



12TH AND 25TH JULY 2021 SECTION 19 FLOOD INVESTIGATION REPORT

14TH NOVEMBER 2022

Executive Summary

Two major flood events occurred across London and the surrounding areas on the 12th and 25th July 2021. Across the two events, approximately 1,000 properties were affected, the 12th July flood event impacted the residents and businesses across Westminster the most. A Section 19 Flood Investigation Report has been undertaken by Westminster City Council as part of their duty under the Flood and Water Management Act 2010. As a result of the major flood events an Independent London Flood Review was also undertaken to understand the flooding mechanisms¹. The Independent London Flood Review was a comprehensive assessment of the two July flood events for the whole of London and was undertaken across four stages:

- Investigation of reported flooding on 12 and 25 July 2021.
- Investigation into the catchment response and root causes that led to flooding on 12 and 25 July 2021.
- Assessment of the performance of Thames Water (TW) assets, including flooding alleviation schemes, critical pumping stations and operational performance of the network on 12 and 25 July 2021.
- Recommendations to improve resilience to future flooding events.

The overall findings of the Independent London Flood Review confirm that the amount of rain that fell during the two storms was the main cause of flooding, overwhelming the surface water and sewerage drainage systems. The review highlighted a number of key recommendations in order to deal with future flood events that may occur. Those recommendations are summarised in the Conclusion of this report and include:

- Establishing a Body with a strategic view and governance with representation from all parties with responsibility for flood management.
- Implementing anti flood devices (e.g. FLIPs²) to protect those at highest risk.
- Supporting homeowners and tenants to understand how they can best protect their homes from flooding, including opportunities to build in resilience.
- Encouraging asset owners to fully understand, develop and maintain their assets so they perform at their optimum level during high intensity events.

Thames Water have created a sewer resilience programme to identify properties at highest risk of sewer flooding to install sewer flooding resilience measures, such as a one-way valve (also called a non-return valve) in their sewer connection, to help prevent this from happening again³. More information about the scheme and how to apply if you were affected by the July 2021 flood events is available on Thames Water website.

¹ London Flood Review, 2022. Available at: <https://londonfloodreview.co.uk/>

² A Flooding Local Improvement Project (FLIP) cuts the gravity foul and surface water drainage from a property to the sewer and includes the installation of a small chamber and pump to lift the flows from basement levels to ground level and into the sewer. The system prevents sewage from entering the property when the sewer is at capacity during a flood event but still allows surface and foul flows to drain from the property.

³ Thames Water, 2022. Available at: <https://www.thameswater.co.uk/about-us/investing-in-our-region/sewer-flooding-prevention>



Thames Water have also outlined a number of actions that they will be focusing on following the flood events⁴ including improving response to adverse weather warnings, approach to customer service and communication, ability to use data and incident response processes.

Following the extreme flood events WCC are proposing and currently undertaking a number of actions in order to understand and prepare for future flood events across the Borough. The following actions are being undertaken by WCC:

- 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 and 25th July flood events.
- WCC are currently in the process of updating and verifying their 2015 surface water hydraulic model using the latest Beckton Sewer model provided by Thames Water and validating it against the 12 July 2021 event.
- WCC Strategic Flood Risk Assessment (SFRA) is currently being updated, this will be completed early 2023.
- Opportunities for a more strategic retrofitting of Sustainable Drainage Systems (SuDS) within Westminster are currently being investigated building on the results of the London Strategic SuDS Pilot Study⁵.
- The updated surface water modelling results will be used to identify highly vulnerable development (e.g. basement self contained accommodation within Westminster) at risk of surface water flooding with the aim of exploring potential mitigation measures for those receptors.
- WCC will also be investigating the possibility of slowing down surface water runoff delaying its discharge into the sewer network during heavy rainfall events, to relieve the pressure on the sewer network when it reaches capacity. The viability of temporarily storing surface water will be a key consideration.

⁴ Thames Water, 2021. Available at: <https://www.thameswater.co.uk/media-library/home/about-us/investing-in-our-region/flooding-review/july-flooding-internal-review.pdf>

⁵ London Strategic SuDS Pilot Study, 2021. Available at: <https://www.lotag.co.uk/london-strategic-suds-pilot-study>



Introduction

This document has been prepared by Westminster City Council (WCC), with support from its specialist flood consultants WSP, as the Lead Local Flood Authority (LLFA) under Section 19 of the Flood and Water Management Act 2010, with the assistance of:

- Environment Agency
- Thames Water
- Local residents
- Independent London Flood Review

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 that a LLFA must investigate which flood management authorities have relevant flood risk management functions in the LLFA's area. The LLFA must investigate the actions each risk management authority has exercised or is proposing to exercise in response to the flood event⁶.

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 to add value⁷.

The flood investigation covers the number of properties affected by the event, causes of flooding and the responsibilities of the various risk management authorities. The findings and recommendations from a section 19 flood investigations enable LLFAs to learn lessons from flood events and address associated infrastructure needs.

This Section 19 Flood Investigation Report covers both the 12th and 25th July 2021 flood events. It is also noted that another flood event occurred on the 4th October 2021, however as less than five properties were recorded to have flooded internally a Section 19 Report is not required.

Summary of events

It should be noted that although this S19 Flood Investigation Reports covers both of the 12th July 2021 and 25th July 2021 flood events, this report focuses mainly on the 12th July flood event. The 25th July flood event predominantly affected areas located in the north-west of London such as the Walthamstow area rather than Westminster, as a result more information and data has been available for the 12th July flood event.

12TH JULY

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

⁶ Flood and Water Management Act 2010, c. 19. Available at: <https://www.legislation.gov.uk/ukpga/2010/29/section/19>

⁷ City of Westminster, 2017. *Local Flood Risk Management Strategy 2017-2022*.

and the West Kilburn / Maida Vale being the worst affected areas. Information from the Met Office shows the nearest Environment Agency rain gauge, located at Putney Heath Reservoir, (approximately 8.5 km to the south-west of the main areas affected in Westminster) recorded 40.1 mm between 14:00 and 17:00 and a total 24-hour rainfall of 47.4mm. The average rainfall for London in July is approximately 45mm⁸. Due to the distance of the Putney Heath Reservoir rain gauge, it is not possible to accurately state the magnitude of the 12th July 2021 event using this source of information, as it is likely the rain gauge did not accurately record the peak rainfall. The rainfall gauge in St. James's Park and Holland Park have not been used to inform this report as they did not record a significant amount of rainfall.

Radar rainfall data was analysed as part of the London Flood Review Report⁹ undertaken by an independent expert group. On 12th July 2021, Westminster received a maximum rainfall intensity of over 150 mm/hr, with the majority of the Borough receiving a maximum rainfall intensity of between 50–100 mm/hr. The highest return period was located in Paddington with an estimated return period of approximately 1 in 200 years. The rainfall data analysis is described in more detail later in the report. As a result of the high intensity rainfall, highway drains and the local sewer network were unable to cope with the intensity and high volume of rainfall. The localised heavy rainfall started in the northeast of the borough and then progressed towards the southwest areas. At the workshop on 28th September 2021 Thames Water confirmed that the sewer network drains from the north to the south across London, and as a result of the extreme rainfall event moving from north to south, when the heavy rainfall fell on the southern areas the sewer system was already at capacity. As confirmed by Thames Water and the London Flood Review, the effects of the rainfall were made worse by the high tide preventing the systems from discharging into the River Thames, often referred to as 'Tide locking'.

Based on information from the survey undertaken by WCC and WCC's Emergency Response team, approximately 250 properties and 60 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.

25TH JULY

A second flood event occurred on the 25th July 2021, during which intense rainfall and thunderstorms caused flooding to areas of Westminster, particularly in the southern region of the borough. The nearest Environment Agency rain gauge, Holland Park, located approximately 4.7km northwest of the main areas affected by flooding, recorded approximately 18.6mm between 13:30 to 17:00, and a total 24-hour rainfall of 20.6mm. The average rainfall for London in July is approximately 45mm. Due to the distance of the Holland Park rain gauge from the affected areas within Westminster, it is not possible to accurately state the magnitude of the 25th July flood event as it is likely the rain gauge did not accurately record the peak rainfall. This seems consistent with the records of the local rain gauge located within St. James's Park which recorded approximately 41.8 mm on the 25th July¹⁰.

The London Flood Review Report⁴ shows the rainfall radar data provided by Thames Water. On 25th July 2021, Westminster received a maximum rainfall intensity of up to 50-100 mm/hr. The majority of Westminster experienced a 1 in 5 year return period, with the worst affected areas in Westminster experiencing a 1 in 10 return period event. As a result of the high intensity rainfall, the local sewer network was unable to cope with the intense rainfall in combination with a high tide (tide locking) preventing the system from discharging into the River Thames.

Based on information from the resident surveys undertaken by WCC and WCC's Emergency Response team, and information from the London Review Report, WCC is aware 24 properties were impacted by flooding across Westminster.

⁸ 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>

⁹ London Flooding Review – Data Discovery and Initial Analysis (February 2022). Available at: <https://londonfloodreview.co.uk/stage-1-report/>

¹⁰ JBA. 2021 Available at: <https://www.jbarisk.com/flood-services/event-response/a-retrospective-look-at-summer-2021-london-flash-floods/>



Rights and Responsibilities

LEAD LOCAL FLOOD AUTHORITY (LLFA)

WCC act as both the LLFA and Highway Authority. As the LLFA WCC is 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 effectively as possible. WCC is responsible for the maintenance of highway drainage within the City of Westminster (excluding Transport for London and Royal Parks assets).

THAMES WATER

Thames Water is the risk management authority responsible for the local sewerage network which in Westminster is a combined sewerage system i.e. surface water drainage and sewer drainage is combined into one network controlled by Thames Water. Thames Water is not responsible for drainage within a property. Thames Water as a risk management authority is 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 is not the responsible risk management authority for the source of flooding on the 12th July flood event.

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 as shown in the map in Annex 1.

For the 12th July flood event, the main affected areas were Maida Vale, West Kilburn and Paddington which 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 south of the Great Western Main Line to approximately 19m AOD near Bishop's Bridge Road.

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 Departments of State including the Home Office, Foreign Office, Treasury, Health etc. along with various palaces including Buckingham Palace.

For the 25th July flood event, the main affected areas were the southern areas of the Westminster Borough, particularly Victoria and Westminster. These areas are heavily urbanised, and generally have flat local topography which gently slopes down from a western to eastern direction, at approximately 9m AOD to the west and 4m AOD to the east, south of Hyde Park. The north to south local topography is predominantly flat across the urbanised area.

Westminster is located above a regional chalk aquifer which is covered with clays, silts and gravel. A review of the Cranfield University Soilscape 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 Water¹¹. 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 (especially below ground level basement 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 properties¹².

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 west¹³. The River Westbourne and River Tyburn were culverted and now form part of the combined sewer network¹³. 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 Street¹⁴. The scheme increased the capacity of the sewerage network to cope with a 1 in 30 year storm event and aimed to protect 102 properties from sewer flooding in a 1 in 30 year rainfall return period as explained by Thames Water at the workshop with LLFAs on 28th September 2021. At the workshop Thames Water confirmed that the flood alleviation scheme performed *exceptionally well* during the 12th July flood event and that *when comparing the reported property flooding (to Thames Water as well as the City of Westminster) from 2021 with the properties alleviated in 2015 only 20 re-flooded*¹⁵. Maida Vale and West Kilburn are served by an approximately 2m diameter trunk sewer (Ranelagh trunk sewer) and the north western storm relief sewer^{16,17}. 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

¹¹ City of Westminster, 2019. Strategic Flood Risk Assessment.

