



12TH JULY 2021 SECTION 19 INTERIM FLOOD INVESTIGATION REPORT - 15TH SEPTEMBER 2021

This document has been prepared by Westminster City Council as the Lead Local Flood Authority (LLFA) under Section 19 of the Flood and Water Management Act 2010, with the assistance of:

- Westminster City Council (WCC)
- Environment Agency
- Thames Water
- Local residents

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

The Flood and Water Management Act 2010 states a LLFA must investigate which flood management authorities have relevant flood risk management functions in Westminster. The LLFA must investigate the actions each risk management authority has exercised or is proposing to exercise in response to the flood event¹.

A section 19 flood investigation report is a public account of how the flood incident occurred and the responsibilities of the various risk management authorities. WCC has developed the following threshold for prioritisation of flood events for which a Section 19 flood investigation will be undertaken.

1. Flooding that posed a threat to the safety of the public or may directly result in serious injury or death.
2. Five or more properties internally flooded in one location.
3. One or more piece of critical infrastructure was affected that impacted the wider area.
4. Flooding that places vulnerable individuals or vulnerable communities at risk e.g. hospitals, care and nursing homes, schools, secure units, etc.
5. Additionally, where one or more residential property has flooded internally from the same source on five or more occasions within the last five years.

WCC may investigate the causes of flooding outside of the above criteria when determined merited². The flood investigation will cover the number of properties affected by the event, causes of flooding and the responsibilities of the various risk management authorities. The recommendations from the section 19 flood investigations enable LLFAs to learn lessons from flood events and address associated infrastructure needs.

This is an interim report while consultation is ongoing with the risk management authorities (Thames Water, Environment Agency and neighbouring boroughs) and local residents/businesses.

Summary of event

On the 11th July 2021, the Met Office issued a Yellow Rain Warning for the south-east of England. During the afternoon of the 12th July 2021 intense rainfall and thunderstorms caused flooding to areas of Westminster, specifically Paddington and the West Kilburn / Maida Vale areas. The nearest Environment Agency rain gauge is located at Putney Heath Reservoir (approximately 8.5km to the south-west of the main areas affected in Westminster) recorded 40.1mm between 2pm and 5pm and a total 24-hour rainfall of 47.4mm. The average rainfall for London in July is approximately 45mm³. Anecdotal conversations with stakeholders suggest that the rainfall return period may have been highly variable depending on location; estimates for the rainfall return period vary from a 1 in 35 year to a 1 in 300 year storm event. Due to the distance of the Putney Heath Reservoir rain gauge, at the time of writing this report it is not possible to accurately state the magnitude of the 12th July 2021 event. As a result of the high intensity rainfall, highway drains and the local sewer network were unable to cope with the intense and high volume of rainfall. This information will be updated and confirmed during ongoing consultation with Thames Water.

Based on information from the survey undertaken by WCC and WCC's Emergency Response team, approximately 230 properties and 64 roads were impacted by flooding across Westminster with residents along Kilburn Park Road, Essendine Road, Formosa Road and Shirland Road being evacuated. Other locations impacted by flooding as reported by WCC's Emergency Response team included one primary school, three libraries and three community centres. As part of those 230 properties 80 were reported by Thames Water as having flooded internally. Seven of the London Underground lines were delayed or closed due to flooding or signal failures. This information will be updated and confirmed during ongoing consultation with Thames Water. A second flood event occurred on the 25th July 2021 and given the timing, geography and impact of the second event we now believe that this warrants its own separate report and that process been started. It's important for the City Council and other agencies to understand what happened and why and a standalone report will support that aim.

Rights and Responsibilities

LEAD LOCAL FLOOD AUTHORITY (LLFA)

WCC act as both the LLFA and Highway Authority. As the LLFA WCC are responsible for managing local flood risk (risks from surface water, groundwater and ordinary watercourses). The LLFA is responsible for developing and maintaining a Local Flood Risk Management Strategy, investigating local incidents of flooding and emergency planning after a flood event.

As the Highway Authority the council has a responsibility to ensure surface water enters the gully network in the streets and discharges to the Thames Water sewer network as efficiently and

¹ Flood and Water Management Act 2010, c. 19. Available at: <https://www.legislation.gov.uk/ukpga/2010/29/section/19>

² City of Westminster, 2017. *Local Flood Risk Management Strategy 2017-2022*.

³ Sky News. 2021. *UK weather: Thunderstorms and heavy rainfall to hit much of country as Met Office issues yellow warning*. Available at: <https://news.sky.com/story/uk-weather-thunderstorms-and-heavy-rainfall-to-hit-much-of-country-as-met-office-issues-yellow-warning-12365468>

effectively as possible. WCC is responsible for the maintenance of highway drainage within the City of Westminster (excluding Transport for London assets).

THAMES WATER

Thames Water are the risk management authority responsible for the local sewerage network including the combined sewerage system. Thames Water is not responsible for drainage within a property. Thames Water as a risk management authority are required to cooperate with the LLFA during the Section 19 flood investigation.

TRANSPORT FOR LONDON

Transport for London (TfL) is responsible for the Strategic Road Network in the City and the gullies on that network. It is also responsible for London Underground drainage assets and TfL must ensure these assets do not increase flood risk.

ENVIRONMENT AGENCY

The Environment Agency is responsible for maintaining a strategic overview of all sources of flooding as defined under the Flood and Water Management Act 2010. The Environment Agency is responsible for flood management on main rivers. As the flooding in Westminster was the result of a combination of surface water and sewer flooding the Environment Agency are not the responsible risk management authority for the source of flooding on the 12th July flood event.

Introduction

SITE DESCRIPTION

Westminster is a heavily urbanised inner city borough located in central-west London. The Borough is bordered by the Royal Borough of Kensington and Chelsea to the west, Camden Council and Brent Council to the north and the City of London to the east. The southern border of the Borough is the River Thames. The general topography of Westminster falls towards the River Thames from the north-west to the south-east. Annex 1 at the end of the report shows the Greater London Topographic map.

Among the affected areas Maida Vale and West Kilburn are heavily urbanised areas located to the northwest within the Borough. The local topography gently slopes from an eastern to western direction approximately 30m Above Ordnance Datum (AOD) to the west of West Kilburn to approximately 24m AOD in Maida Vale and the surrounding area.

Paddington is a heavily urbanised area bordered to the south by Kensington Gardens and Hyde Park. The local topography gently slopes from both the east and west areas towards the south from approximately 23m AOD to approximately 19m AOD to the south of the Great Western Main Line.

There are several surface water features within the Borough including the River Thames (located approximately 4km to the south of Paddington) and the Grand Union Canal (located approximately 500m to the north of Paddington). Key national infrastructure within Westminster includes: seven

underground stations serving 10 of the 11 London Underground lines, The Houses of Parliament and Buckingham Palace.

Westminster is located above a regional chalk aquifer which is covered with clays, silts and gravel. A review of the Cranfield University Soilsdapes database indicates that the majority of the underlying soils in Westminster are slowly permeable clayey soils.

Drainage

The highway drainage is owned and maintained by WCC as the Highway Authority, and generally consists of gullies connected to the combined sewers. The public drainage across Westminster consists of combined sewerage infrastructure which is owned and maintained by Thames Water. A combined sewerage system carries a mixture of surface water and foul water. During periods of intense rainfall, the available capacity within these sewers can be exceeded. When this occurs combined surface water and foul water can back-up into properties unless flow is able to spill out elsewhere. Therefore, combined sewer overflows were developed to allow the network to outflow into rivers and reduce the risk of water backing up into properties⁴.

