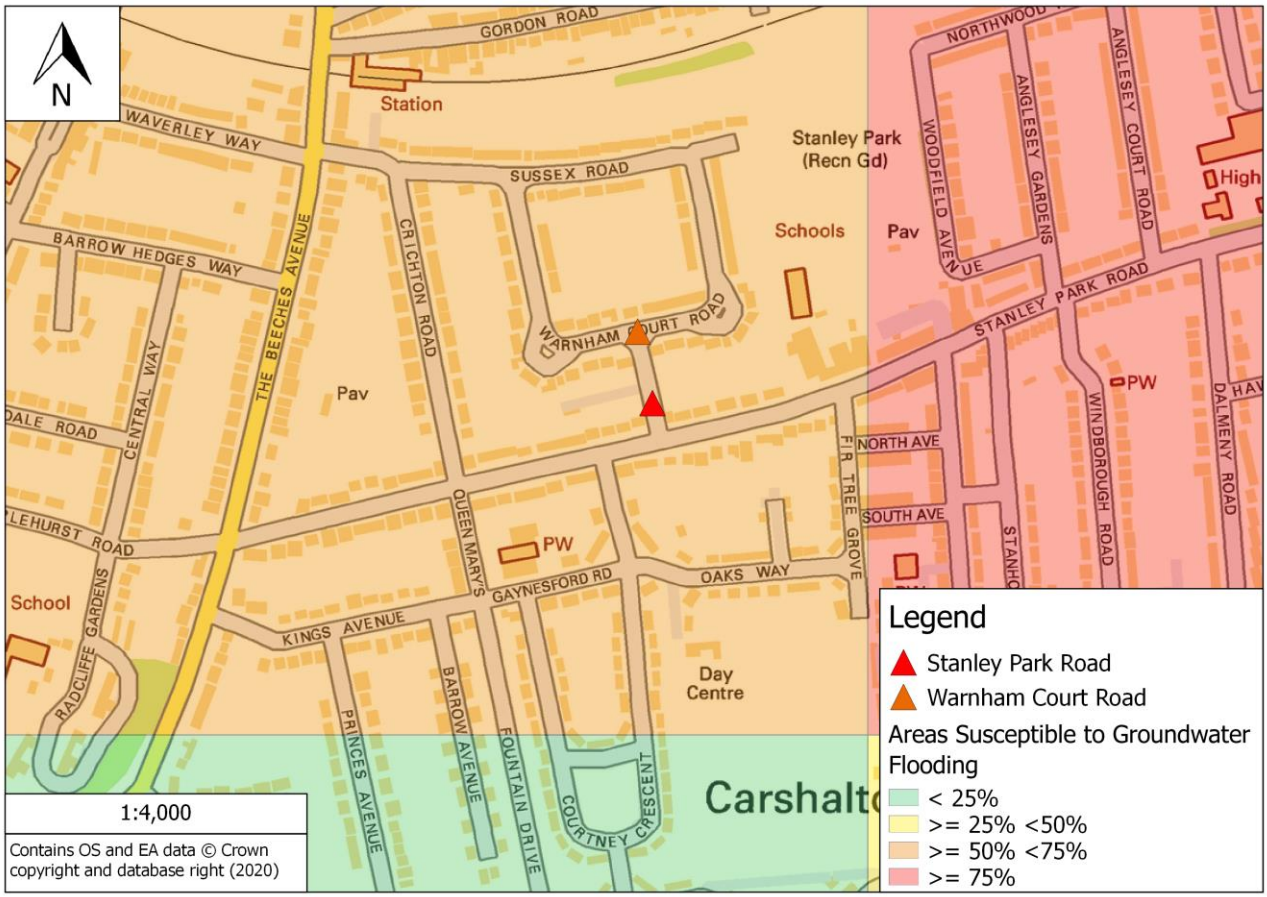

Figure 8-5. Areas susceptible to groundwater flooding – Stanley Park Road and Warnham Park Road

8.4.5 Sewer Flood Risk

As mentioned in *Chapter 8.1*, anecdotal evidence from residents would suggest that one of the drains along Stanley Park Road was overwhelmed with water during the rainfall event. However, as the surface sewer network for Warnham Court Road originates in close vicinity to the intersection, it would suggest that there may be insufficient capacity in the network to accommodate surface water runoff. Based on this information, it is believed that this flooding incident can be attributed to sewer flood sources.

8.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Warnham Court Road and Stanley Park Road sit outside of the predicted reservoir flooding extent. Therefore, the intersection between Warnham Court Road and Stanley Park Road is not at predicted risk of flooding from other sources.

8.5 Actions taken by relevant RMAs (and other stakeholders affected)

Table 8-1: Risk Management Authorities - Actions

Authority	Authority Response to Flooding
Sutton	***Before*** Gullies were cleaned on 27/08/2015 ***During*** No known actions were taken by Sutton during the flood event. ***After*** Residents were contacted by email and asked for some photos. They were told to report the sewer issues to TWUL and that the flooding event would be investigated. The engineer responsible for the speed ramp was contacted and responded that the gullies were left untouched and should not be causing an issue. A site visit was carried out by the Sutton Highways Inspector and the LLFA on 23/01/2018. During the site visit, it was unclear how water could travel down the resident's path as there is a wider corner footway with good kerb height. It was established that the only way water could get on to the footway would be through water surcharging from the BT chamber to one side of the property, which would only happen in storm conditions.

	A second site visit was organised during heavy rainfall and there was no flooding. Water was flowing along the front edge of the speed hump and not damming. The resident had re-sited his entrance more into Warnham Court Road and is now not protected by the high kerb face. A third site visit by the LLFA was carried out on 22/02/2018. Gully cleaning was requested for the gully on Warnham Ct Road to the side of 184 Stanley Park Road. The Highways Inspector confirmed that an extra channel installed in the speed hump would have no impact as long as all assets are cleaned regularly. Soakaways near Warnham Court were cleansed in 25/08/2018. Three soakaways along the pathways on Sussex Road were cleared on 26/09/2019.
TWUL	***Before*** No known actions were taken by TWUL before the flood event. ***During*** No known actions were taken by TWUL before the flood event. ***After*** TWUL carried out a CCTV survey on the 05/03/2018 and 09/03/2018 which identified a build-up of silt. A clean of 300m of sewer in Warnham Court Road and Stanley Park Road took place on 23/03/2018. A subsequent CCTV survey was completed on 23/03/2018 and no issues were found, with all pipes deemed operational. A CCTV survey in Stanley Park Road was carried out in January 2020. Structural defects such as cracks were identified in one section. Another section presented multiple defects suggesting that the pipe is at immediate risk or backing up and/or causing flooding. The surveys had to be abandoned at multiple sections due to a large volume of settled deposits leading to up to 80% cross sectional area loss. TWUL organised for a clean of the local sewer network for 06/02/2020. TWUL has confirmed that the sewer has been cleaned and lined.