¹² Environment Agency, 2020. *Combined Sewer Overflows Explained*. Available at: <https://environmentagency.blog.gov.uk/2020/07/02/combined-sewer-overflows-explained/>

¹³ City of Westminster, 2011. *Surface Water Management Plan*.

¹⁴ Thames Water, 2014 Maida Vale Flood Alleviation Scheme Project update. Available at: <https://www.facebook.com/MaidaFloodAction/photos/pcb.289779381180114/289779211180131/?type=3&theater>. It should be noted that this link was active at the time of writing the report.

¹⁵ Thames Water workshop with LLFAs 28th September 2021

¹⁶ 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

¹⁷ 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.

Figure 2 below shows an extract of the Environment Agency’s Flood Map for Planning across Westminster. The Flood Zones shown in the figure below are associated with potential flooding from the River Thames.

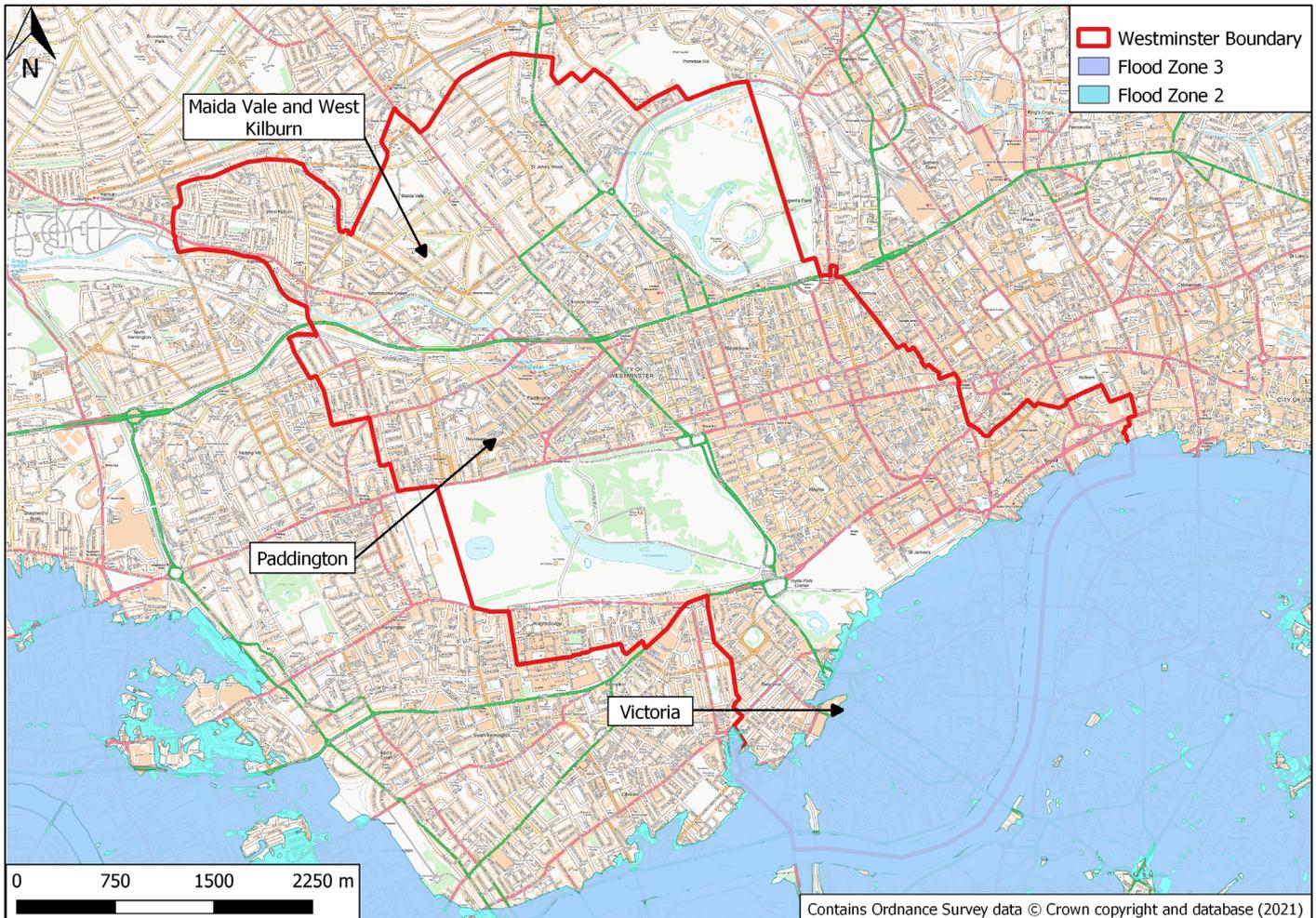


Figure 2: Environment Agency’s Flood map for Planning

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 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 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 risk of flooding from surface water sources included areas that experienced flooding during the July 12th flood event²¹. Annex 2 at the end of the report shows extracts from WCC’s Flood Risk from Surface Water map. It should be noted that the modelling which informed the risk of flooding from surface water mapping is currently being updated.

Groundwater flooding typically occurs in low lying areas where groundwater springs reach ground level. Potential impacts are therefore generally more significant for basements; however the associated risk is generally lower than that related to other sources of flooding.

²¹ 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.

Westminster sits on a regional chalk aquifer covered by clay, silt and gravels. Areas with increased potential for elevated groundwater exist within the borough, as discussed in the SFRA, meaning that in those areas there is an increased potential for groundwater to be within 2 m of the ground surface. Notwithstanding this the Westminster Local Flood Risk Management Strategy 2017 outlines that the risk from groundwater flooding is very low and that there are no records of groundwater flooding within Westminster.

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' Park²² with widespread flooding in Pimlico also linked to the failure of the Longmoore Street Pumping Station²³.

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 sources²⁴. The Brent and Kilburn Times reported Maida Vale flooded in June 2009 and in July 2007 due to the sewer network becoming overloaded²⁵. 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 London²⁶. The Met Office estimated the storm return period exceeded a 1 in 200 year event in parts of England²⁷. WCC have reviewed the council's flood incident records and no further flood events were identified.

Table 1 outlines the historic sewer flooding taken from the Strategic Flood Risk Assessment (2019). 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 external 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

²² 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>

²³ Cities of London & Westminster Conservative Association. 2018. *Flooding in Pimlico again*. Available at: <https://www.twocitiesconservatives.org.uk/news/flooding-pimlico-again>

²⁴ City of Westminster, 2011. *Preliminary Flood Risk Assessment*.

²⁵ Brent and Kilburn Times, 2009. *Thames chiefs in hot water*. Available at: <https://www.kilburntimes.co.uk/news/thames-chiefs-in-hot-water-3676110>

²⁶ BBC News. 2008. *The summer floods: What happened*. Available at: <http://news.bbc.co.uk/1/hi/uk/7446721.stm>

²⁷ 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

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 external 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
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 12th July

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 8.5 km to the south-west of the main areas affected during the flood event. The Putney Heath reservoir rain gauge recorded 40.1 mm between 2pm and 5pm. The next nearest rainfall gauge is located at Kew Gardens, approximately 12 km to the south-west of Westminster, recorded 40.2 mm between 3pm and 6pm. Figure 3 below shows a comparison of the rainfall data recorded at the Kew Gardens and Putney Heath reservoir rain gauges. The rainfall gauges located at St. James's Park and Holland Park did not record significant amounts of rainfall and as result have not been included the assessment of the magnitude of the flood event.

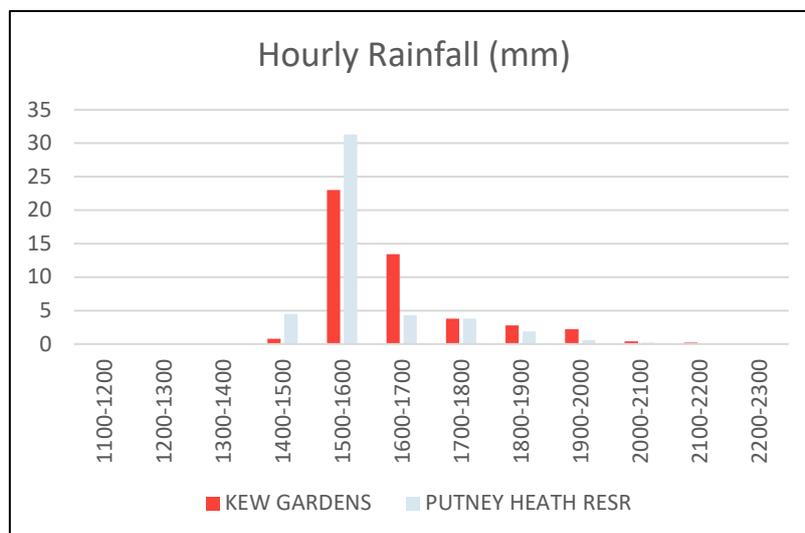


Figure 3: Comparison of rainfall gauges - 12th July 2021

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 (Putney Heath Reservoir and

Kew Gardens) did not record the actual amount of rainfall experienced across Westminster and its variability, with very intense localised rainfall at specific locations.

Radar rainfall data was analysed as part of the London Flood Review Report²⁸ undertaken by an independent expert group. On 12th July 2021, Westminster received a maximum rainfall intensity of over 150 mm/hr, with the majority of the Borough receiving a maximum rainfall intensity of between 50–100 mm/hr. The highest return period (which can be described as the average time between events of a particular magnitude: the more extreme the event, the higher the return period) was located in Paddington just north of Hyde Park with an estimated return period of just under 1 in 200 years. Figure 4 below shows the maximum rainfall intensity as analysed as part of the independent London Flood Review for the 12th July flood event.

Figure 5 shows the return period of rainfall for the 12th July 2021 for a 2 hour duration across London, including Westminster borough highlighted in red. This shows that the areas within Westminster experienced a greater than a 1 in 200 year return period. The London Review Report also highlighted very localised areas which may have experienced a greater than a 1 in 200 year return period.