The Thames Water sewer network are combined sewers designed in the 1860s. North of the River Thames the combined sewers flow from west to east and all flows are treated at the Beckton Sewage treatment works in east London during normal operation. The City of Westminster's sewer system receives flows from the Royal Borough of Kensington and Chelsea to the west. The River Westbourne and River Tyburn were culverted and now form part of the combined sewer network⁵. During periods of intense rainfall, the network flows from north to south with the flows discharging into the River Thames.

In 2015 Thames Water built the £21 million Maida Vale flood alleviation scheme. New sewers were constructed on Chippenham Road and Formosa Street⁶. The scheme increased the capacity of the sewerage network to cope with a 1 in 30 year storm event. During ongoing consultation with Thames Water the performance of the flood alleviation scheme during the 12th July flood event will be confirmed. Maida Vale and West Kilburn are served by an approximately 2m diameter trunk sewer and storm relief sewer^{7,8}. A weir was installed at Formosa Street which directs flows into the throttle pipe and then into the trunk sewer during normal operation. In storm events when the trunk sewer is at capacity flows back up over the drowned weir into a 20m diameter and 26m deep storage shaft located in Westbourne Green Park. **Error! Reference source not found.** shows a sketch of the

⁴ Environment Agency, 2020. *Combined Sewer Overflows Explained*. Available at: <https://environmentagency.blog.gov.uk/2020/07/02/combined-sewer-overflows-explained/>

⁵ City of Westminster, 2011. *Surface Water Management Plan*.

⁶ Thames Water, 2014 Maida Vale Flood Alleviation Scheme Project update. Available at: <https://www.facebook.com/MaidaFloodAction/photos/pcb.289779381180114/289779211180131/?type=3&theater>

⁷ Breeds, H., 2018. *Maida Vale And The Tale Of The Throttle Pipe - Passive-Control To Eliminate Foul Pumping*. Annual Conference Papers. Water New Zealand, pp.1-3. Available at: https://www.waternz.org.nz/Article?Action=View&Article_id=1560

⁸ City of Westminster, 2021. *Public meeting, Friday 30 July, 12-1pm*. [video] Available at: <https://www.westminster.gov.uk/flood-information-and-help>, Minute 15:30 of meeting.

Maida Vale Flood Alleviation scheme. After the duration of the extreme storm event flows are pump back into the receiving sewer.

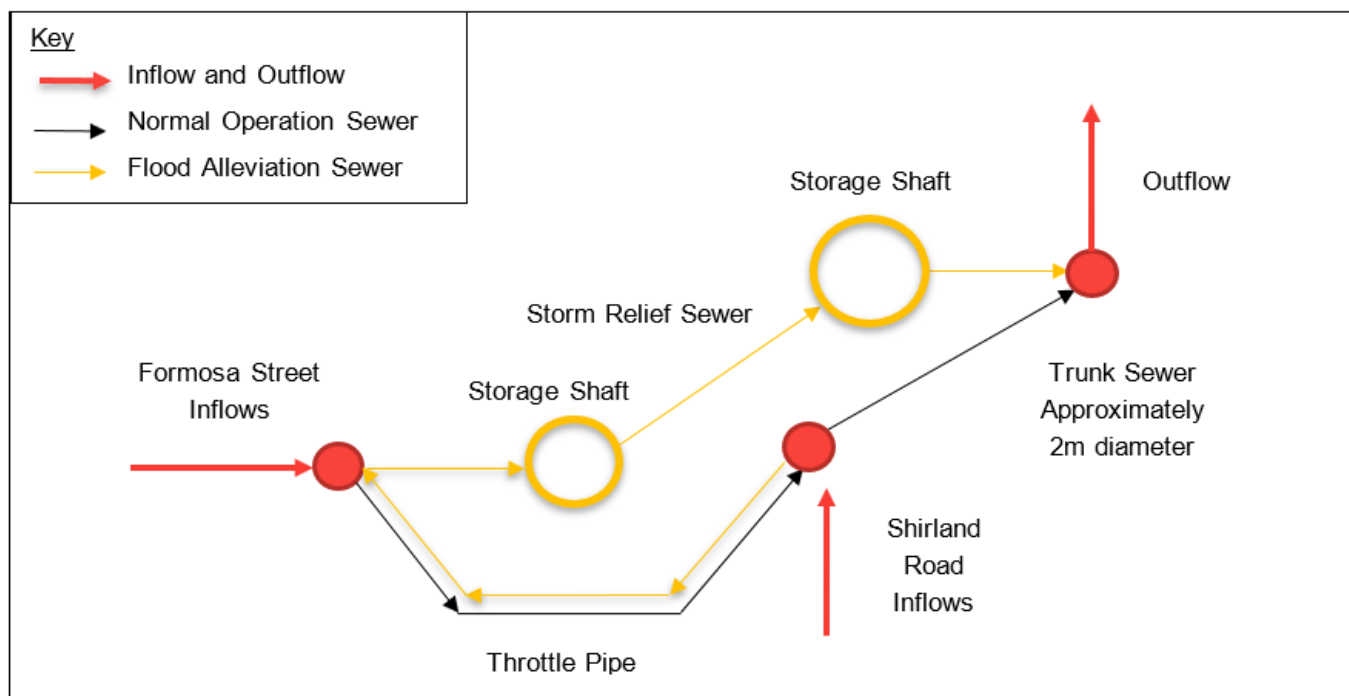


Figure 1: Sketch of Maida Vale Flood Alleviation⁷

An additional overspill tank was constructed in Tamplin Mews Gardens⁹. The tank was over 15m diameter and 15m deep. The project was part of the £350 million scheme Thames Water spent across London and the Thames Valley to protect properties at risk from sewer flooding between 2010 and 2015¹⁰. This information will be updated and confirmed during ongoing consultation with Thames Water.

FLOOD RISK

The majority of Westminster, excluding its southern end, is located within Flood Zone 1, including Maida Vale, West Kilburn and Paddington. Flood Zone 1 is defined as having low probability of flooding from fluvial and tidal sources less than 0.1% annual probability of flooding.

Flooding from surface water is typically associated with natural overland flow paths and local depressions in topography where surface water runoff can accumulate during or following heavy rainfall events. WCC commissioned WSP in 2015 to undertake enhanced surface water modelling in Westminster. This study used the 2d Thames Water sewer network to identify areas within Westminster at the greatest risk of surface water flooding. The surface water flood risk maps produced from the study for the 30 year, 100 year and 1000 year storm return period have been

⁹ My London, 2014. Thames Water to build two underground tanks to stop sewer flooding. Available at: <https://www.mylondon.news/news/local-news/thames-water-build-two-underground-6759411>

¹⁰ Water Briefing, 2013. Thames Water invests £17.5m to prevent sewer flooding. Available at: <https://www.waterbriefing.org/home/company-news/item/7619-thames-water-invests-%C2%A3175m-to-prevent-sewer-flooding>

incorporated into the Environment Agency's Surface Water Flood Map. WCC's Flood Risk from Surface Water map shows that the areas indicated to be at a high risk of flooding from surface water sources included areas that experienced flooding during the July 12th flood event¹¹. Annex 2 at the end of the report shows an extract from WCC's Flood Risk from Surface Water map.