8.6 Recommendations

Following the June 2017 flood event, Sutton has collaborated with TWUL to investigate the flooding mechanism for this location and carry out mitigation measures. The Sutton Highways Inspector and LLFA visited the site multiple times and coordinated the gully cleansing and CCTV surveys.

Further recommendations include:

- Sewer pipe sections identified as damaged in the 2020 CCTV survey should be investigated by TWUL and appropriate measures taken.
- Regular cleaning of the gullies at the junction between Warnham Court Road and Stanley Park Road should be carried out.
- Regular cleaning of the soakaways within the vicinity of Stanley Park and Warnham Court Road should be carried out.

9 HOTSPOT 5 – OXFORD ROAD

Oxford Road is located within Carshalton, at the south east part of the borough. Oxford Road lies within CDA 31.

9.1 Location-wide flood incident(s)

The heavy downpour in the afternoon of June 2nd, 2017 led to properties on Oxford Road experiencing flooding. A homeowner account reported that they had regular ongoing problems with the drain situated on Harrow Road, which is at the side of their house. They also reported that Oxford Road became flooded and eventually poured onto the pavement and down into their driveway. The resident's garage was also flooded along with the sideway entry to their property. Another homeowner account confirmed that they have experienced numerous flood incidents in 2012, 2014, 2015 and June 2017. They also reported that their garage and the sideway to their property were flooded during the flood event.

9.2 Local drainage network

There is a surface water pipe which serves Oxford Road. The surface water sewer starts on Oxford Road and flows in a north easterly direction, first onto Wales Road and then onto Carshalton Road with an interchanging diameter of 225mm and 675mm. There are also two foul sewer networks along Oxford Road which flow from south to north. The first pipe has a diameter of 450mm, and the second pipe has a diameter of 225mm. See *Figure 9-1* for further details on the local drainage network.

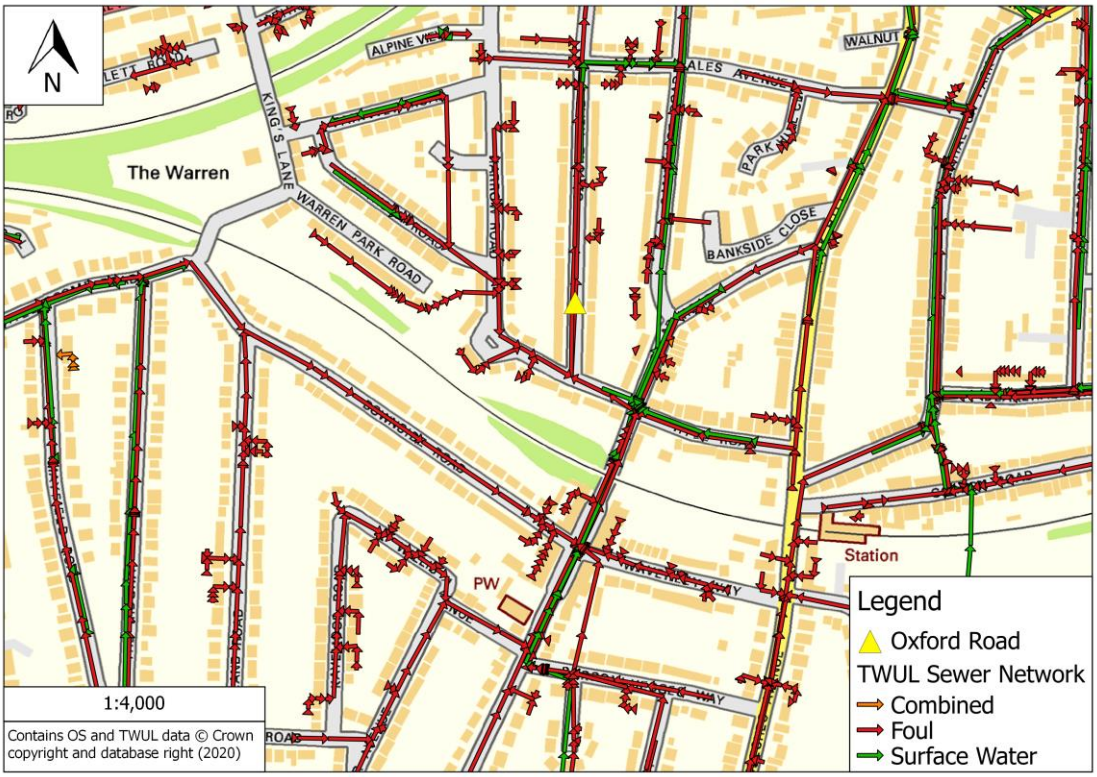

Figure 9-1. Local sewer network – Oxford Road

There are two concrete lined soakaways that lie along Oxford Road. The southernmost soakaway is 6.2m deep and the northernmost soakaway is 2.9m deep. The condition of both soakaways has been labelled as 'very good'. Details of the location of soakaways in the local area are shown in

Figure 9-2.