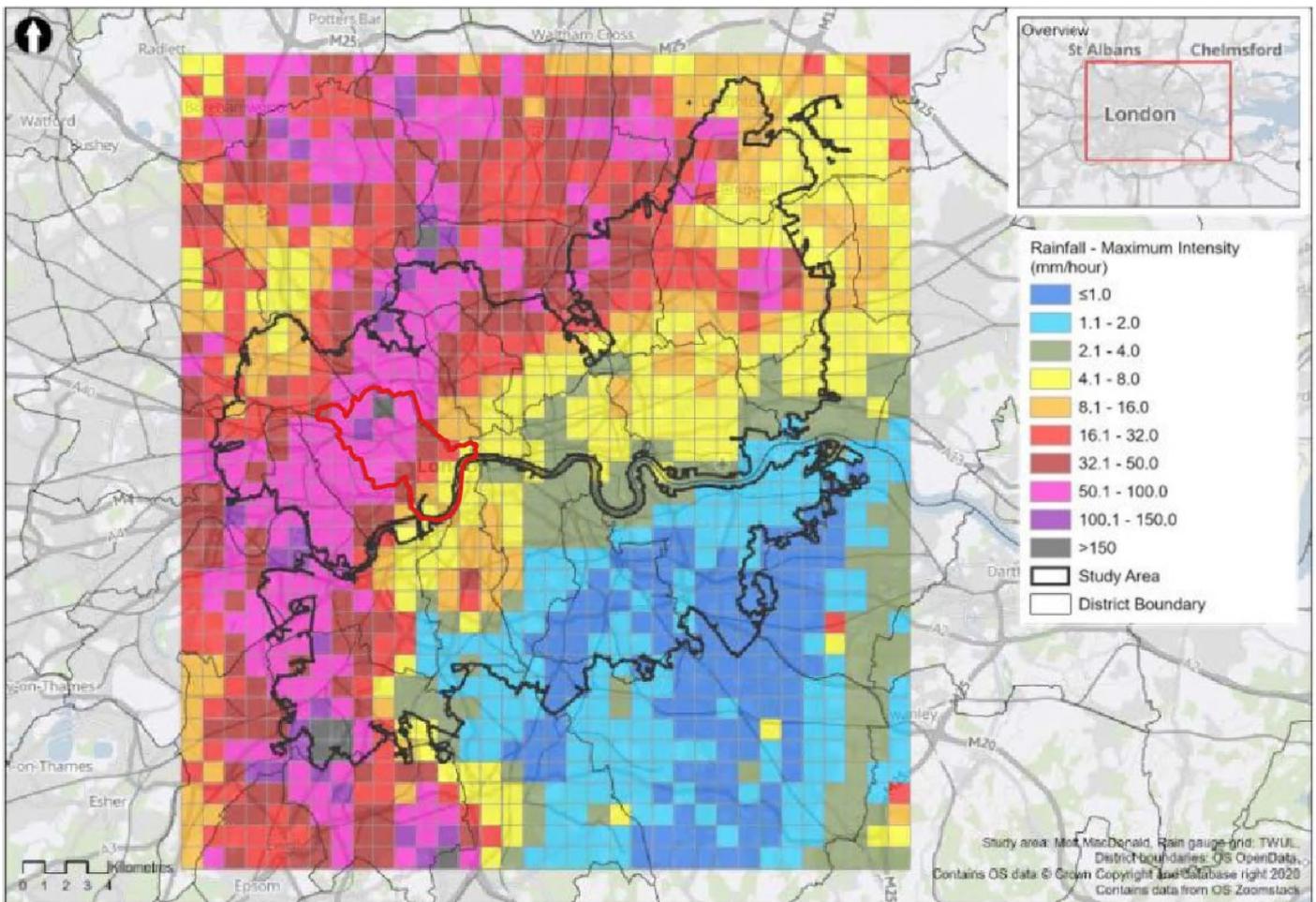


Figure 4 - Maximum rainfall intensity of the 12th July 2021 across London. Westminster Borough boundary marked in red. Source: London Flood Review Report.

²⁸ London Flooding Review – Data Discovery and Initial Analysis (February 2022). Available at: <https://londonfloodreview.co.uk/stage-1-report/>

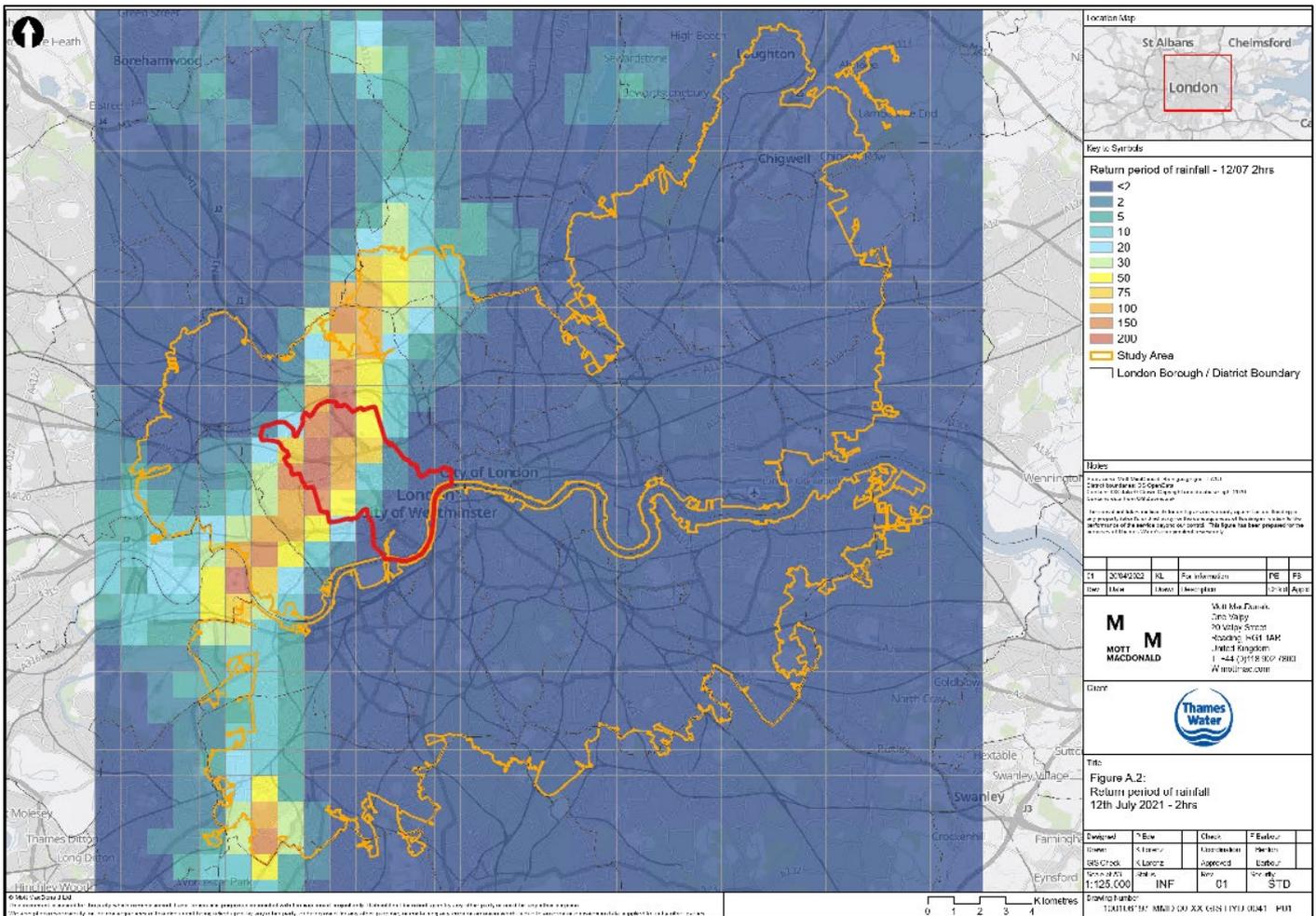
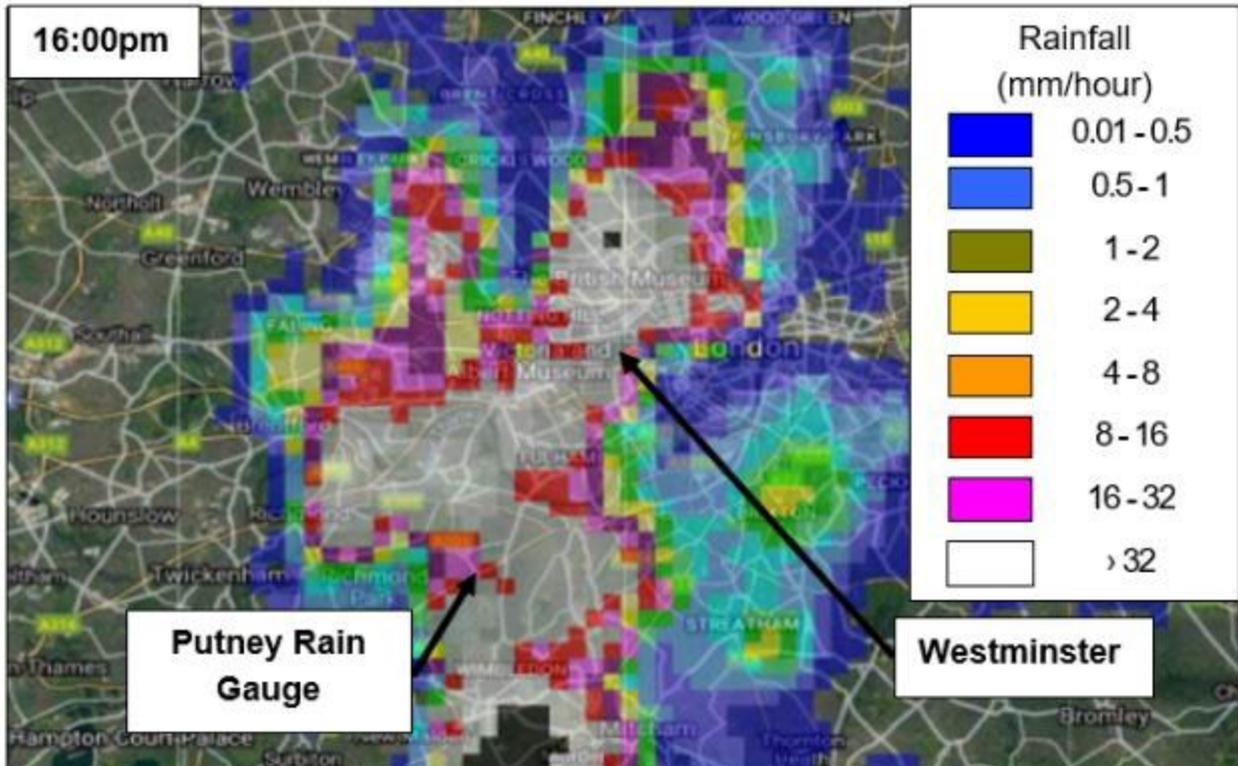
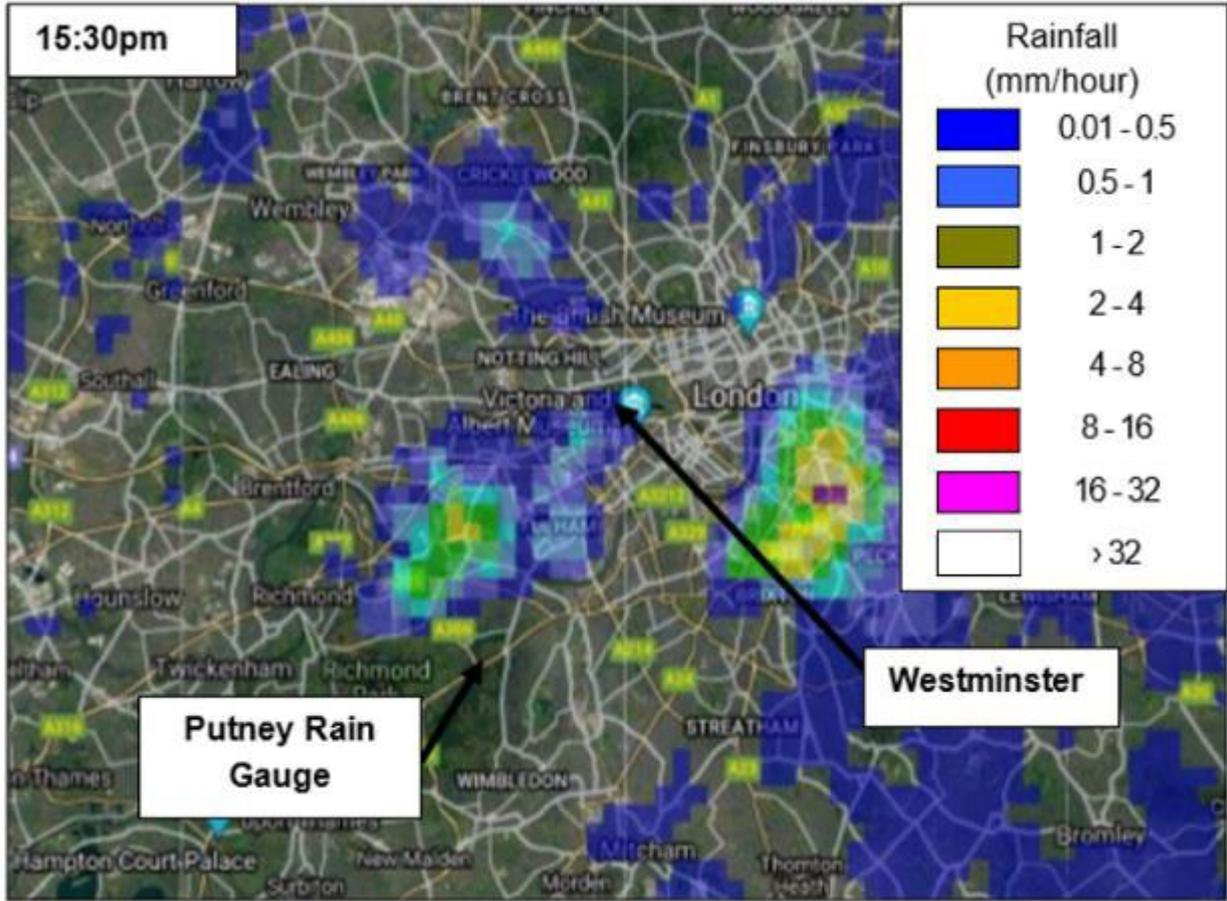