Groundwater flooding typically occurs in low lying areas where groundwater springs reach ground level. Westminster sits on a regional chalk aquifer covered by clay, silt and gravels. The Westminster Local Flood Risk Management Strategy 2017 outlines that the risk from groundwater flooding is low in Westminster. Potential impacts are generally more significant for basements.

Flooding History in Westminster

PREVIOUS FLOOD INCIDENTS

Information on previous flood events is limited, therefore information was obtained from various sources including feedback from residents. Evidence indicates that on the 29th May 2018 flooding occurred to 39 properties in Pimlico due to heavy rainfall and failure of the Longmoore Street Pumping Station. Flooding previously occurred on the 26th June 2016 when 44mm of rain fell on St James' Park¹² with widespread flooding in Pimlico also linked to the failure of the Longmoore Street Pumping Station¹³. This information will be updated and confirmed during ongoing consultation with Thames Water who own the Longmoore Street Pumping Station.

Table 4.1 from the Preliminary Flood Risk Assessment 2011 (PFRA) outlined five incidents of historic surface water flooding. These incidents included the closure of Victoria Station and flooding to Westminster Station entrance. The PFRA outlined basement property flooding on Formosa Street due to sewer flooding and property flooding along Dorset Street caused by surface water sources¹⁴. The Brent and Kilburn Times reported Maida Vale flooded in June 2009 and in July 2007 due to the sewer network becoming overloaded¹⁵. In July 2007 parts of England experienced over 100mm of rain within a 24-hour period and the River Thames overflowed its banks. During the summer 2007 floods 1,410 properties and businesses were internally flooded across London¹⁶. The Met Office estimated the storm return period exceeded a 1 in 200 year event in parts of England¹⁷. WCC have reviewed the council's flood incidence records and no further flood events were identified.

¹¹ High risk of flooding from surface water is defined as having a greater than 3.3% chance of flooding every year. Medium risk of flooding from surface water is defined as having between 1% and 3.3% chance of flooding. Low risk of flooding from surface water is defined as having between 0.1% and 1% chance of flooding.

¹² BBC News. 2016. *Travel disruption and floods warnings as South East hit by more rain*. Available at: <https://www.bbc.co.uk/news/uk-36603508>

¹³ Cities of London & Westminster Conservative Association. 2018. *Flooding in Pimlico again*. Available at: <https://www.twocitiesconservatives.org.uk/news/flooding-pimlico-again>

¹⁴ City of Westminster, 2011. *Preliminary Flood Risk Assessment*.

¹⁵ Brent and Kilburn Times, 2009. *Thames chiefs in hot water*. Available at: <https://www.kilburntimes.co.uk/news/thames-chiefs-in-hot-water-3676110>

¹⁶ BBC News. 2008. *The summer floods: What happened*. Available at: <http://news.bbc.co.uk/1/hi/uk/7446721.stm>

¹⁷ Met Office. *Heavy rainfall/flooding - July 2007*. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2007/heavy-rainfall_flooding---july-2007---met-office.pdf

Table 1 outlines the historic sewer flooding taken from the Strategic Flood Risk Assessment (2019). This information will be updated and confirmed during ongoing consultation with Thames Water. An internal incident is defined as when sewer flooding causes internal property flooding.

Table 1: Summary of the historic flood records

Postcode	At least 2 internal incidents in the last 10 years	At least 1 internal incident in the last 10 years	At least 1 internal incident in the last 20 years	At least 2 internal incidents in the last 10 years	At least 1 external incident in the last 10 years	At least 1 external incident in the last 10 years
W9	1	10	8	0	0	0
W2	0	2	44	0	0	1
W1	1	8	442	0	2	0
SW1	11	2	738	1	1	1
NW1	1	4	76	0	0	0
NW6	0	2	0	0	1	0
NW8	0	0	0	0	0	0
WC2	0	0	4	0	0	0
SW7	0	0	0	0	0	0
SW3	0	0	50	0	0	0
Total	14	28	1,362	1	4	2

Flood Incident Description

MAGNITUDE OF THE EVENT

Information was obtained from the Met Office regarding local rainfall data. The closest Environment Agency rain gauge is located at Putney Heath reservoir approximately 8.5km to the south-west of the main areas affected during the flood event. The Putney Heath reservoir rain gauge recorded 40.1mm between 2pm and 5pm. The next nearest rainfall gauge is located at Kew Gardens, approximately 12km to the south-west of Westminster, recorded 40.2mm between 3pm and 6pm. Figure 2 below shows a comparison of the rainfall data recorded at the Kew Gardens and Putney Heath reservoir rain gauges.