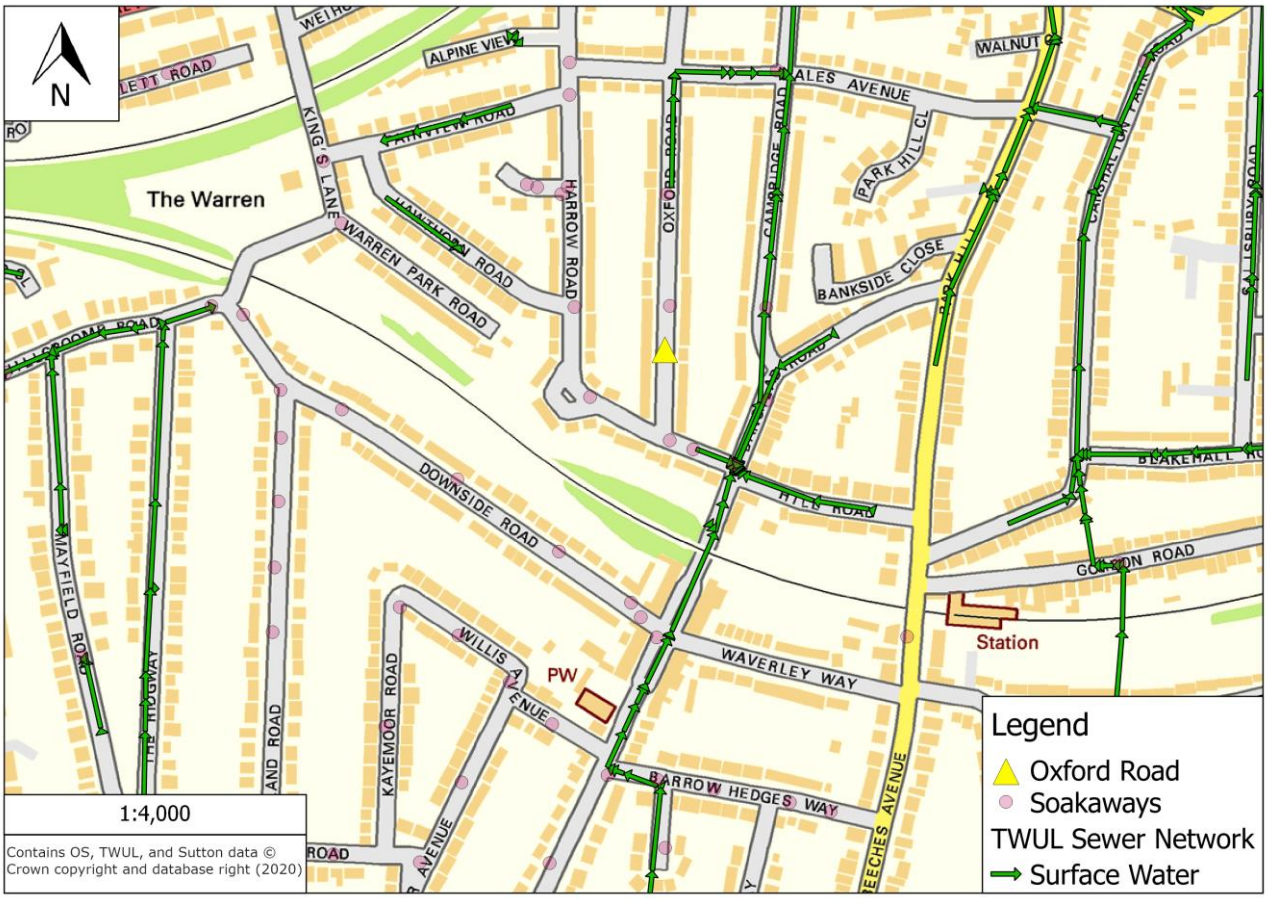

Figure 9-2. Surface water sewer network and soakaways – Oxford Road

9.3 Local flood mechanism

Analysis of the area using a GIS provided several outputs, including defined hydrological catchments and primary flow paths (shown as 'Hydrological Catchment Stream' in **Figure 9-3**). LiDAR data shows that Oxford Road lies within a topographical low point within the hydrological catchment. This means that surface water within the defined catchment will naturally drain towards Oxford Road. Therefore, the properties along Oxford Road are considered to be located within a flood hotspot.

The primary flow path is the main overland flow route for surface water in the defined catchment. The main overland flow route for the catchment area flows in a north westerly direction towards Oxford Road. The overland flow path then outfalls into the River Wandle just north of Oxford Road.

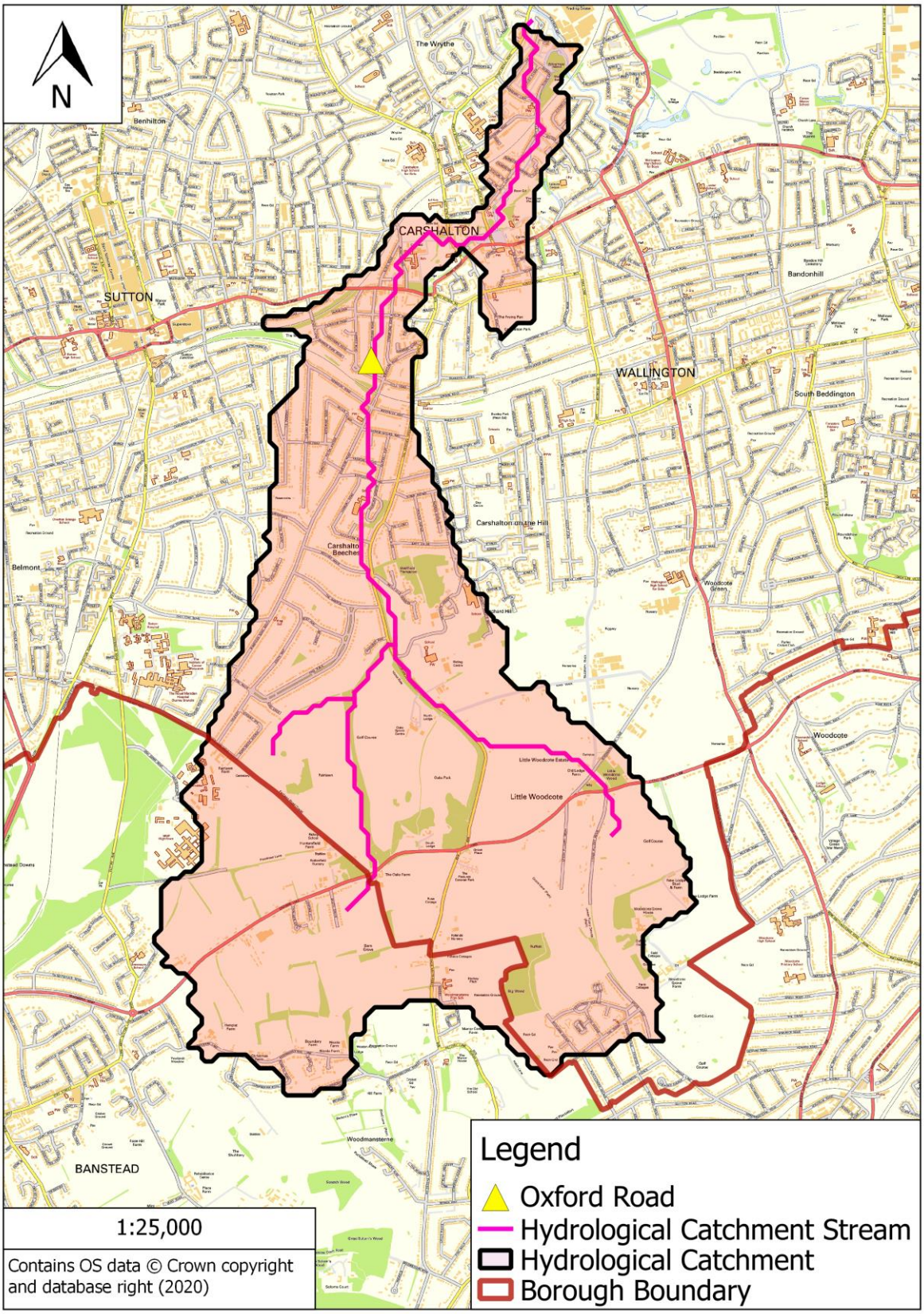

Figure 9-3. Hydrological Catchment – Oxford Road

9.4 Local Flood Risk

9.4.1 Surface water flood risk

A review of the EA's RoFSW data shows that the Oxford Road carriageway does not fall within the predicted surface water flood risk extent for the 1 in 30 year, 1 in 100 year and 1 in 1000 year flood event. However, the mapping also shows that there is an overland flow path which lies adjacent to Oxford Road behind the set of houses on the right-hand side and flows in a north easterly direction. See **Figure 9-4** for flood extent information in the local area.