Figure 5 – Return period of rainfall on the 12th July, 2 hour duration. Westminster Borough boundary highlighted in red border. Source: London Flood Review Report.

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 65²⁹ below outlines how the intense rainfall and thunderstorms rapidly developed in the afternoon. The storm travelled from north to south in west London, in the areas that are shown as white in Figure 5 below the rainfall intensity exceeded 32 mm per hour.

²⁹ London Flooding Review – Stage 3: Performance of Schemes and Hotspot Areas (May 2022). Available at: <https://londonfloodreview.co.uk/wp-content/uploads/2022/05/Stage-3-Report-Final.pdf>



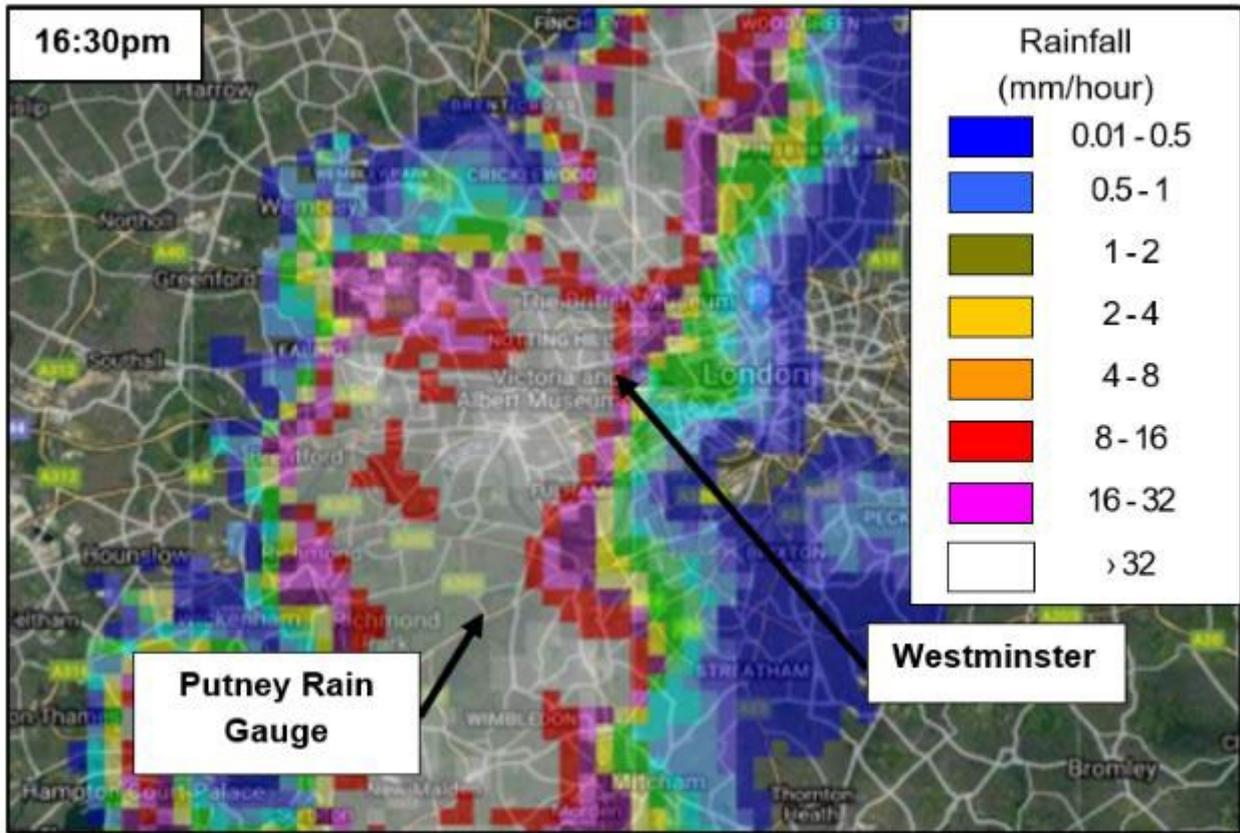


Figure 6: Met Office 12th July Radar Imagery

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 July³⁰. This confirms the large 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. At the time of writing this report it is known that over 250 properties flooded internally.

Flood incident data from Thames Water has been obtained during consultation due to the widespread reports of sewerage flooding. These properties are included below in Table 2. Annex 3 at the end of the report shows the location of the impacted roads.

³⁰ 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	1	Flooding occurred due to overflowing drains. A resident reported 130 cm 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 flooded.	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 30 cm flood depth	WCC and Resident Questionnaire
Bourne Terrace	1		WCC
Bristol Gardens	6	Basement flooding between 15 cm to 60 cm 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
Bulstrode Place	1	Up to 30 cm flood depth reported.	Resident Questionnaire
Carlton Hill	1	3 cm flood depth internally and externally.	Resident Questionnaire
Caroline Terrace	2		Thames Water
Charlbert Street	2	Up to 50 cm internal flood depth.	Thames Water
Chepstow Road	1		WCC

Road Location	Number of Internally Flooded Properties	Comments/Cause	Source of Data
Chippenham Road	3		Thames Water and WCC
Clarendon Gardens	2		WCC
Cleveland Square	1	70 cm internal flood depth. The resident reported the property is uninhabitable.	Resident Questionnaire
Clifton Hill	1		WCC
Cliveden Place	1		Thames Water
Craven Road	2		Thames Water
Delaware Road	1		WCC
Devonshire Terrace	4	50 cm to 100 cm 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	10	Flooding to basement properties. One resident reported 5 cm of internal property flooding.	Thames Water, WCC and Resident Questionnaire
Essendine Road	5	Flooding to basement properties. Residents reported 10 cm to 50 cm 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

Road Location	Number of Internally Flooded Properties	Comments/Cause	Source of Data
Formosa Street	5	100 cm internal property flood depth. Residents were evacuated. Residents stated flooding caused by sewer flooding.	WCC and Resident Questionnaire
Garway Road	1		WCC
Gloucester Terrace	7	Up to 100 cm 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
Guildhouse Street	1	Reported sewer flooding.	WCC and Resident Questionnaire
Harrow Road	5	70 cm flood depth. Flooding to basement and ground floor of properties.	Thames Water, WCC and Resident Questionnaire
Hatton Street	1	5 cm internal flood depth. Property is uninhabitable and resident reported flooding is due to building roof.	WCC and Resident Questionnaire
Hereford Road	1		Thames Water
Kensington Garden Square	1	30 cm flood depth externally.	Resident Questionnaire
Kilburn High Road	1		WCC
Kilburn Park Road	56	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 100 cm depth of flooding.	Thames Water, WCC and Resident Questionnaire
Lanark Road	2	Basement property was inundated by 50 cm 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

Road Location	Number of Internally Flooded Properties	Comments/Cause	Source of Data
Lanhill Road	5	Basement properties were affected by up to 100 cm 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
Old Queen Street	2	Flooding reported in the basement at a depth of approximately 30cm.	Resident Questionnaire
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
Prince Albert Road	2		Resident Questionnaire
Princes Gate	1		Thames Water
Queensway	1		Thames Water
Randolph Crescent	1		Thames Water
Randolph Road	1	50 cm external flooding depth and 40 cm internal flood depth.	Resident Questionnaire
Saltram Crescent	5		WCC
Shirland Road	36	Basement flats were internally flooded up to 150 cm 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	19	Internal property flooding to basements and ground floor.	Thames Water and WCC

Road Location	Number of Internally Flooded Properties	Comments/Cause	Source of Data
Upbrook Mews	2	30 cm 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	30 cm to 100 cm depth of flooding to basement properties. Residents reported several neighbouring properties were flooded.	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	254		

FLOOD MECHANISMS

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 high tide at Chelsea Bridge (approximately 3km south of the main flood area) was 6.20m above Chart Datum and this occurred at approximately 16:45pm³¹. At the workshop on 28th September 2021 Thames Water confirmed that tidal lock has had a significant effect along the North West Storm Relief Sewer (Maida Vale to Hammersmith) impacting on the capacity of the network. 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 generated additional runoff trying to enter the network. Thames Water reported that for 45 minutes to an hour in the Kilburn Park Road area, which was the worst affected street by the 12th July event, there was no capacity for the storm relief sewer to discharge into the trunk sewer³².

³¹ *Chelsea Bridge Tide Times for 12th July 2021*. Available at: <https://www.tidetimes.co.uk/chelsea-bridge-tide-times-20210712>

³² 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.

The London Flooding Review Report³³, states that there were two main affected areas which were impacted by the flooding that occurred on 12th July 2021, in Westminster (see Figure 7 below). Figure 7 also identifies the four different areas based on the locations of the affected properties for both July flood events. Most properties affected within area 3, as labelled in Figure 7 below, experienced both above and below ground flooding. From the London Review Report analysis, the primary flooding mechanism appears to be an overload on the sewerage system, with surface water runoff not being able to enter the system due to the rainfall intensity being a secondary flooding mechanism. The areas identified in the London Review Report assessment is in agreement with the data collated from the resident surveys and local observations made during the flood event.