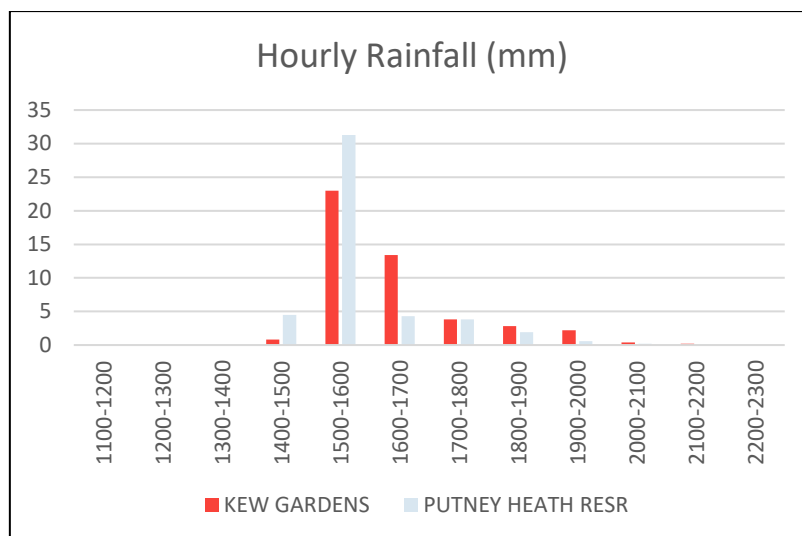


Figure 2: Comparison of rainfall gauges - 12th July 2021

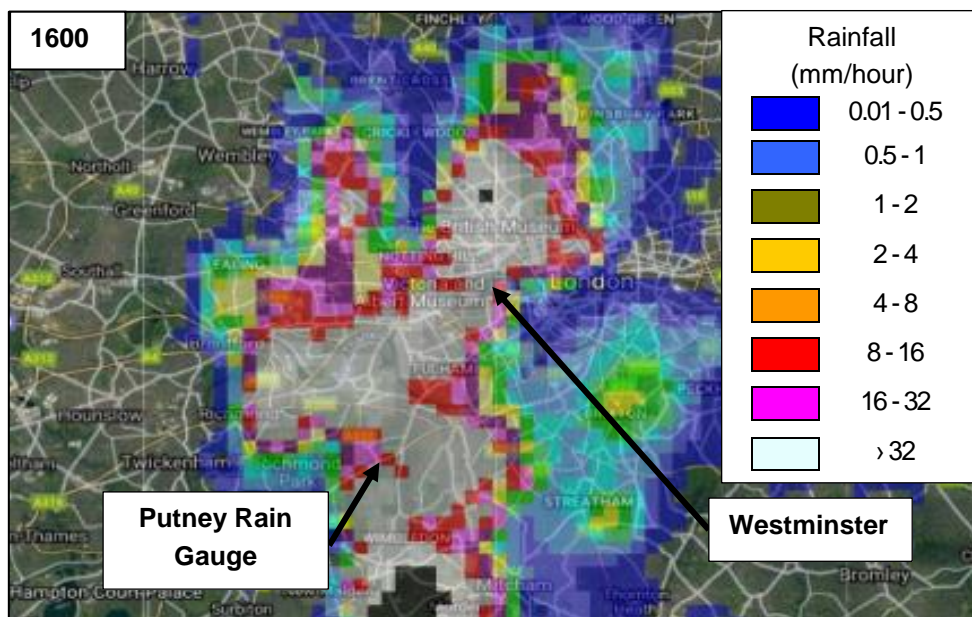
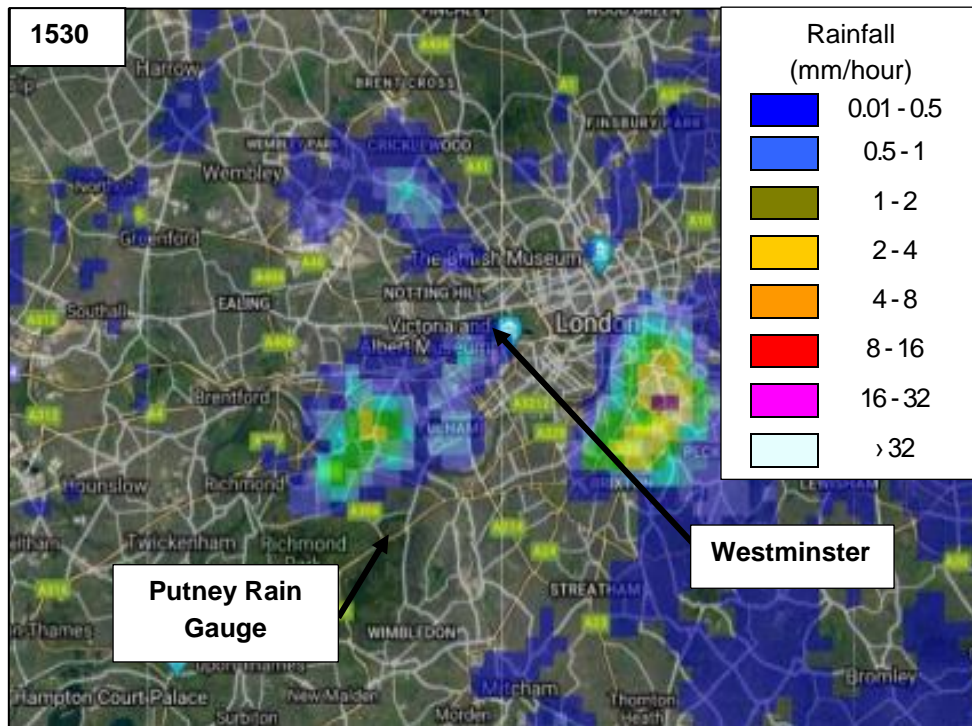
Based on information provided by the Met Office and Thames Water; due to the very localised nature of the intense rainfall experienced during the flood event, it is highly likely that the closest rain gauges did not record the actual amount of rainfall experienced across Westminster. As a result, it is not considered useful to estimate the Annual Exceedance Probability (AEP), where the AEP is the likelihood of rainfall of this depth or more falling in a year in a location. This information will be updated and confirmed as appropriate during ongoing consultation with Thames Water and the Environment Agency.

Thames Water stated in a LinkedIn post that in some areas the rainfall was equivalent to a 1 in 300 year return period¹⁸. It is expected that Thames Water will provide further information on the calculation of the rainfall return period as part of their review of the event.

FLOOD INCIDENT DESCRIPTION

The flood incident that occurred on Monday 12th July 2021 was the result of intense rainfall during the afternoon. The Met Office reported a convergence line developed from East Anglia down to west London in the afternoon. A convergence line occurs when winds of differing directions combine and rise up into the atmosphere. This leads to the development of thunderstorms and showers. Rainfall radar imagery shown in Figure 3 below outlines how the intense rainfall and thunderstorms rapidly developed in the afternoon. The storm travelled from north to south in west London. More than 32mm of rainfall per hour fell in the areas that are shown as white in Figure 3 below.

¹⁸ Thames Water, 2021. Available at: https://www.linkedin.com/posts/thames-water_a-message-from-steve-spencer-our-operations-activity-6823527837107154944-aQ7S



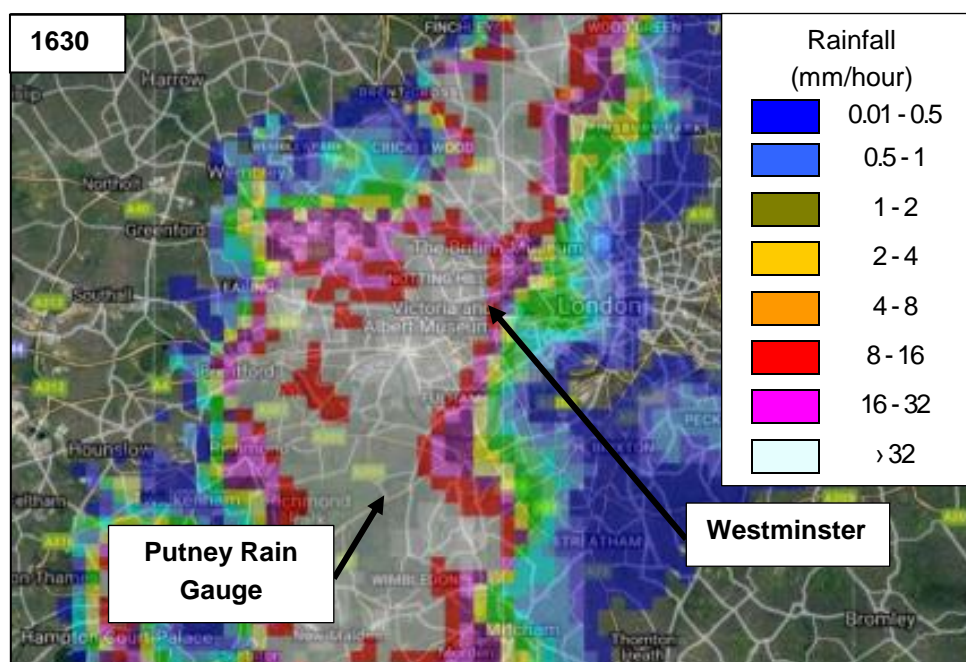


Figure 3: Met Office 12th July Radar Imagery

The London Fire Brigade stated they had received over 1,000 calls in relation to the flooding across London and Thames Water stated they had received over 2,500 calls in five hours on the 12th July¹⁹. council's out of hours call centre took 1173 calls that evening. Generally, they would forecast 209 calls which further illustrates the scale of the event.

WCC undertook a survey of affected residents in August 2021 collating information about the 12th July flood event to inform this Section 19 Investigation. Table 2 below provides a summary of the known properties impacted, including the information collated from the flood survey. Based on the survey responses, it can be qualitatively estimated that damages from the flood event were in excess of £1 million. At the time of writing this interim report it is known over 234 properties internally flooded.

Flood incident data from Thames Water will be obtained during the ongoing consultation due to the widespread reports of sewerage flooding. As part of those 234 properties 80 were reported by Thames Water as having flooded internally, these properties are included below in Table 2. Annex 3 at the end of the report shows the location of the impacted roads. This information will be updated and confirmed during ongoing consultation with Thames Water.