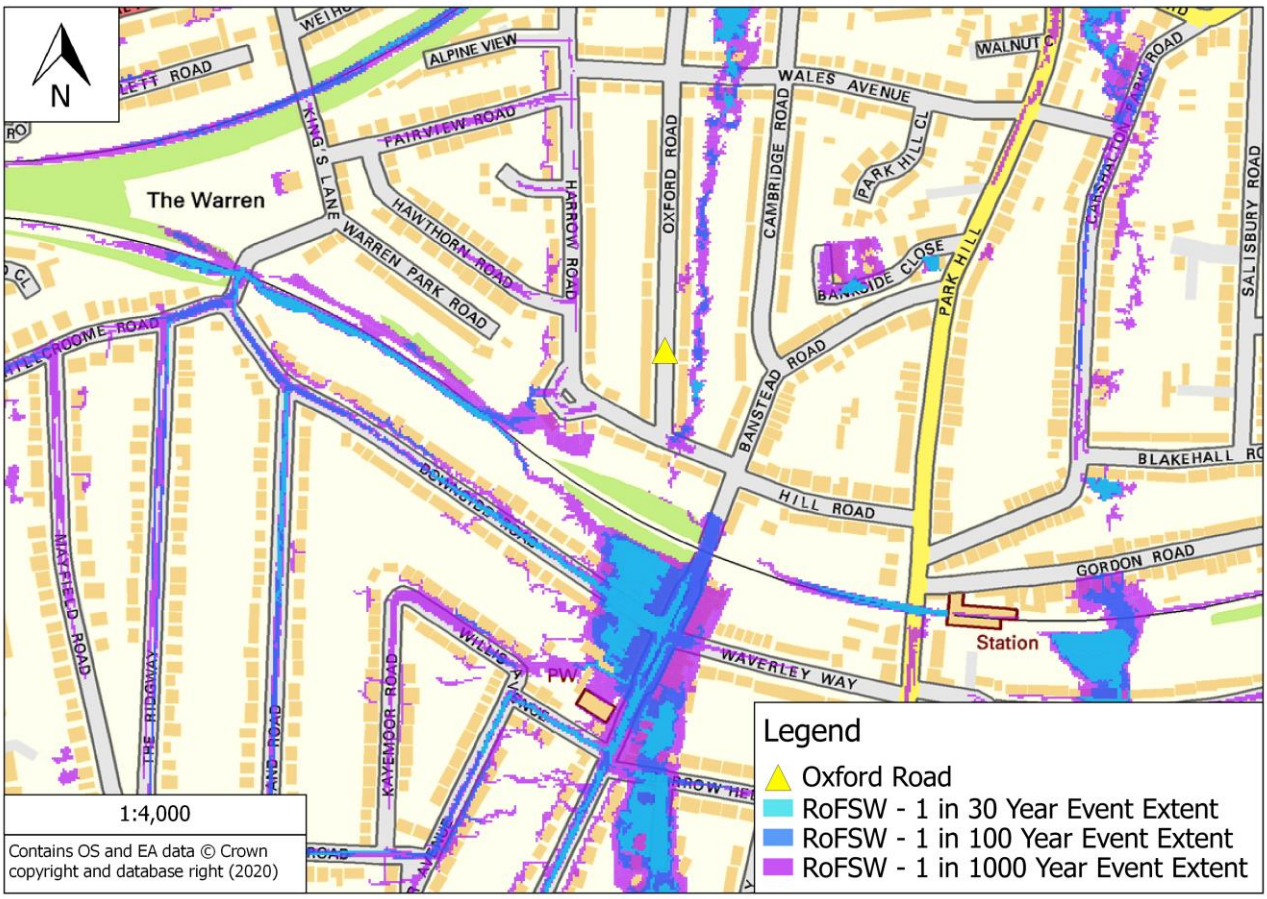

Figure 9-4. Risk of flooding from surface water – Oxford Road

9.4.2 Ordinary Watercourse flood risk

Flooding from ordinary watercourses is included within the EA's RoFSW map. A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of Oxford Road. Therefore, Oxford Road is not at risk of flooding from ordinary watercourses.

9.4.3 Fluvial Flood Risk

According to the EA Flood Map for Planning, Oxford Road is situated in Flood Zone 1 and is therefore not at risk of fluvial flooding.

9.4.4 Groundwater Flood Risk

Oxford Road lies within the '>=50% <75%' and '>=75%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (See **Figure 9-5**). However, there were no reports of basement or subsurface flooding during the June 2017 event, flooding which could have been caused by a high groundwater table. Based on the lack of such reports, it is not believed that this flood incident can be attributed to groundwater flood sources.