Area 4, as labelled in Figure 7 below, also experienced both above and below ground flooding. The affected area matches well with the reported flood incidents on the 12th July. Local sewer systems were subsequently overwhelmed, and surface water was unable to enter the system due to the rainfall intensity. Both elements seem to be dominant flooding mechanisms. The areas affected by the flood event are reasonably consistent with the areas identified to be at risk of flooding as identified from the surface water modelling undertaken by WCC.

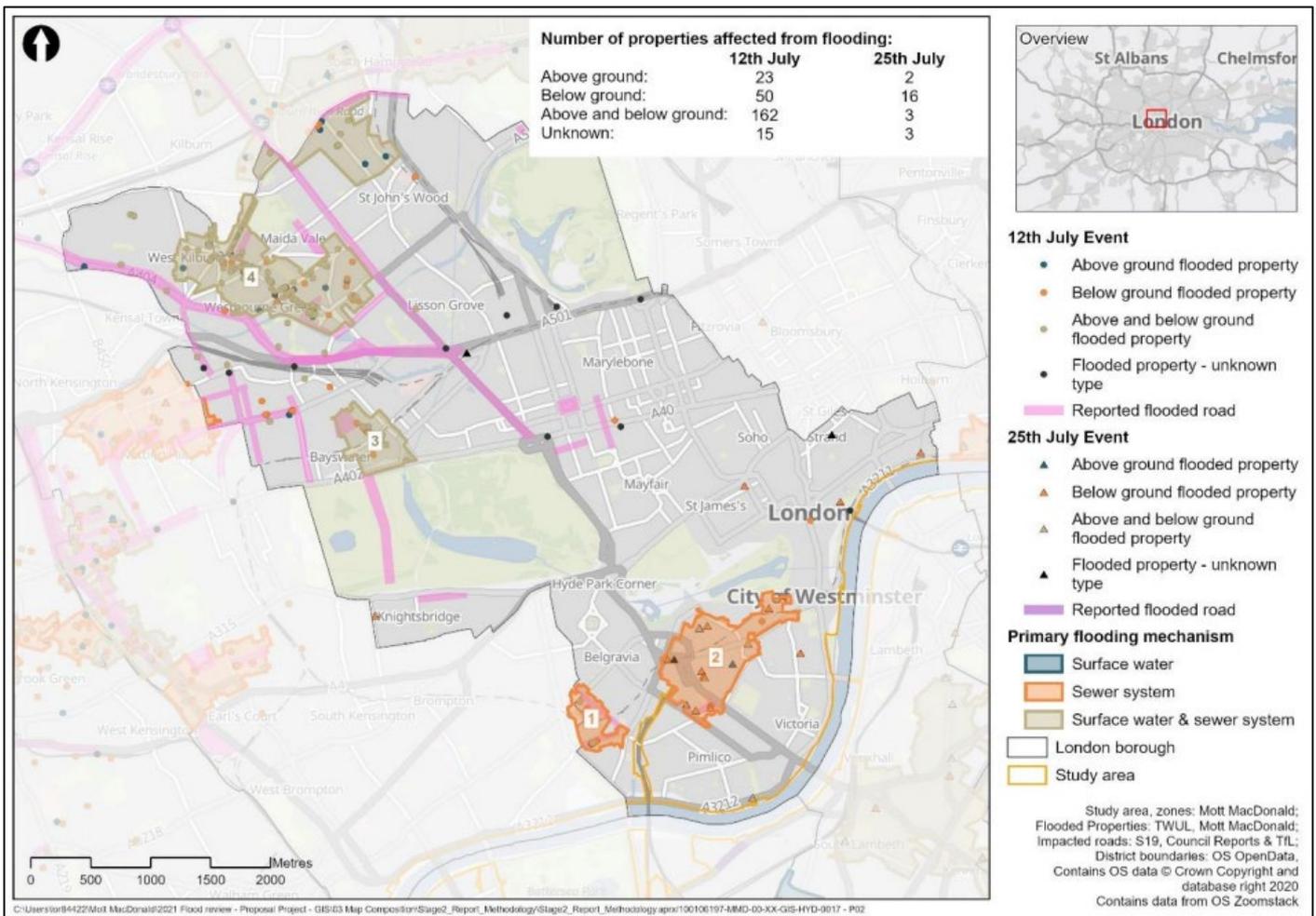


Figure 7 - City of Westminster flooded properties and flooding mechanisms. Source: London Flood Review Report.

³³ London Flooding Review – Stage 2: Root Cause Assessment and Outcomes from Sensitivity Testing (April 2022). Available at: <https://londonfloodreview.co.uk/stage-2-report/>



Flood Incident Description – 25th July

MAGNITUDE OF THE EVENT

Information was obtained from the Met Office regarding local rainfall data. The closest Environment Agency rain gauge is located at Holland Park located approximately 4.7 km northwest of the main areas affected by flooding, recorded approximately 18.6 mm between 13:30 to 17:00, and a total 24-hour rainfall of 20.6 mm. This seems consistent with the records of the local rain gauge located within St. James's Park which recorded approximately 41.8 mm on the 25th July. 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 gauge (Holland Park) did not record the actual amount of rainfall experienced across the southern areas of Westminster. The rainfall gauge Putney Heath did not record significant amounts of rainfall and as result have not been included the assessment of the magnitude of the flood event.

Radar rainfall data was analysed as part of the London Flood Review Report³⁴. On 25th July 2021, Westminster received a maximum rainfall intensity of over up to 50 – 100 mm/hr. Westminster experienced a maximum rainfall intensity of 50 – 100 mm/hr. The majority of Westminster experienced a 1 in 5 year return period, with the worst affected areas in Westminster experiencing a 1 in 10 return period event. Figure 8 below shows the maximum rainfall intensity as analysed as part of the independent London Flood Review for the 25th July flood event.

Thames Water were approached about reports from the public that a 'Fatberg' may have been removed in the Tothill Street/Dartmouth Street area shortly after the 25th July event. Thames Water looked back over their records but do not have information about clearing a fatberg from Tothill Street/Dartmouth Street in the days immediately after the floods. The only incident Thames Water attended at about that time was a call out to deal with a blockage on a private line at the end of August 2021 but this wasn't a fatberg. Fatbergs are much larger than normal blockages, the only fatberg Thames Water have cleared in Westminster since July 2021 was in the first week of October 2022, on Great Queen Street. In total, Thames Water have cleared 138 blockages in Westminster in the 12 months to October 2022, but these were all much smaller than fatbergs and often on private pipes.

³⁴ London Flooding Review – Data Discovery and Initial Analysis (February 2022). Available at: <https://londonfloodreview.co.uk/stage-1-report/>

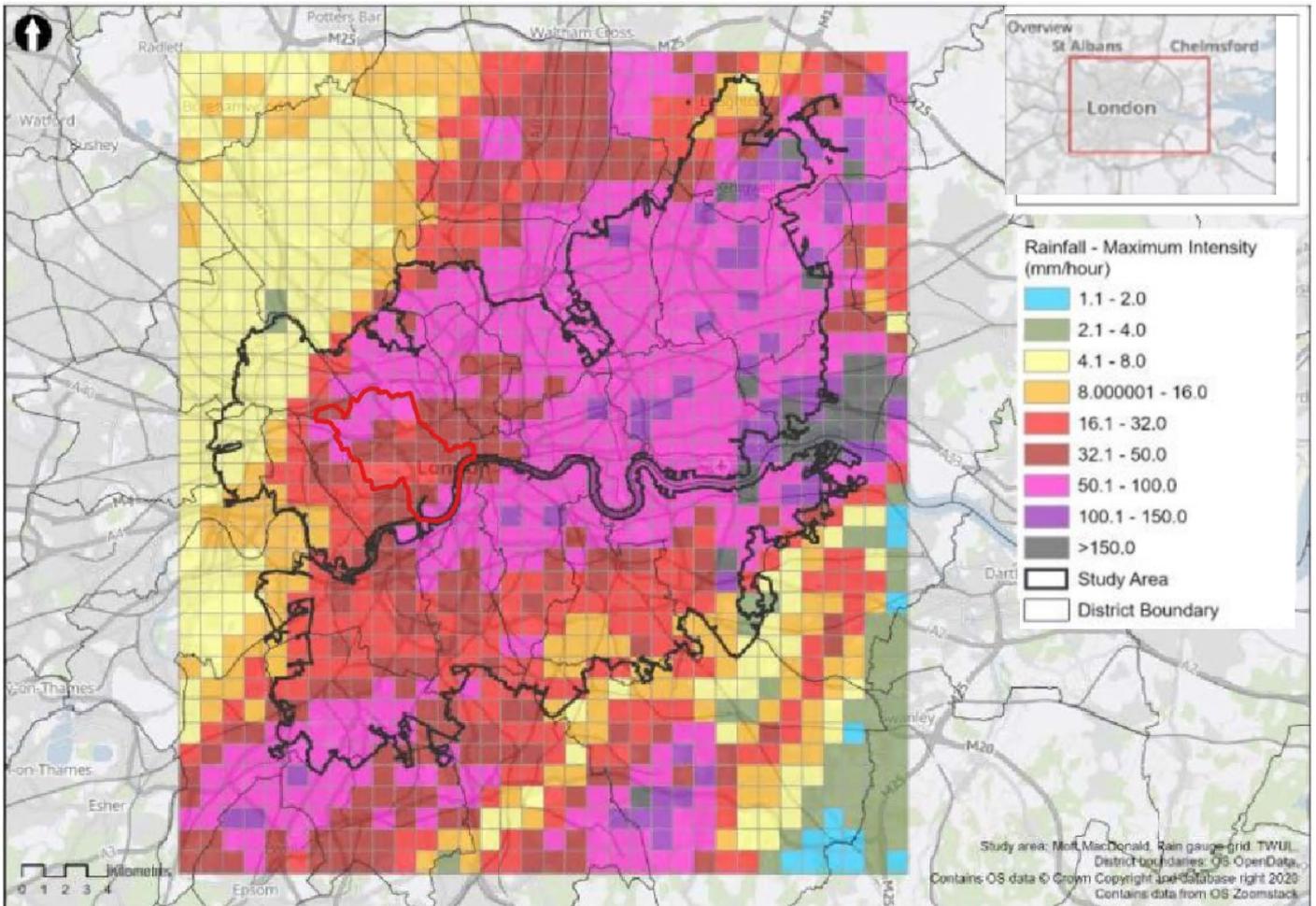


Figure 8 - Maximum rainfall intensity of the 25th July 2021 across London. Westminster Borough boundary marked in red.
Source: London Flood Review Report.

Figure 9 shows the return period of rainfall for the 25th July 2021 for a 2 hour duration across London, including Westminster borough highlighted in red. This shows that some areas within Westminster experienced a greater than a 1 in 200 year return period.