¹⁹ BBC News. 2021. *Flash floods: Parts of London receive a month of rain in one day*. Available at: <https://www.bbc.co.uk/news/uk-england-london-57816647>

Table 2: Summary of the investigated flooding issues

Road Location	Number of Internally Flooded Properties	Comments/Cause	Source of Data
Abbey Road	2	Flooding occurred due to overflowing drains. A resident reported 130cm flood depth to the basement property.	Thames Water, WCC and Resident Questionnaire
Alexander Street	1		Thames Water
Ashworth Road	1		Thames Water
Bayswater Road	1	Lancaster Gate Tube Station	Thames Water
Beethoven Street	1		WCC
Belgrave Gardens	1		Thames Water
Blomfield Road	1		Thames Water
Boundary Road	3	Internal flooding to the basement and property ground floor.	Thames Water
Bourne Street	1	Approximately 30cm flood depth	WCC and Resident Questionnaire
Bourne Terrace	1		WCC
Bristol Gardens	6	Basement flooding between 15cm to 60cm flood depth. Residents reported overflowing sewers as the flood source. Properties were uninhabitable and residents reported the entire street was flooded.	Thames Water, WCC and Resident Questionnaire
Bristol Mews	1		Thames Water
Caroline Terrace	2		Thames Water

Chepstow Road	1		WCC
Chippenham Road	3		Thames Water and WCC
Clarendon Gardens	2		WCC
Cleavedon Square	1	70cm internal flood depth. The resident reported the property is uninhabitable. The resident stated the road drains flood between 3-5 times a year.	Resident Questionnaire
Clifton Hill	1		WCC
Cliveden Place	1		Thames Water
Craven Road	2		Thames Water
Delaware Road	1		WCC
Devonshire Terrace	4	50cm to 100cm internal property flood depth. Resident reported flooding was caused by sewers overflowing. The resident reported the property was uninhabitable	Thames Water, WCC and Resident Questionnaire
Droop Street	1		WCC
Duke Street	1	Flooding to property basement and ground floor.	Thames Water
Eaton Terrace	2		Thames Water
Edgware Road	1		Thames Water
Elgin Avenue	9	Flooding to basement properties. One resident reported 5cm of internal property flooding.	Thames Water, WCC and Resident Questionnaire

Essendine Road	5	Flooding to basement properties. Residents reported 10cm to 50cm of internal property flooding. Residents were evacuated. Source of flooding stated as overflowing sewer and overland flows.	WCC and Resident Questionnaire
Fernhead Road	1		WCC
Formosa Street	5	100cm internal property flood depth. Residents were evacuated. Residents stated flooding caused by sewer flooding.	WCC and Resident Questionnaire
Garway Road	1		WCC
Gloucester Terrace	6	Up to 100cm internal flood depth. One resident reported the property was flooded due to a blocked drain.	WCC and Resident Questionnaire
Great Western Road	1		WCC
Green Street	1		Thames Water
Harrow Road	5	70cm flood depth. Flooding to basement and ground floor of properties.	Thames Water, WCC and Resident Questionnaire
Hatton Street	1	5cm internal flood depth. Property is uninhabitable and resident reported flooding is due to building roof.	WCC and Resident Questionnaire
Hereford Road	1		Thames Water
Kilburn High Road	1		WCC

Kilburn Park Road	52	Flooding due to overflowing drains Resident reported 130 properties were flooded on Kilburn Park Road. Residents were evacuated. Basement flats were inundated by up to 100cm depth of flooding.	Thames Water, WCC and Resident Questionnaire
Lanark Road	1	Basement property was inundated by 50cm internal property flood depth. Source of flooding was overflowing sewer. Resident reported the several neighbouring properties were flooded.	Resident Questionnaire
Lancaster Mews	1	Flooding to ground floor of property.	Thames Water
Lanhill Road	5	Basement properties were affected by up to 100cm internal property flood depth. Source of flooding was overflowing sewer. Resident stated several properties on Lanhill Road were flooded.	Thames Water, WCC and Resident Questionnaire
Longmoore Street	5		Thames Water
Maida Vale	1		Thames Water
Ormonde Court	1		Thames Water
Oxford Street	1		Thames Water
Pimlico Road	8	Flooding to basement and ground floor.	Thames Water
Portman Square	1		Thames Water
Princes Gate	1		Thames Water
Queensway	1		Thames Water

Randolph Crescent	1		Thames Water
Saltram Crescent	4		WCC
Shirland Road	35	Basement flats were internally flooded up to 1.5m flood depth. Residents reported source of flooding as overflowing sewers. Residents were evacuated and properties are uninhabitable.	Thames Water, WCC and Resident Questionnaire
Sutherland Avenue	17	Internal property flooding to property basements and ground floor.	Thames Water and WCC
Upbrook Mews	2	30cm depth internal property flooding. Flooding was a result of overflowing drains. The resident states the property is uninhabitable.	WCC and Resident Questionnaire
Upper Tachbrook Street	2		Thames Water
Walterton Road	4	30cm to 100cm depth of flooding to basement properties. Residents reported several neighbouring properties were flooded. One resident stated the drains outside their property are often blocked.	WCC and Resident Questionnaire
Warwick Avenue	1		Thames Water
Westbourne Green	6	Basement and ground floor flooded.	Thames Water
Westbourne Grove	7	Flooding to property basement.	WCC
Westbourne Park Road	1		WCC

Westbourne Terrace Road	1	WCC
Whitehall	1	Thames Water
Total	234	

FLOOD MECHANISM

The flood incident that occurred on 12th July 2021 was the result of intense rainfall during the afternoon which led to the highway drainage and sewerage systems within Westminster becoming overwhelmed resulting in surcharge. The intense rainfall was exacerbated by the sewer layout as the network flows from north to south discharging via overflows into the River Thames during intense storm periods. The predicted high tide at Chelsea Bridge (approximately 3km south of the main flood area) was 6.15m and this occurred at approximately 16:45pm²⁰. Tidal lock may have had an effect and impacted the capacity of the network; this will be discussed and confirmed with Thames Water. Westminster receives flows from the wider London catchment, Thames Water reported that it is likely the network would have been at capacity when the intense rainfall from Maida Vale tried to enter the network. Thames Water reported that for 45 minutes to an hour in the Kilburn Park Road area there was no capacity for the storm relief sewer to discharge into the trunk sewer²¹. This information will be updated and confirmed during ongoing consultation with Thames Water and the Environment Agency.

GULLY CLEANSING

In 2018 the City Council moved to a risk-based approach for managing highways assets to comply with the National Code of Practice – Well Managed Highway Infrastructure (WMHI) -. This included a risk- based approach to cleaning its gullies meaning that silt levels in gullies are recorded before cleansing. Based on silt level trends a cleaning regime is developed which aims to optimise the cleansing of gullies on a street. The council aim to clean gullies when the average silt levels are between 60% to 70% full, i.e. there is still capacity in the gullies to take surface water away. The measurement of silt levels in a gully is shown in Figure 4, the level of silt is measured from the bottom of the gully to the bottom of the outlet pipe which runs to the Thames Water sewer.