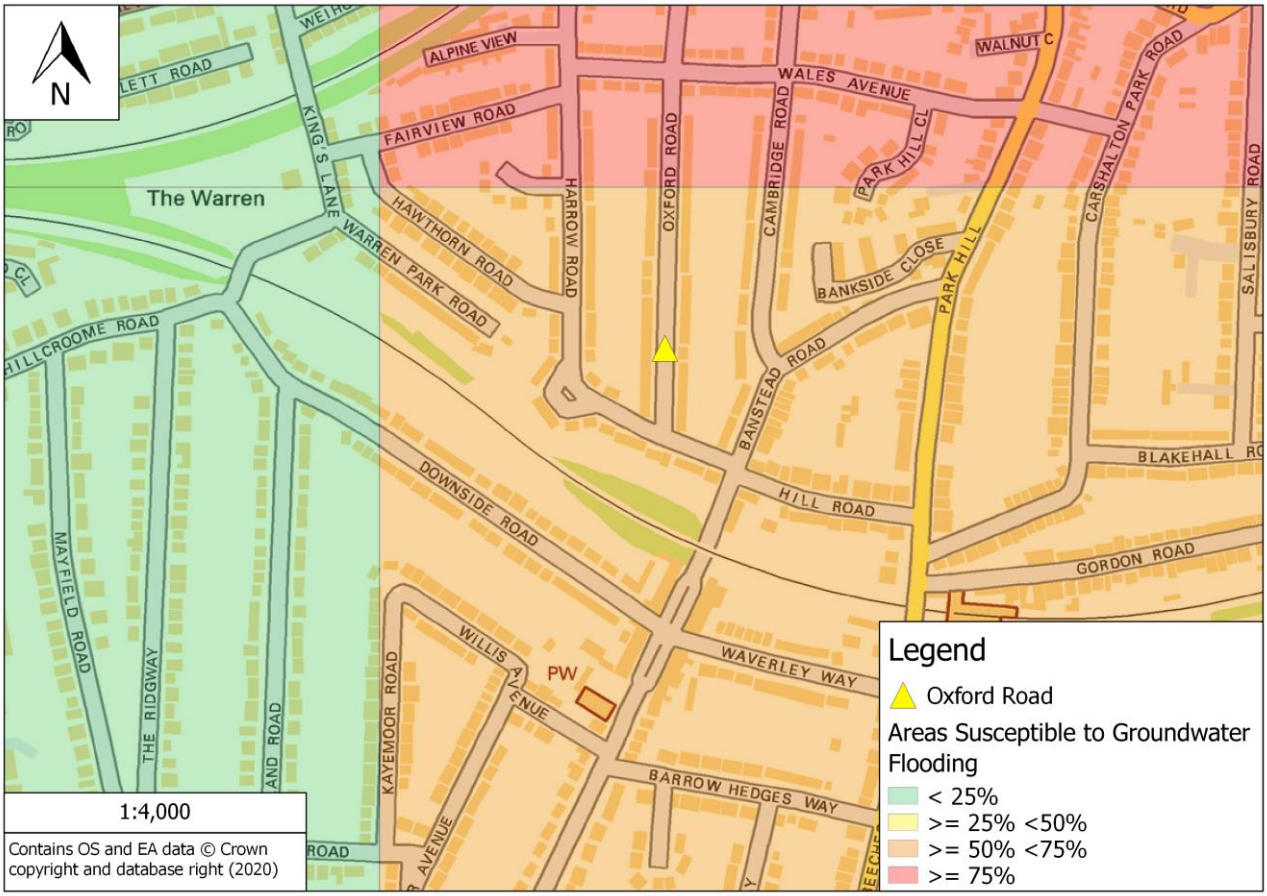

Figure 9-5. Areas susceptible to groundwater flooding – Oxford Road

9.4.5 Sewer Flood Risk

As highlighted in *Chapter 9.1*, residents reported that they had regular ongoing problems with the drain situated on Harrow Road. A review of the drainage assets within the local area shows that there are two soakaways along Oxford Road. Both soakaways are reported to be in 'very good' condition. A review of the TWUL assets confirms that there is water chamber which lies over a surface water channel towards the middle of Oxford Road. The chamber is reported to be full of silt at each heading. The surface water chamber has been designed to feed into the southernmost soakaway on Oxford Road, however this has not occurred due to the silt causing a blockage. The reported issues with the drainage assets within the local area could have exacerbated flooding during the June 2017 event.

Based on this information, it is believed that this flooding incident can be attributed to sewer flood sources.

9.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Oxford Road sits outside of the predicted reservoir flooding extent. Therefore, Oxford Road is not at predicted risk of flooding from other sources.

9.5 Actions taken by relevant RMAs (and other stakeholders affected)

Table 9-1: Risk Management Authorities - Actions

Authority	Authority Response to Flooding
Sutton Council	Before No known actions were taken by Sutton before the flood event. During No known actions were taken by Sutton during the flood event. After Letters were sent to residents to facilitate communication with those who were impacted by the flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence which has been used as part of this Section 19 investigation. Soakaways in the vicinity of Oxford Road and Harrow Road were cleared during a period between 11/09/18 – 15/09/18. Soakaways on Banstead Road were cleared during a period between 30/10/19 – 31/10/19 and 04/11/19 – 05/11/19.
TWUL	***Before*** No known actions were taken by TWUL before the flood event. ***During*** No known actions were taken by TWUL during the flood event. ***After*** No known actions were taken by TWUL after the flood event.

9.6 Recommendations

- TWUL should conduct a detailed investigation of their assets along Harrow Road and the surface water chamber which is designed to feed into the southernmost soakaway on Oxford Road to confirm any potential faults or blockages.
- TWUL should regularly clear the surface water chamber of any silt and debris to minimise blockages occurring to their assets.
- TWUL to investigate the installation of new gullies or swales in the vicinity of Oxford Road to reduce the load on the current sewer network capacity if feasible.
- Sutton Council to collaborate with the affected local residences to explore property level protection.
- Sutton and TWUL should a site visit to meet with residents and discuss further flood risk issues.
- Sutton and TWUL to investigate mitigation measures such as SuDS to reduce the risk of flooding in the local area.
- In the event of future flooding, Sutton should investigate opportunities for introducing automated traffic diversions, signage, and alarms.

10 HOTSPOT 6 – OAKS AVENUE

Oaks Avenue lies within Worcester Park, in the north west region of the borough. Oaks Avenue lies within CDA 22.

10.1 Location-wide flood incident(s)

A homeowner account reported that 65 Oaks Avenue experienced groundwater rising in the back garden approximately two weeks after the flood event on the 14th June 2017.

10.2 Local drainage network

There are several surface water sewers on serving Oaks Avenue. One surface water sewer flows in a north westerly direction from the south of Oaks Avenue. The diameter of the pipes range between 150mm and 450mm and discharge into a 900mm diameter surface water sewer at the Dalmeny Road junction. Another surface water sewer is a 750mm diameter pipe which flows in a north westerly direction from the north of Oaks Avenue and discharges into the 1200mm diameter surface water sewer at the at the Dalmeny Road junction. Another surface water sewer is a 150mm diameter pipe which flows in a south easterly direction from the south of Oaks Avenue. This surface water pipe then discharges into a 230mm pipe at the junction by London Road. There are also two foul sewer runs along Oxford Road which have a diameter of 180mm and flow from south to north. See **Figure 10-1** for further details on the local drainage network.