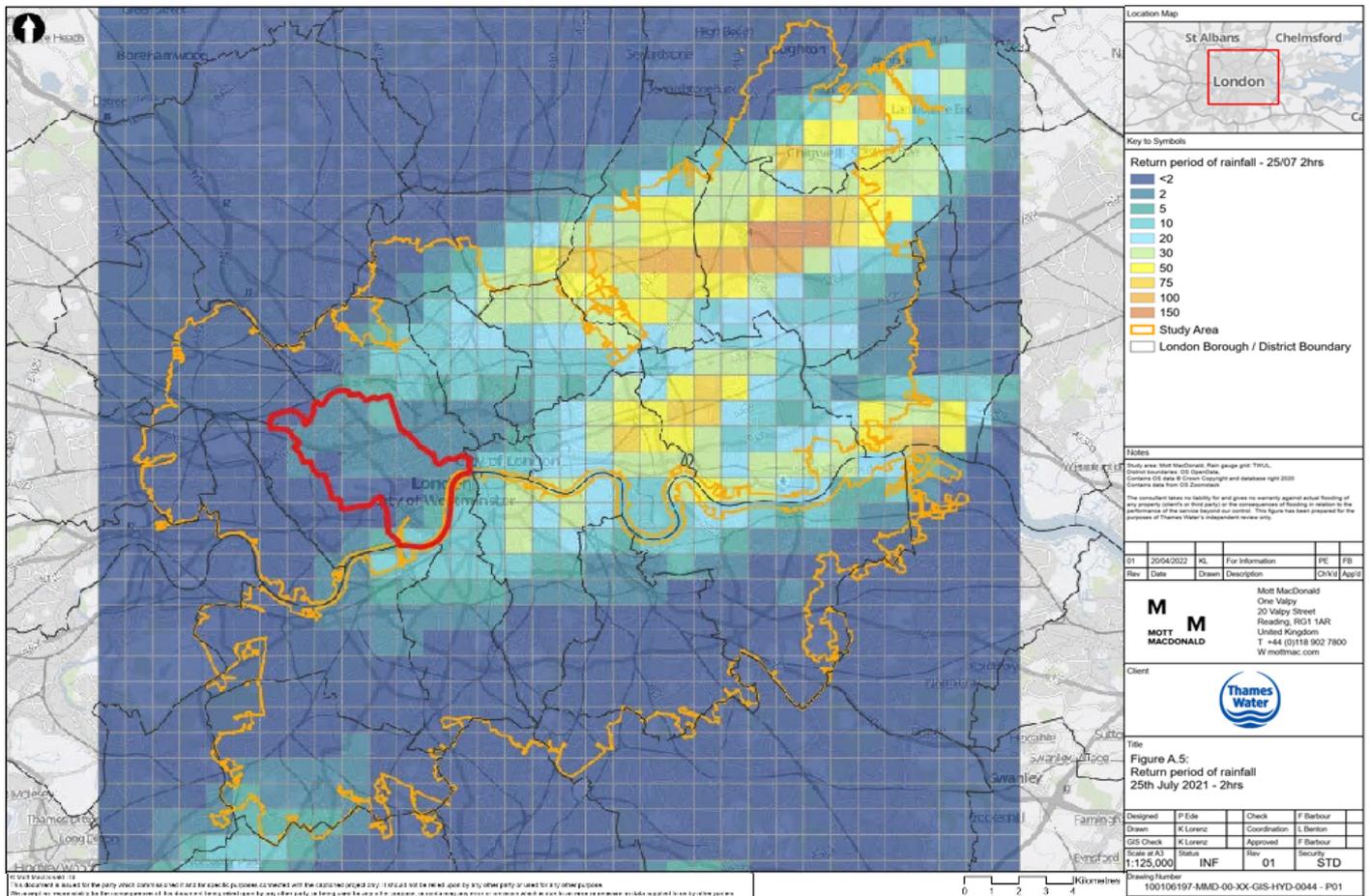


Figure 9 - Return period of rainfall on the 25th July, 2 hour duration. Westminster Borough boundary highlighted in red border. Source: London Flood Review Report.

FLOOD INCIDENT DESCRIPTION

The flood incident that occurred on Sunday 25th July 2021 was the result of intense rainfall. The 25th July flood event was considerably smaller in comparison to the previous flood event on the 12th July in terms of both rainfall recorded and the number of properties reported to have been affected across Westminster. The Met Office reported localised heavy rainfall in parts of southern England leading to thunderstorms³⁵. The 25th July flood event affected different parts of London in comparison to the 12th July, with areas in eastern London receiving the most rainfall on the 25th July.

The London Fire Brigade received over 1,000 calls in relation to the flooding across London and Thames Water received 2,867 calls to their customer service centre between 25th and 26th July in relation to the flood event³⁶.

Table 3 below provides a summary of the known properties impacted, including information collated from Thames Water and information referring to the 25th event from resident surveys sent out regarding the 12th July flood event. At the time of writing this report it is known approximately 24 properties were affected by flooding, as reported in the Independent London Flood Review Report. However, the exact location of all those properties is not known. It should be noted there is less information available regarding properties impacted from flooding in comparison to the 12th July flood event, likely due in part to the lower magnitude of the event.

³⁵ https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/uk_monthly_climate_summary_202107a.pdf

³⁶ <https://www.thameswater.co.uk/media-library/home/about-us/investing-in-our-region/flooding-review/july-flooding-internal-review.pdf>

Table 3: Summary of the investigated flooding issues

Road Location	Number of Internally Flooded Properties	Comments/Cause	Source of Data
Buckingham Place	1		Thames Water
Carlisle Place	2		Thames Water
Dartmouth Street	1	Combination of both surface water and sewerage flooding.	Thames Water
Guildhouse Street	2		Resident Questionnaire / Thames Water
Morpeth Terrace	1		Thames Water
Old Queen Street	2		Resident Questionnaire / Thames Water
Palace Street	1		Thames Water
Regent Street	1		Thames Water
St. George's Square	1		Thames Water
Sutherland Avenue	1		Thames Water
Tufton Street	1		Thames Water
Victoria Street	1		Thames Water
Villiers Street	1		Thames Water
Total	17³⁷		

FLOOD MECHANISMS

The flood incident that occurred on 25th July 2021 was the result of intense rainfall which led to the sewerage systems within Westminster becoming overwhelmed resulting in surcharge³⁸. 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 high tide at Chelsea Bridge (approximately 3 km to the south of the main flooded areas) was 6.43m above Chart Datum and this occurred at approximately 14:10 as provided by the Port of London Authority. This indicates that the high tide is likely to have impacted the ability of the drainage systems to discharge into the River Thames.

³⁷ 17 properties are known to have flooded based on data collated from Thames Water and WCC as part of consultation. However, the London Review Report states that 24 properties were affected by flooding on the 25th July 2021, as the location of the additional 7 properties has not been disclosed they have not been included within Table 3.

³⁸ London Flooding Review – Stage 2: Root Cause Assessment and Outcomes from Sensitivity Testing (April 2022). Available at: <https://londonfloodreview.co.uk/stage-2-report/>

The London Flood Review Report, states that there were two main areas which were affected by flooding on 25th July 2021 in Westminster (see Figure 7 in the Flooding Mechanisms section for the 12th July flood event). Both areas experienced flooding from the sewer system with more below ground properties affected than above ground. As such it indicates that the main cause of flooding for the 25th July event is attributable to the capacity of the sewerage system and the impact of the high tide impacting the ability to discharge into the River Thames. This information is in agreement with the data collected from Thames Water as the majority of flooded properties were reported to them and not to WCC.

Gully cleansing

WCC has adopted a risk based approach to cleaning its gullies, this means 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 10, 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. For the purposes of clarity, gullies with silt levels of 100% will still be able to discharge water from the outlet pipe efficiently, however, once silt levels rise above the 100% level, then the outlet pipe will start to become restricted until eventually the outlet pipe becomes completely blocked.

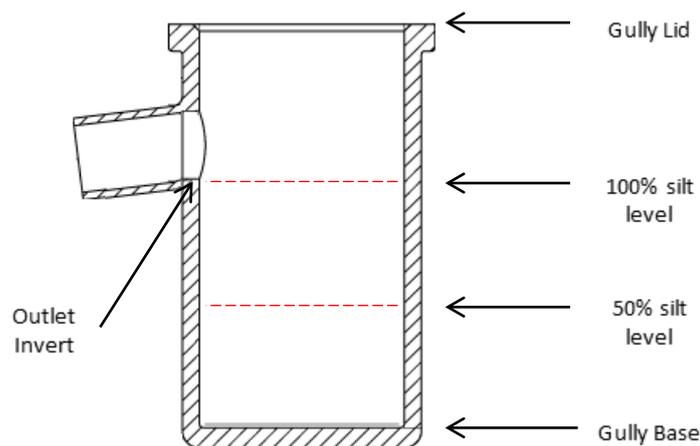


Figure 10: Sketch of gully pot silt levels

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 also carried out work to identify streets where standing water accumulates after periods of heavy rainfall and actively investigates and seeks to resolve these issues. 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 Borough to ensure they are in good condition and not reducing water flows into the sewers. To date the council has surveyed almost 75% of our drainage assets.

Since January 2021, the council has started to investigate the use of gully sensors to give real-time information on silt level data in gullies.

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 July flood events. 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. Annex 4 outlines the gullies that were cleaned after the flood event when all the gullies in the worst affected streets were cleaned over a 2 week period to ensure that the gullies were clear of any debris that may have washed into the gullies as a result of the ferocity of the rainfall experienced on the 12th July 2021.

Flood Response

The Council, along with other Category 1 and Category 2 responders are responsible for planning for, responding to and then recovering from major incidents and emergencies. The Council's Major Incident and Emergency Plan was activated following the flooding events on both 12th July and 25th July. On the night of 12th July, the Council opened a rest centre for any displaced residents, supported by the British Red Cross. While London Fire Brigade have advised that there had been no major evacuations. Four displaced residents were supported by City Inspectors to the Rest Centre and were supported to identify suitable accommodation. In subsequent days, the location was used as an information / assistance centre for residents and businesses to go to. This was attended by Council Officers, Thames Water and Registered Housing Providers.

A decision was taken to remove all bulky waste free of charge to those affected by flooding and the Council's contractors worked to support residents in the removal of damaged possessions. A marquee information point for residents was established with officers from Housing, Social landlords and social care and letter drops were undertaken to reach families that had been affected, some of whom were waiting for services to contact them.

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 across London after the 12th July flood event³⁹. Within Westminster, Thames Water attended approximately 13 properties as part of their clean-up response. These clean-ups were not standard Thames Water procedure but were offered as a good will gesture⁴⁰. Thames Water's trust fund, which helps the most vulnerable customers, provided additional support (furniture and white goods) to 14 households⁴¹.

It is recognised that the council's response to this major incident was not to the standard that would be expected of the council, or to which the council should be looking to deliver. It is accepted that in the initial response phase, communication, reassurance and welfare support to impacted residents was insufficient. In light of this, an external Emergency Planning Consultant was commissioned to conduct a review, with the aim and objectives being to complete an urgent 'hot' review of emergency planning and preparedness to identify any urgent improvements that are required to improve confidence in the service.

The Westminster multi-agency Flood Plan is based on the London flood response framework and is owned by the Borough Resilience Forum. It has been reviewed entirely in light of the recommendations of the above review and from the pan-London 'lessons learned' exercise. This has been shared with external partners to add their activity and for comment. The final plan will be signed off at the Forum meeting in December 2022.

One area highlighted within the review was the strategic oversight of emergency preparedness and ensuring that 'resilience is everyone's business'. The wider management and organisational structures are being considered as part of the Emergency Preparedness Review outlined below. The team now report directly to the council's Chief Executive who is driving this work.