²⁰ *Chelsea Bridge Tide Times for 12th July 2021*. Available at: <https://www.tidetimes.org.uk/chelsea-bridge-tide-times-20210712>

²¹ City of Westminster, 2021. *Public meeting, Friday 30 July, 12-1pm*. [video] Available at: <https://www.westminster.gov.uk/flood-information-and-help>, Minute 33:30 of meeting.

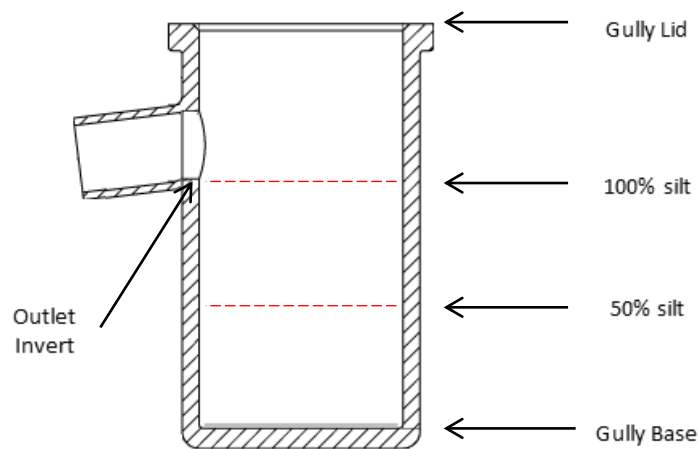


Figure 4: Sketch of gully pot silt levels

In addition to cleaning the gullies, the council also has an annual programme to replace gullies that are in poor condition or reached the end of their serviceable life. The council has replaced 673 gullies since 2017 with more upgrades planned. The council has done work to identify streets where standing water accumulates after periods of heavy rainfall. To reduce the risk of road flooding the council has carried out CCTV surveys on gully outlet pipes (the pipe that extends from the gully into the Thames Water Sewer) across the City to ensure they are in good condition and not reducing water flows into the sewers. Since 2017 the council has CCTV surveyed around 35% of its drainage network (roughly 20,000 metres of lateral pipe). In January 2021, the council commenced a trial of gully sensors to give real-time information on silt level data in gullies. The intention is to link this to Met Office weather warnings to enable the cleaning of gullies in areas vulnerable to surface water flooding ahead of significant rainfall events.

The gullies located in the worst affected flood areas (West Kilburn and Maida Vale) were generally among the most recently cleaned gullies. The majority of these gullies had been cleansed within three months prior to the 12th July flood event. WCC Highways recorded the average percentage of silt found in the gullies during cleaning operations varied from between 20% to 70% indicating that gully blockages were not a cause of the flooding. Annex 4 at the end of the report includes a table ('Affected roads gullies cleansing record') which outlines when the gullies were cleaned and the level of siltation.

Investment in Highways Drainage Infrastructure

Since 2018 the Council has invested £2.4m on CCTV surveys and the repair of gullies and collapsed lateral pipes with a further £6.8m of expenditure profiled up until 2027.

Flood Response

Thames Water deployed additional resources to support affected customers. The clean-up team were deployed to support customers clearing the debris and Thames Water completed work at over

150 properties after the 12th July flood event²². This information will be updated and confirmed during ongoing consultation with Thames Water.

Conclusion and Recommendations

On the 12th July 2021 intense rainfall and thunderstorms caused flooding to areas of Westminster, specifically Paddington and the West Kilburn / Maida Vale areas. The nearest Environment Agency rain gauge located at Putney Heath Reservoir recorded 40.1mm between 2pm and 5pm and a total 24-hour rainfall of 47.4mm. Consequently, highway drains and the local sewer network were unable to cope with the intense and high volume of rainfall.

In a highly urbanised area such as London to more accurately capture the return period of future storm it may be beneficial to increase the concentration of reliable rain gauges.

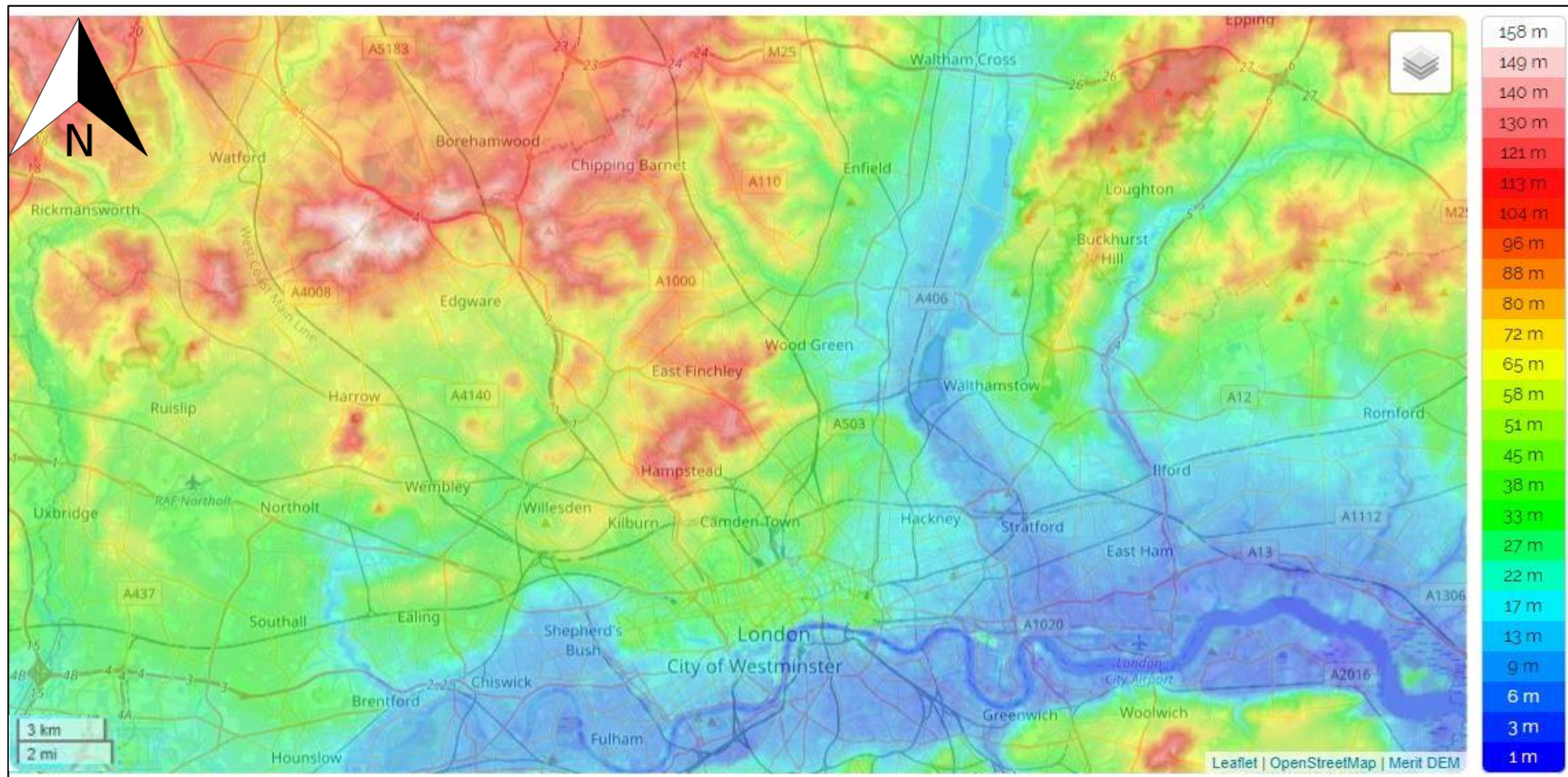
It would also be beneficial for the council to keep better records of past flood events for future reference. Section 19 reports will help the council to maintain better flood records in the future.