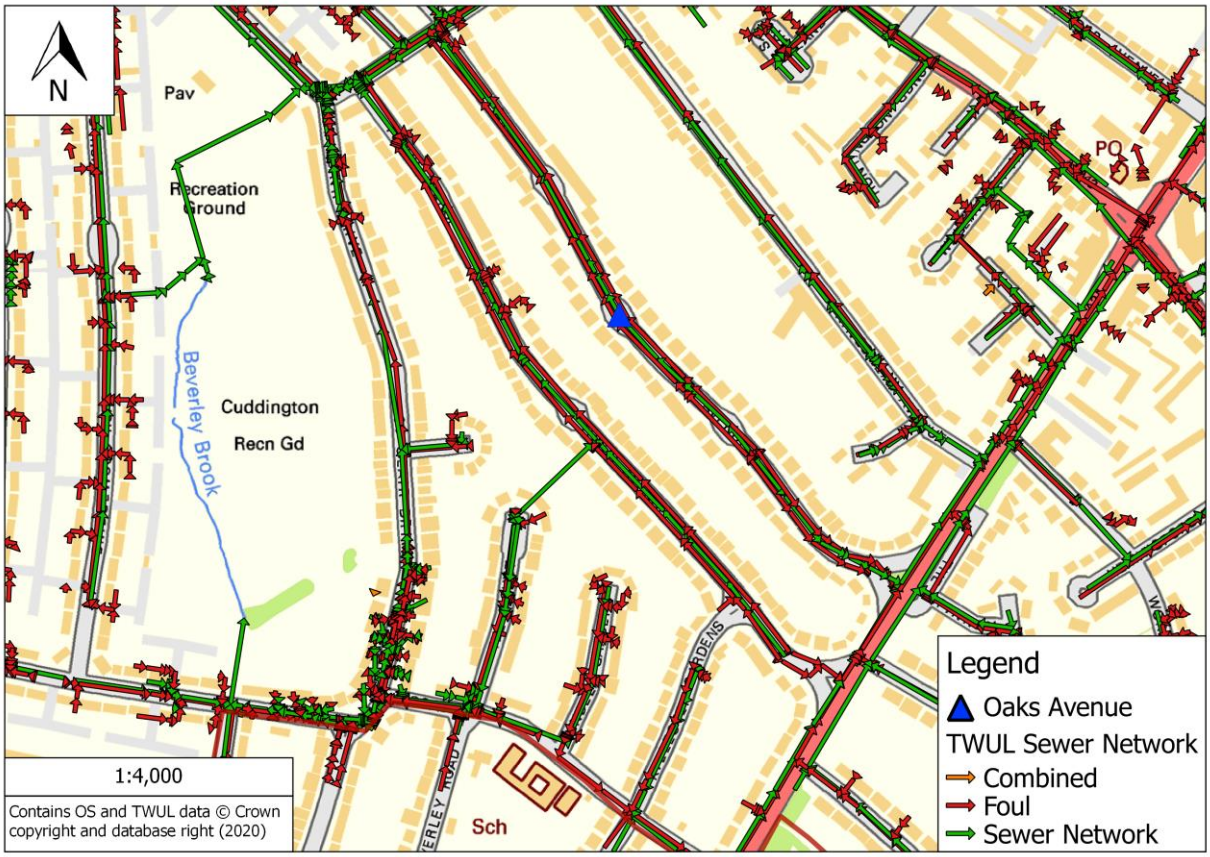

Figure 10-1. Local sewer network – Oaks Avenue

10.3 Local flood mechanism

Analysis of the area using a GIS provided several outputs, including defined hydrological catchments and primary flow paths (shown as 'Hydrological Catchment Stream' in **Figure 10-2**). The primary flow path is the main overland route for surface water within the catchment. The catchment's primary flow path appears to flow to the north of the catchment before discharging into the Beverley Brook. This would suggest that rainfall that falls in this catchment and along Oaks Avenue flows towards this flow path.

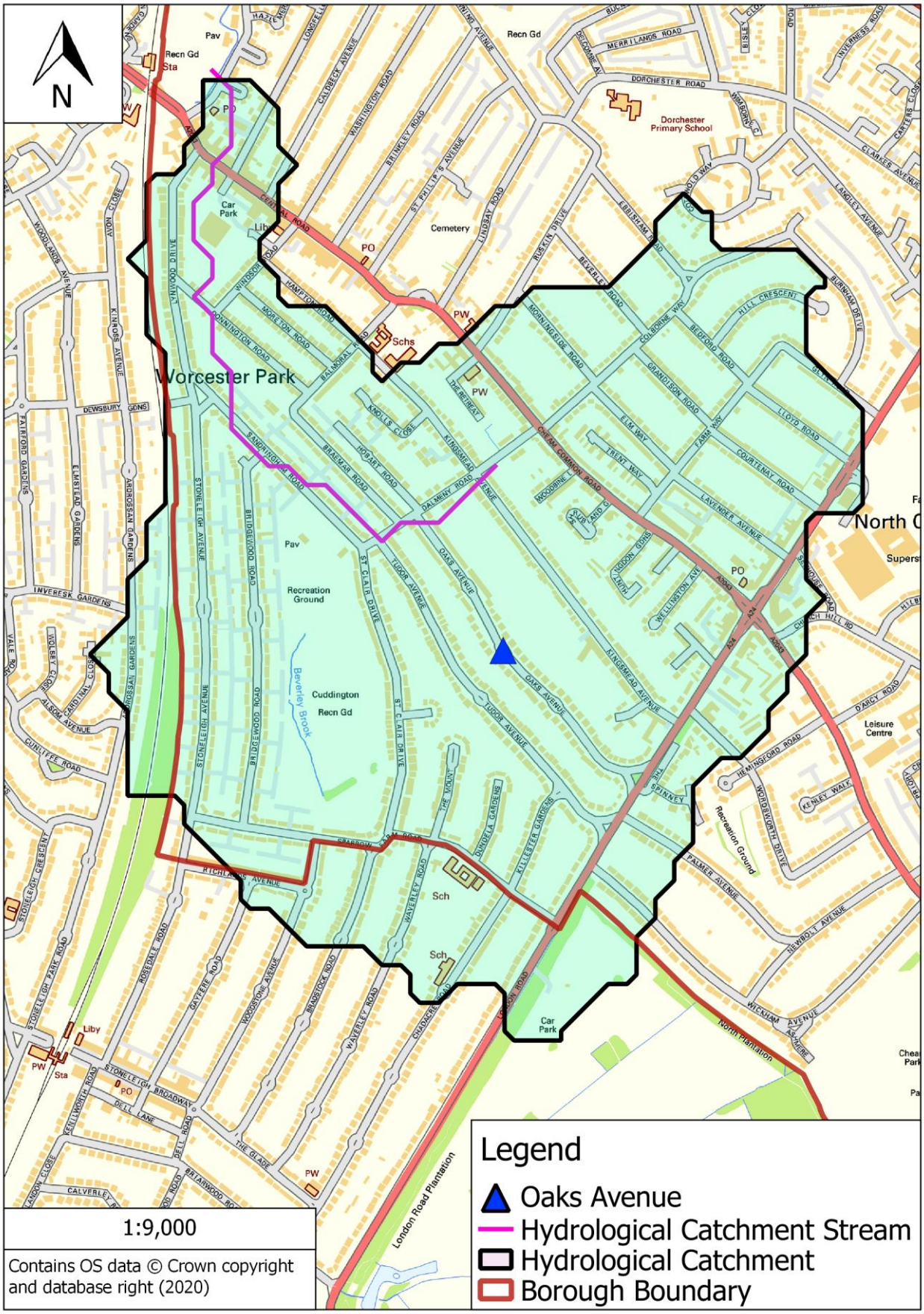

Figure 10-2. Hydrological Catchment – Oaks Avenue

10.4 Local Flood Risk

10.4.1 Surface water flood risk

A review of the EA's Risk of Flooding from surface water (RoFSW) data shows that the Oaks Avenue is at predicted risk of flooding from a 1 in 100 year and 1 in 1000 year event, with flood depths ranging from to 0.15m – 0.9m maximum (see **Figure 10-3** for flood extent information). A small area of Oaks Avenue by the Dalmeny Road junction is at risk from a 1 in 30 year event. The mapping shows that the property impacted by flooding in June 2017 is not in the predicted surface water flood risk extent for the 1 in 30, 1 in 100 and 1 in 1000 year event. Therefore, Oaks Avenue and the adjoining properties are at low risk of surface water flooding.