An internal Resilience Hub has been produced, bringing together organisational resilience and business continuity, emergency preparedness and humanitarian assistance into a single place. This is being used to engage and encourage staff to volunteer for training enabling them to support our response to major incidents. This includes strategic and tactical controllers, emergency centres, crisis support and borough emergency control centre staff. This will continue as an ongoing piece of work.

³⁹ Thames Water, 2021. Available at: https://www.linkedin.com/posts/thames-water_a-message-from-steve-spencer-our-operations-activity-6823527837107154944-aQ7S

⁴⁰ Thames Water workshop with LLFAs 28th September 2021

⁴¹ Finance, Smart City and City Management Policy and Scrutiny Committee report

Conclusion and Way Forward

On the 12th especially and, to a lower extent, on 25th July 2021 intense rainfall and thunderstorms caused flooding to areas of Westminster, specifically Paddington, the West Kilburn / Maida Vale (12th July) and southern Westminster areas (25th July). The extreme rainfall events coincided with high tides which limited the ability for both the combined surface water and sewerage drainage systems to discharge from the public drainage network into the River Thames. Consequently, highway drains and the local sewer network were unable to cope with the intense and high volume of rainfall.

Following the extreme flood events WCC are proposing and currently undertaking a number of actions in order to understand and prepare for future flood events across the Borough. The following actions are being undertaken by WCC:

- WCC installed a rainfall gauge along Grantully Road within Maida Vale in February 2022 in order to provide additional rainfall data which will be able to inform any future flood investigation reports and analysis. If the installation of this rain gauge proves successful, the intention is to have rain gauges in the North, South and Central areas of the borough.
- 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. The average silt levels within gully pots were within the council's optimum range of 60% to 70% in the streets affected by flooding during the 12th July flood event. The council subsequently checked average silt levels across the whole borough and confirmed that the 60%-70% average silt level targets were being met boroughwide.
- WCC are currently in the process of updating and verifying the 2015 surface water hydraulic model using the latest Beckton Sewer model provided by Thames Water. The model will reflect the latest climate change scenario and is being validated against the 12th July 2021 event; on this note the updated surface water hydraulic model takes into account tide lock scenarios as those have been identified as one of the drivers of the July 2021 flood events.
- WCC Strategic Flood Risk Assessment (SFRA) is currently being updated and will reflect the most up to date flood information including data from the above mentioned updated surface water hydraulic model and including relevant information from the 2021 flood events. This will help in updating the identification of the flood risk hotspots within Westminster. The SFRA will reinforce the guidance on flood risk and drainage for future development including a stronger focus on SuDS.
- Opportunities for a more strategic retrofitting of SuDS within Westminster are currently being investigated building on the results of the London Strategic SuDS Pilot Study⁴²; the goal is to promote a more widespread introduction of SuDS within WCC public realm, which will improve long term resilience reducing surface water flooding risk and maximising the benefits associated to green infrastructure.
- The updated modelling results will be used to identify highly vulnerable development (e.g. basement self contained accommodation within Westminster) at risk of surface water flooding with the aim of exploring potential mitigation measures for those receptors.
- Improving emergency response procedures for similar events in the future.

In the third bullet point above regarding hydraulic modelling to take account of 'tide locking', the Independent London Flood Review commissioned by Thames Water looked into the possible benefits of the Thames Tideway Tunnel and Tide Locking. The purpose of the Thames Tideway Tunnel (once completed and commissioned), is to reduce spills to

⁴² <https://www.lotag.co.uk/london-strategic-suds-pilot-study>

the River Thames from the sewer network to improve water quality, rather than to act as a flood risk asset. However, Thames Water did carry out analysis to demonstrate any benefits that the tunnel system, and associated improvements, may provide during similar events in the future. For the July 25th event, the tunnel was predicted to fill to maximum. During the 12 July 2021 event, the rainfall was more localised so the impact across the whole drainage network was reduced. In both events, there was a minor improvement in reducing levels near to interceptions (points at which the existing sewer system diverts flows to the new scheme) but, overall, the tunnel will not make a major difference to flood risk for extreme events.

It should also be noted that the Thames Tideway Tunnel will not connect to all outfalls, only the 34 most polluting overflows, this means that a number of overflows will not be connected to the Thames Tideway Tunnel and will continue to be tide-locked during high water periods.

Thames Water have created a sewer resilience programme to identify properties at highest risk of sewer flooding to install sewer flooding resilience measures, such as a one-way valve (also called a non-return valve) in their sewer connection, to help prevent this from happening again⁴³. More information about the scheme and how to apply if you were affected by the July 2021 flood events is available on Thames Water website. Thames Water have also outlined a number of actions that they will be focusing on following the flood events⁴⁴:

- Improve response to adverse weather warnings.
- Improve approach to customer service and ability to respond to contacts from customers.
- Improve ability to use data to better understand the impact of adverse weather.
- Improve communication with other stakeholders.
- Review and improve incident response processes.
- Improve on-site responses to flood events.

At the time of completing this report Thames Water provided an update some headline data on the status of the sewer resilience programme, please see the below:

As of 18 October 2022, Thames Water confirm that the Sewer Resilience Programme data for Westminster is:

Number of customers contacted = 1,055
Number of properties to be surveyed based on reported flooding = 507
Number of customers that originally reported flooding = 237
Number of customers who responded to call to report flooding = 270
Number of vulnerable customers = 10 (No response from 3)
Number of surveys completed = 2 (all vulnerable)

The Independent London Flood Review highlighted a number of key recommendations in order to deal with future flood events that may occur as summarised below:

- Establishing a body with a strategic view and governance, with representation from all parties with responsibility for flood management, so that surface water and sewer systems can be assessed, and investments designed to optimise outcomes across different organisational boundaries.
- Using data and digital tools to more rapidly assess sewer network performance and prioritise responses in extreme events.

⁴³ <https://www.thameswater.co.uk/about-us/investing-in-our-region/sewer-flooding-prevention>

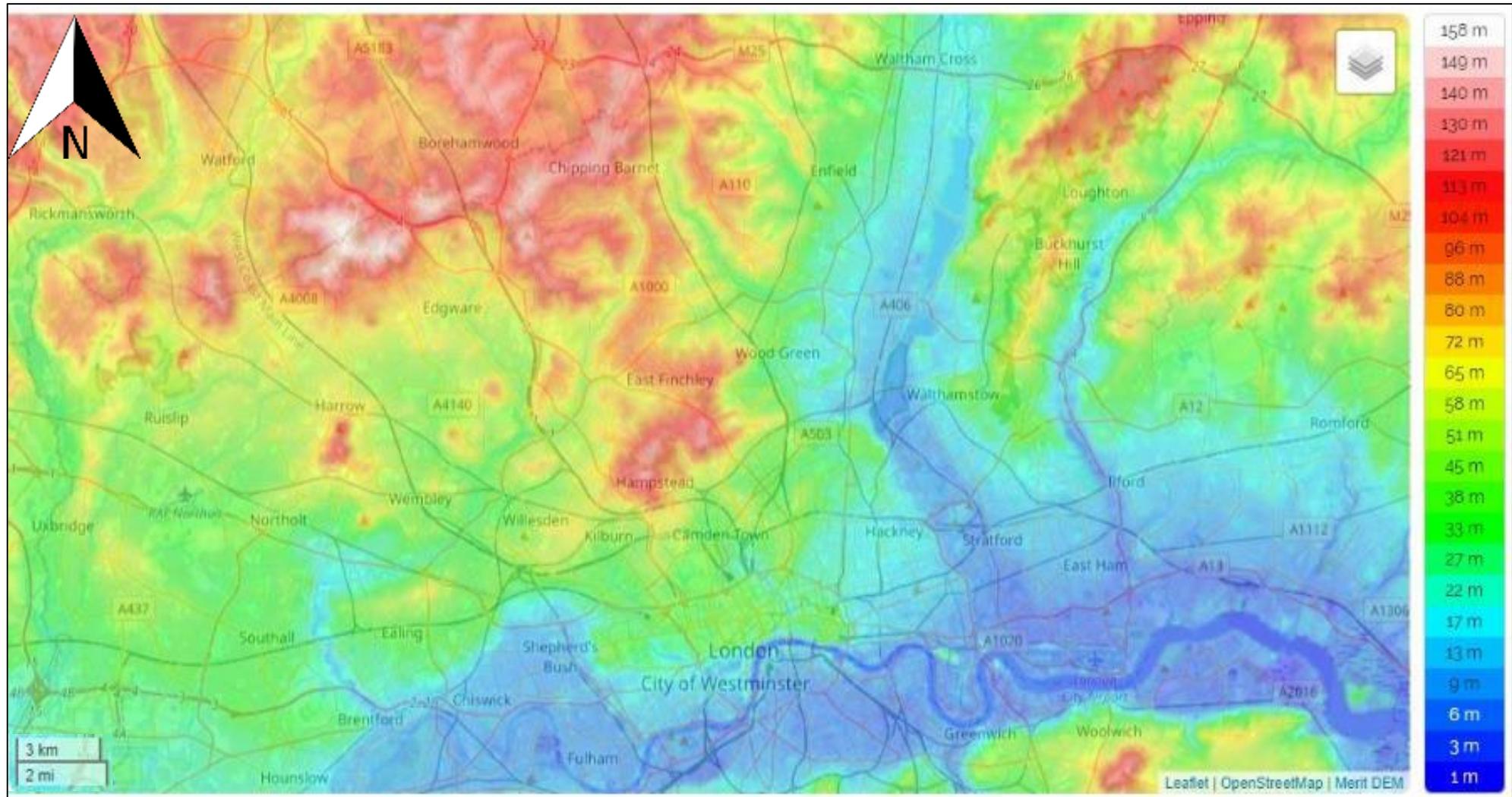
⁴⁴ Finance, Smart City and City Management Policy and Scrutiny Committee report

- Protecting those at highest risk of flooding by installing anti-flood devices such as non-return valves, FLIPs or flood gates depending on the flood mechanisms.
- Supporting homeowners and tenants to understand how they can best protect their homes from flooding, including opportunities to build in resilience.
- Encouraging asset owners to fully understand, develop and maintain their assets so they perform at their optimum level during high intensity events.
- Understanding how the above and below ground systems operates when flow capacity of the sewers is exceeded, who will be affected and how the landscape can be altered to allow safe passage of flood waters to areas away from properties.
- Adopting a suite of flood risk measures, including a combination of green (i.e. Sustainable Drainage Systems) and grey (i.e. traditional) engineering solutions, which can be installed in alignment with the planning policy to provide an agreed level of service across all organisations.

Other wider and strategic measures that would help prepare and deal with future flood events in a highly urbanised area such as London include to increase the concentration of reliable rain gauges in addition to the new gauge installed in Maida Vale: this will help in more accurately capture the return period of future storm events.