WCC will review their current gully maintenance strategy and determine if the current frequency and strategy of maintenance is still appropriate or could be further optimised. WCC has commenced an investigation of its gully maintenance procedures, however the initial review has assessed that the gully network was working effectively during the 12th July flood event. As the average silt levels within gully pots were within the council's optimum range of 60% to 70% in the streets affected by during the 12th July flood event. The council will however look to see where it can make further improvements, these will be reported in the final version of the report once Thames Water's input is received.

Further consultation with other local LLFAs and Thames Water will be undertaken to start investigations as to whether there are wider catchment considerations that will reduce local flood risk across the wider London area. The Regional Flood and Coastal Committee may play a role in future consultation.

Thames Water are undertaking workshops with LLFAs in September 2021 and an independent review of the 12th July flood event; their findings and recommendations will inform the final version of this report. The date of the independent review is not known at the time of writing. However, it is anticipated the report review will take over 6 months.

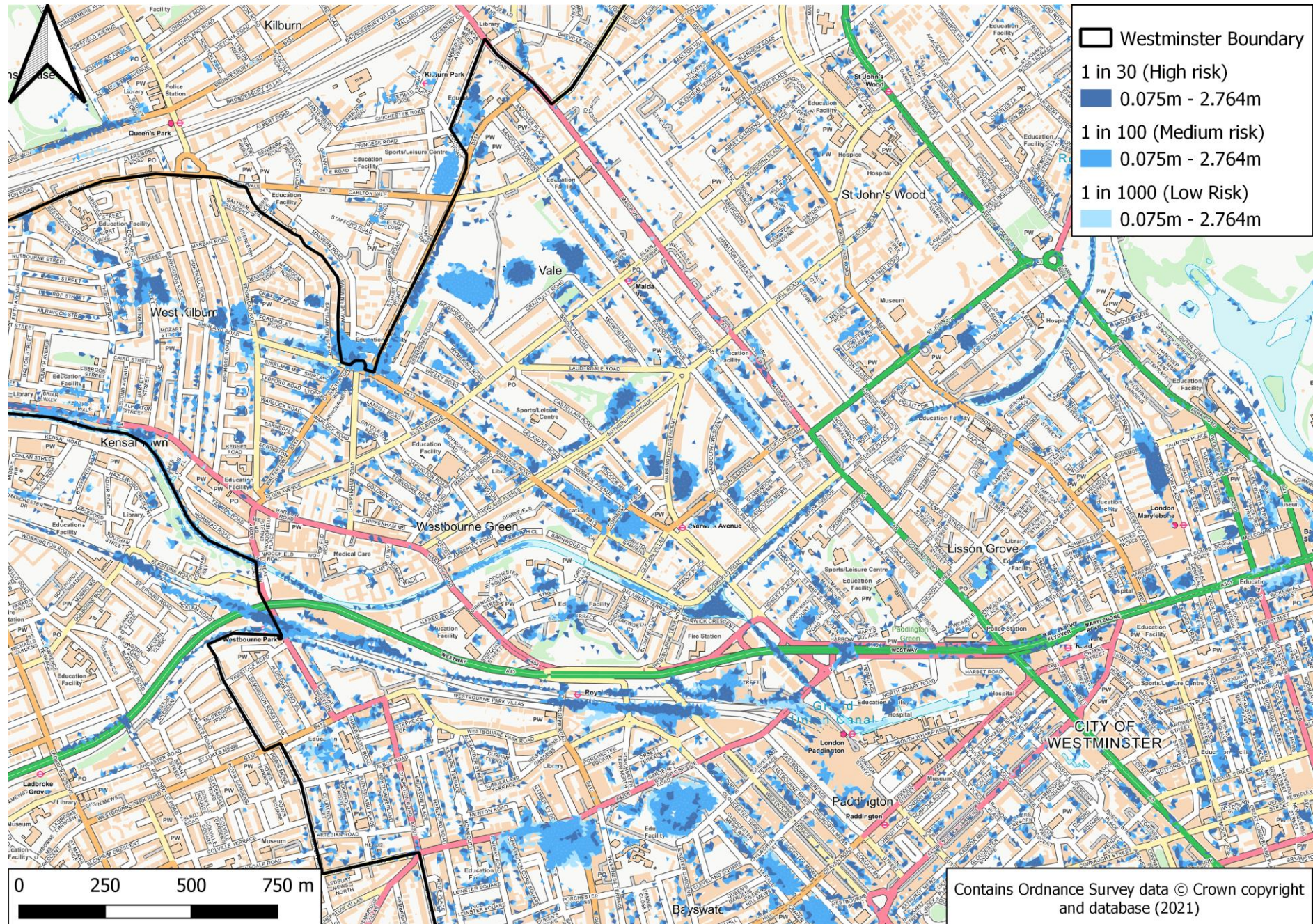
²² Thames Water, 2021. Available at: https://www.linkedin.com/posts/thames-water_a-message-from-steve-spencer-our-operations-activity-6823527837107154944-aQ7S