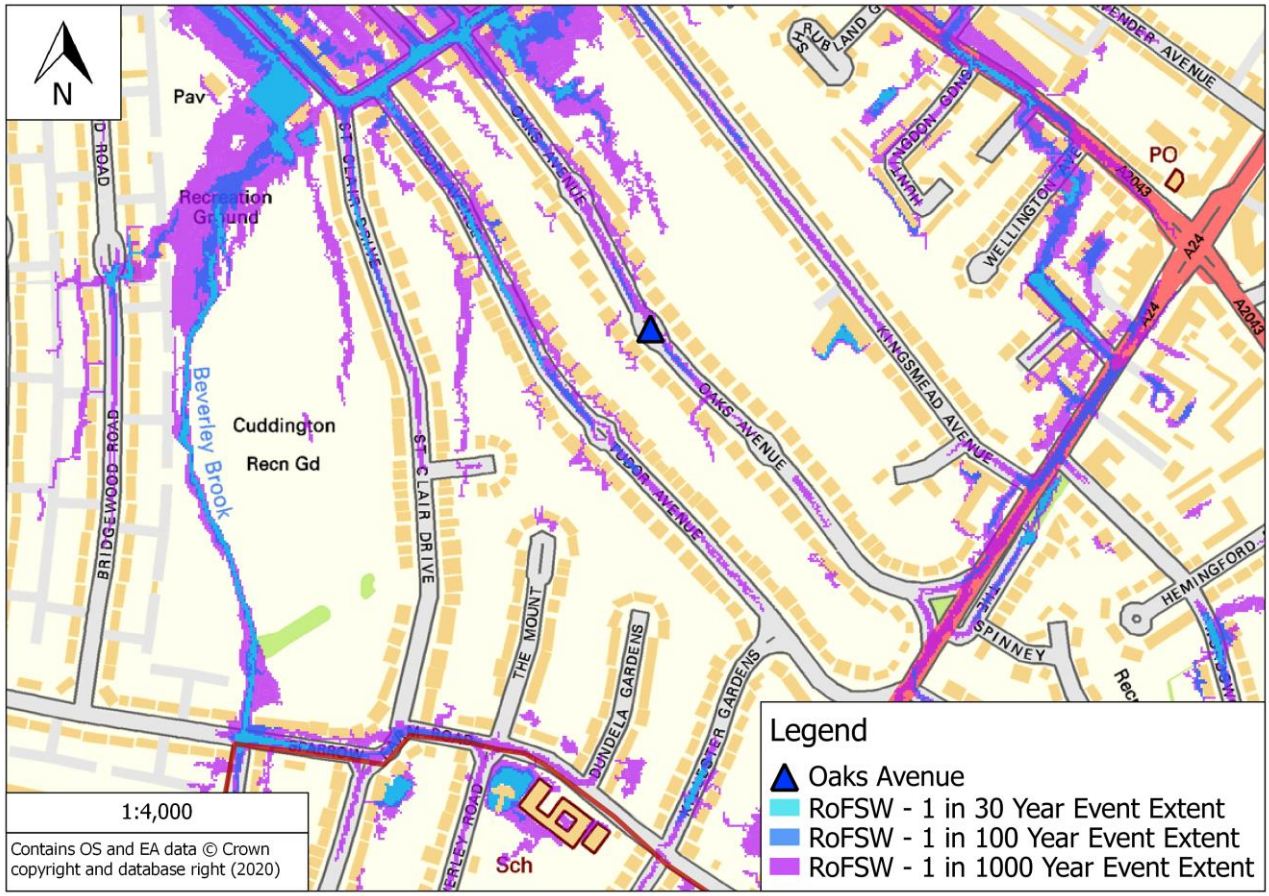

Figure 10-3. Risk of flooding from surface water – Oaks Avenue

10.4.2 Ordinary Watercourse flood risk

Flooding from ordinary watercourses is included within the EA's RoFSW map. A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of Oaks Avenue. Therefore, Oakes Avenue is not at risk of flooding from ordinary watercourses.

10.4.3 Fluvial Flood Risk

According to the EA Flood Map for Planning Oaks Avenue is situated in Flood Zone 1 and therefore is not at risk of fluvial flooding.

10.4.4 Groundwater Flood Risk

Oaks Avenue lies within the '<=25%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see **Figure 10-4**). However, as highlighted in *Chapter 10.1*, a homeowner reported that their property experienced flooding in their back garden two weeks after the June 2017 flood event. They believe it may be due to rising groundwater. A review of British Geological Survey (BGS) data shows that the underlying bedrock geology at Oaks Avenue is 'London Clay formation – Clay and Silt'. This bedrock geology is classified as "low permeable" as it is difficult for water to drain through this type of soil. After a heavy rainfall event, water could sit above clayey soils due to their low permeability. This can potentially lead to a high groundwater table and potential groundwater flooding. Oaks Avenue may be at risk from groundwater flooding; however, further investigations are required to confirm.