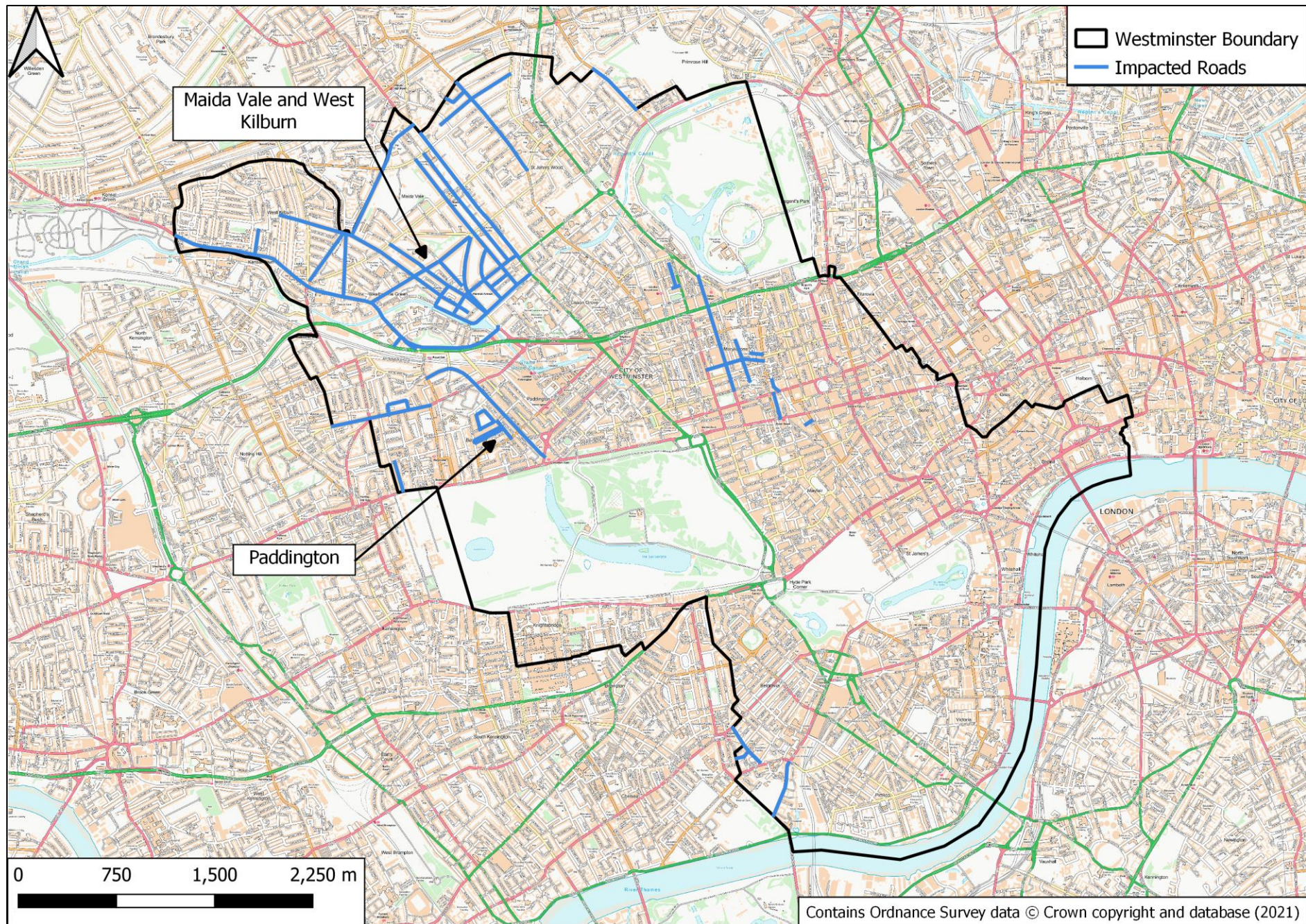


Annex 1 Greater London Topographic map²³

²³ Greater London Topographic Map. Available at: <https://en-gb.topographic-map.com/maps/sn5u/Greater-London/>

Annex 2 Extract from WCC Flood Risk from Surface Water map





Annex 3 Flood Locations map

Full list of known streets	Number of Gullies	Cleaned	Not Cleaned (parked cars/jammed lids/no access)	Average Silt %	Number of Cleans Per year	Last Date of Attendance	Number cleaned on second visit	Reactive visits since April 2020
Abbey Road	39	38	1	50.49%	1PA	27/07/2021	1	3
Avenue Road	35	18	3	60.00%	1PA	07/06/2021	2	3
Baker Street	38	35	3	48.65%	1PA	20/10/2020	0	2
Blandford Street	17	13	4	55.45%	1PA	20/10/2020	0	1
Blenheim Street	5	5	0	34.00%	1PA	15/10/2020	0	1
Blomfield Road	27	16	11	67.06%	1PA	01/03/2021	6	0
Bourne Street	11	7	4	72.86%	1PA	12/05/2020	0	0
Bristol Gardens	4	4	0	60.00%	1PA	09/07/2021	0	0
Castellain Road	35	22	13	70.91%	1PA	02/07/2021	0	1
Chester Row	21	19	2	61.58%	1PA	02/10/2020	0	2
Chippenham Road	12	3	9	60.00%	1PA	28/06/2021	0	1
Clarendon Gardens	2	0	2	50.00%	1PA	07/07/2021	0	0
Cleveland Square	13	8	5	43.33%	1PA	18/03/2021	2	2
Clifton Hill	21	14	7	22.31%	1PA	14/07/2021	1	0
Clifton Gardens	15	6	9	70.00%	1PA	05/07/2021	3	0
Clifton Villas	7	5	2	60.00%	1PA	25/06/2021	1	0
Cliveden Place	6	1	5	60.00%	1PA	18/03/2021	0	0

Delaware Road	29	20	9	60.00%	1PA	25/05/2021	0	1
Devonshire Terrace	13	12	1	55.00%	1PA	21/09/2020	0	3
Ebury Bridge Road	23	17	6	58.82%	1PA	18/11/2020	0	1
Elgin Avenue	69	56	13	67.20%	1PA	21/06/2021	5	2
Ennismore Street	3	3	0	70.00%	1PA	19/05/2020	0	0
Essendine Road	16	8	8	53.75%	1PA	05/05/2021	0	1
Formosa Street	17	11	6	64.00%	1PA	21/07/2021	5	1
Garway Road	5	4	1	57.50%	1PA	22/07/2021	0	1
Gloucester Terrace	53	28	25	56.30%	1PA	28/10/2020	0	6
Graham Terrace	17	11	6	70.00%	1PA	19/05/2020	0	3
Harrow Road	244	162	82	50.92%	2PA	08/06/2021	0	5
Huntsworth Mews	10	9	1	20.00%	1PA	15/06/2021	0	3
Kilburn Park Road	25	12	13	60.00%	1PA	11/05/2021	3	3
Lanark Road	46	41	5	59.76%	1PA	23/07/2021	0	2
Lanhill Road	9	4	5	68.00%	1PA	17/05/2021	0	1
Maida Vale	64	56	8	50.41%	1PA	24/04/2020	2	4
Manchester Street	12	8	4	60.00%	1PA	15/10/2020	0	0
Marylebone Lane	31	30	1	50.71%	1PA	15/10/2020	0	0
Montpelier Square	17	11	6	40.00%	1PA	18/03/2021	3	7
Newton Road	8	6	2	50.00%	1PA	09/07/2020	0	2
Palace Court	14	11	3	75.45%	1PA	02/07/2020	0	2

Queen's Gardens	9	6	3	55.00%	1PA	08/07/2020	0	2
Randolph Avenue	62	23	39	68.70%	1PA	17/05/2021	0	4
Randolph Crescent	20	11	9	73.33%	1PA	07/07/2021	0	1
Randolph Road	8	5	3	70.00%	1PA	07/07/2021	0	2
Second Avenue	7	5	2	52.00%	1PA	13/04/2021	0	0
Shirland Road	71	62	9	61.85%	1PA	22/07/2021	4	5
ST Christopher's Place	4	4	0	25.00%	2PA	30/04/2021	0	1
Sutherland Avenue	64	37	27	60.59%	1PA	15/07/2021	4	6
Thayer Street	9	8	1	51.43%	1PA	19/10/2020	0	1
Torquay Street	4	4	0	66.67%	1PA	11/02/2021	0	0
Upbrook Mews	7	7	0	42.86%	1PA	18/02/2021	0	0
Walterton Road	14	13	1	50.77%	1PA	09/09/2020	0	2
Warrington Crescent	28	17	11	63.53%	1PA	06/07/2021	0	1
Warwick Avenue	41	29	12	58.44%	1PA	23/07/2021	10	0
Westbourne Grove	54	41	13	36.59%	1PA	18/01/2021	5	4
Westbourne Terrace Road	4	1	3	60.00%	1PA	15/07/2021	0	2
Totals	Total number of	Total number of gullies	Total number of gullies not cleaned on					

gullies =1439	cleaned =1007 (70% of total)	initial visit =418.
------------------	---------------------------------------	------------------------

Annex 4 Affected Road Gullies Cleansing Record

70% of all gullies in the affected roads were cleared on the initial visit with the remained unable to be accessed primarily due to parked cars. Of the gullies that couldn't be accessed 13% were cleared on a second visit with the remainder to be cleared, as is routine, with the use of a car lifter before the end of November 21. We also clear gullies on a reactive basis if we receive enquiries from the public or our own highways inspectors.