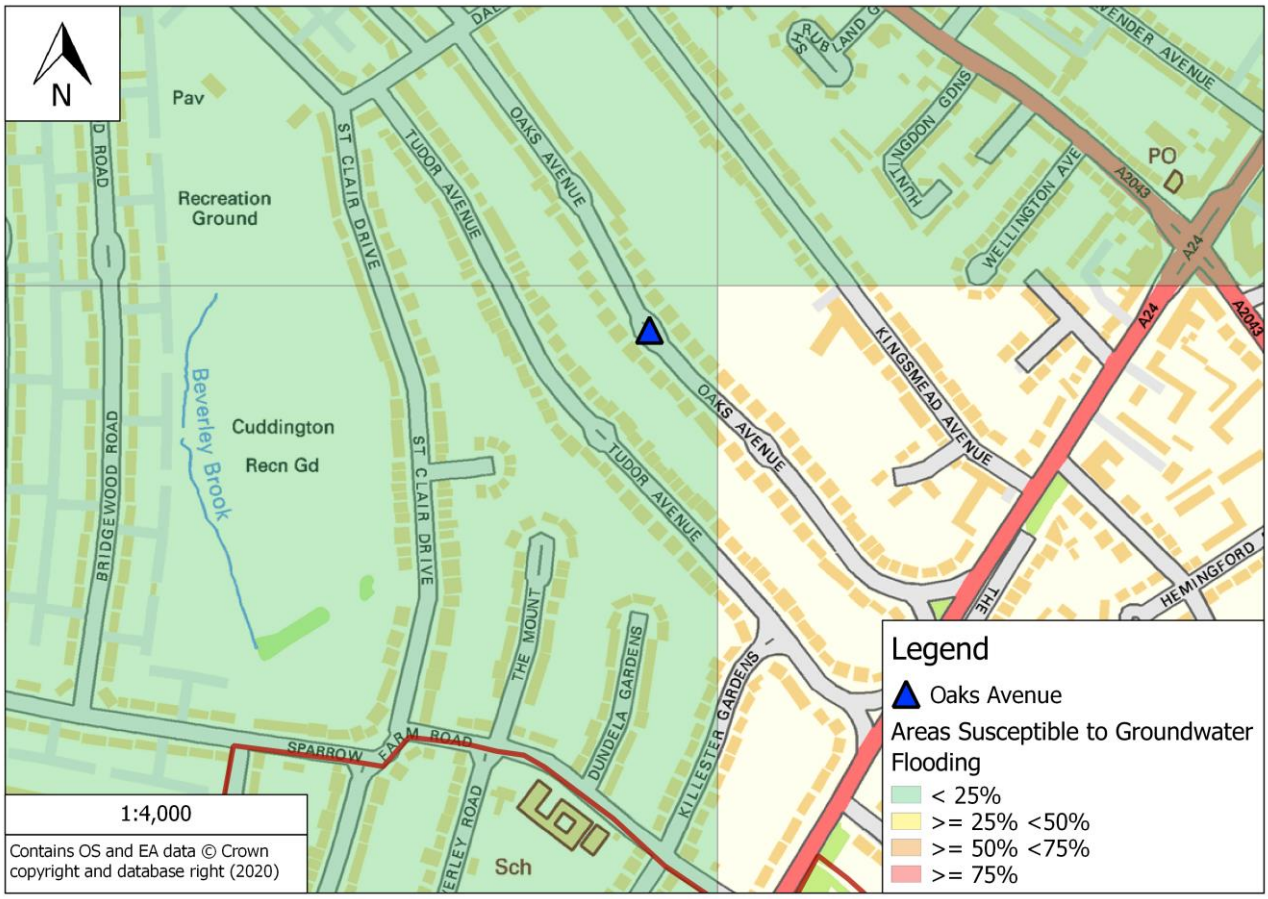

Figure 10-4. Areas susceptible to groundwater flooding – Oaks Avenue

10.4.5 Sewer Flood Risk

There were no reported incidences of sewer flooding during the June 2017 and prior flood events. A review of the topographical data (LiDAR) shows that Oaks Avenue does not lie within a topographical low point within the wider area. Therefore, if the sewer network along Oaks Avenue were to fail or exceed its capacity during a heavy rainfall event, surface water would naturally drain along Oaks Avenue and enter Dalmeny Road to the north west. Based on this information, it is believed that this flooding incident cannot be attributed to sewer flood sources.

10.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Oaks Avenue sits outside of the predicted reservoir flooding extent. Therefore, Oaks Avenue is not at predicted risk of flooding from other sources.

10.5 Actions taken by relevant RMAs (and other stakeholders affected)

Table 10-1: Risk Management Authorities - Actions

Authority	Authority Response to Flooding
Sutton	***Before*** Oakes Avenue lies within the CDA22 Worcester Park catchment boundary and was modelled as part of the CDA22 hydraulic model. ***During*** No known actions were taken by Sutton during the flood event. ***After*** Letters were sent to residents to facilitate communication with those who were impacted by the flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence which has been used as part of this Section 19 investigation.

10.6 Recommendations

- Sutton to conduct a geotechnical assessment and/or basement impact assessment (if required) to confirm if the site is vulnerable to groundwater or groundwater influenced flooding. These assessments should include mitigation measures to reduce the risk of potential groundwater influenced flooding to the site.
- Sutton Council to collaborate with the affected local residences to explore property level protection.

11 General Conclusions and Recommendations

11.1 Conclusions

This borough wide flood risk investigation was triggered due to the significant flooding that took place on the 2nd June 2017 which resulted in multiple properties experiencing internal flooding. To better understand the potential causes of flooding at a borough wide scale, hydrological catchment areas were defined. Through hydrological analysis of the wider catchment, the 28 flood sites in question were grouped into six different sub catchments, with five shown to drain towards the River Wandle. The property 'hotspot' represents a localised area or group of properties that lie at a topographical low point within a catchment area. This means that during a heavy rainfall event, surface water will naturally drain towards these areas. In order to define the property hotspots that would be analysed in detail, the predicted and known flood mechanisms within the six hydrological catchments were reviewed. Based on this review the sites were grouped into six hotspot groups. The data collection and investigation exercises established that the sites were at varying risks of flooding, mainly from surface water flooding, sewer flooding, and groundwater flooding to a lesser extent. The flood risk at each site was exacerbated due to several varying factors including:

- Being positioned topographically lower compared to the areas immediately to the east, northeast, north, northwest, and west.
- The potential failure and blockage of key TWUL assets
- Sites being underlain with low permeable bedrock geology (London Clay)
- The urbanised nature of the hydrological catchment

11.2 Recommendations

The following recommendations are provided for the identified hotspots (where appropriate) and for the sites impacted by the 2017 flood event that that are not within hotspots. For hotspot specific recommendations, see the 'Recommendation' sections in *Chapter 5* to *Chapter 10*.

- Sutton to collaborate with the Environment Agency (EA) to further investigate the June 2017 flood event. Further analysis should be carried out on the recorded rainfall gauge data to confirm the flood event's return period.
- TWUL should investigate and resolve blocked assets which potentially exacerbated or led to sewer flooding for the affected sites.
- Sutton should provide regular maintenance of the gullies and street cleansing for the sites affected by sewer flooding.

- Sutton to review the sewer network capacity to see if any additional sewer features could alleviate flooding within the network.
- Sutton to collaborate with the affected local residences to explore property level protection.
- Sutton to collaborate with TWUL and residents affected by the June 2017 events to explore potential retrofit SuDS opportunities to increase the catchment's resilience to flood risk.
- Sutton to collaborate with TWUL and the EA as part of the DWMP process.

APPENDICES

Appendix A – Rainfall Return Period Estimations