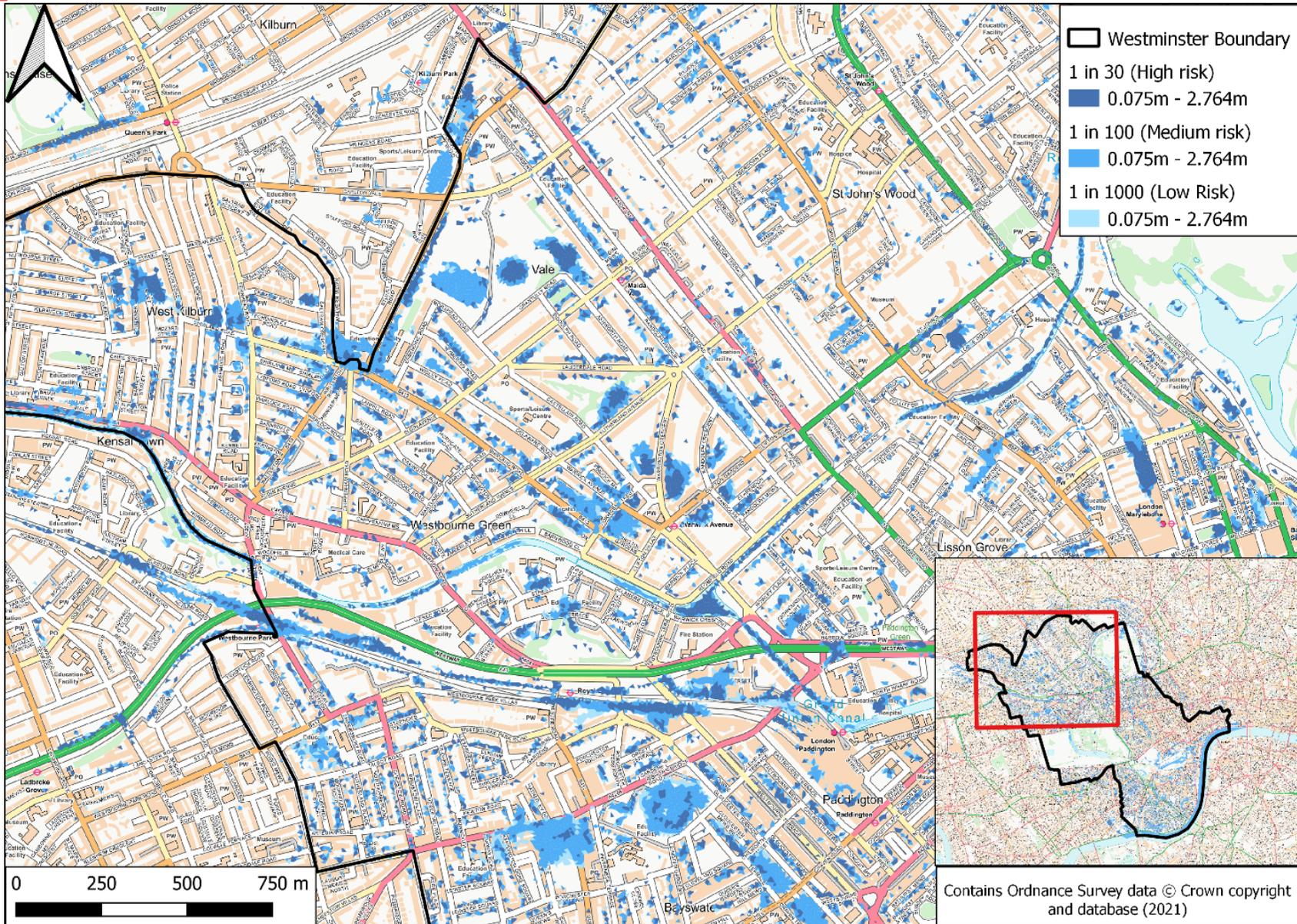
It would also be beneficial for the council to keep better records of past flood events for future reference. Section 19 reports will help the council to maintain better flood records in the future. Further consultation with other local LLFAs and Thames Water will be undertaken to start investigations 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.

A one-page summary of the improvements that have been introduced since the flooding events in July 2021 can be viewed in Annex 5 at the back of this report.

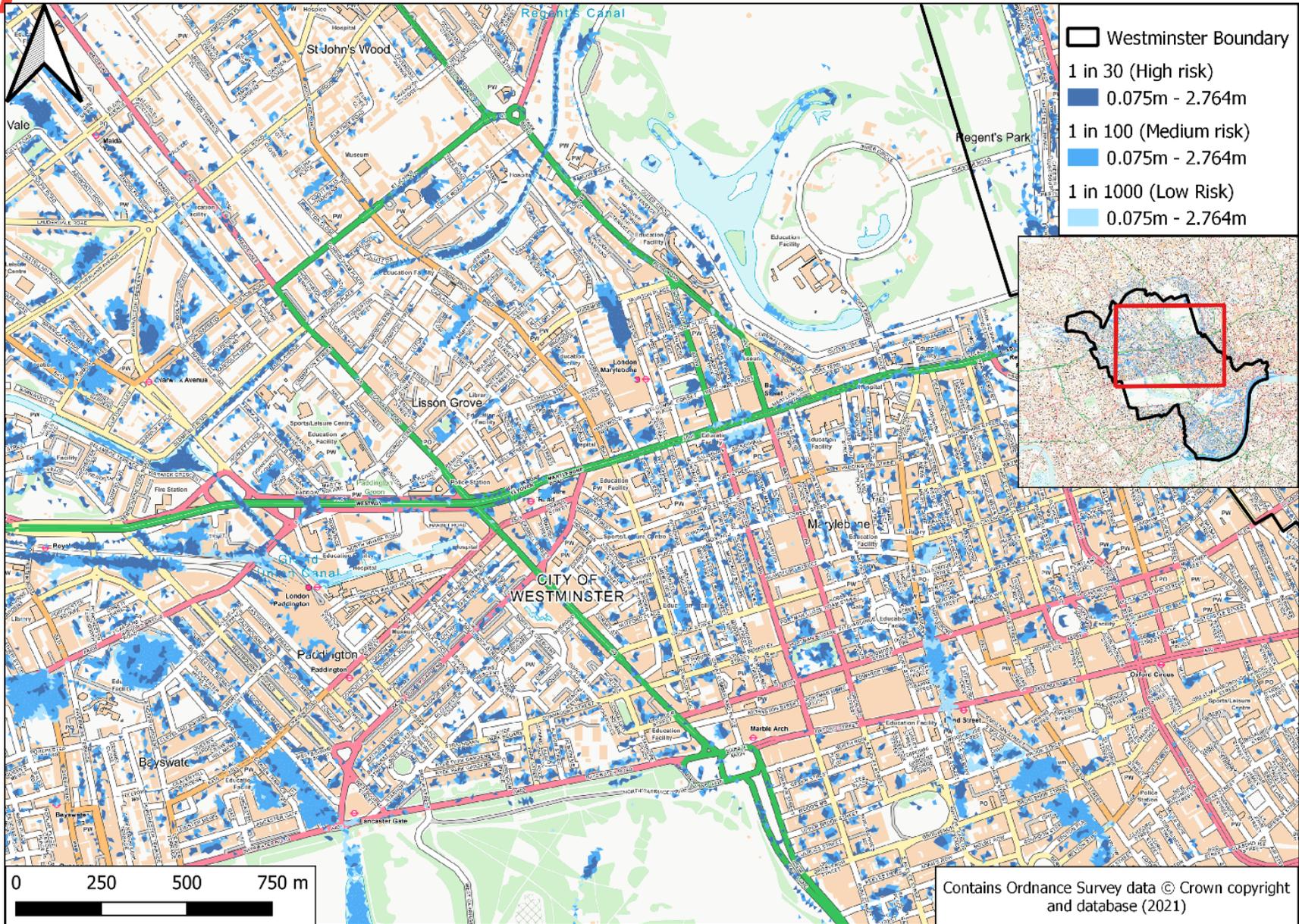


Annex 1 Greater London Topographic map⁴⁵

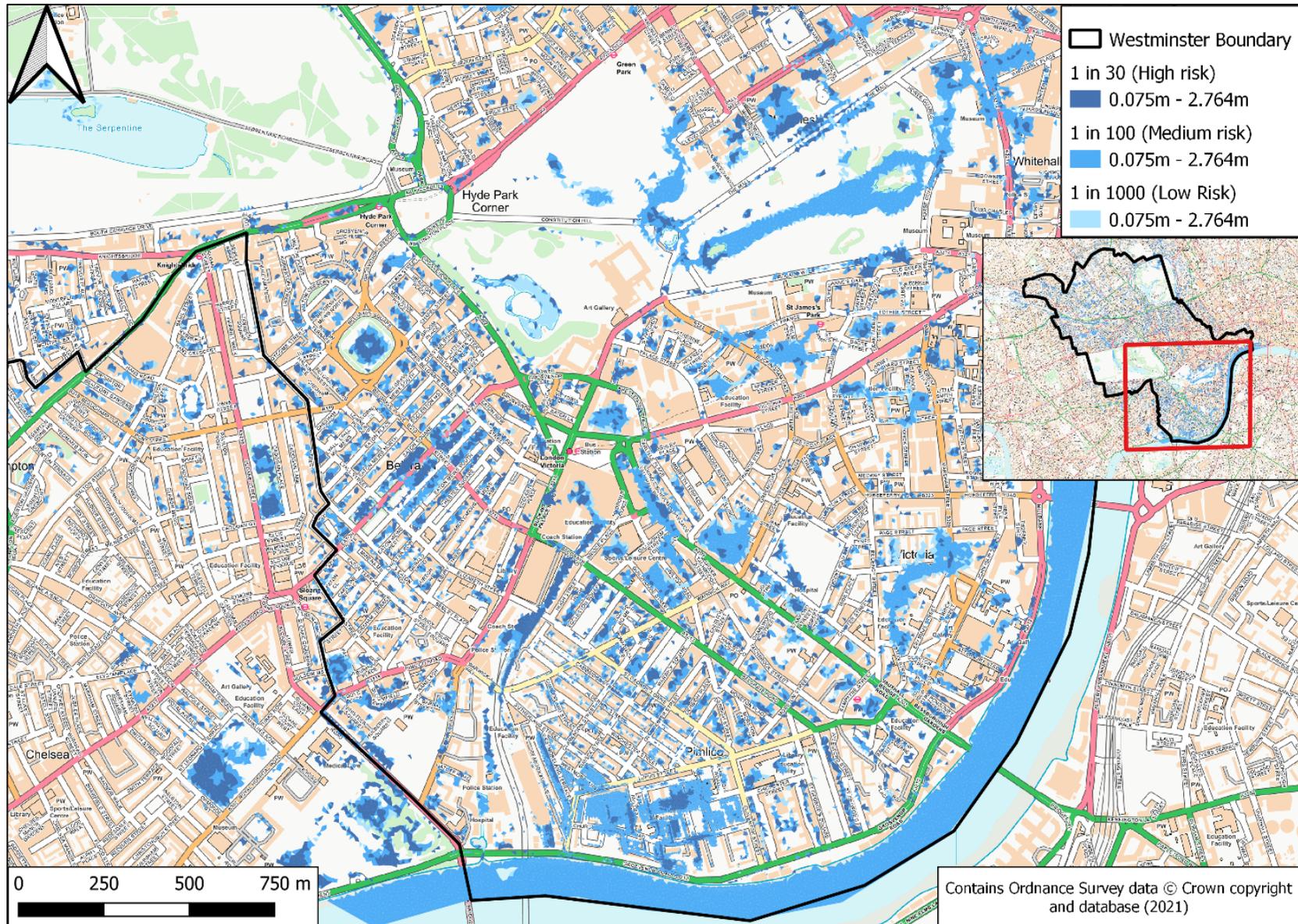
⁴⁵ Greater London Topographic Map. Available at: <https://en-gb.topographic-map.com/maps/sn5u/Greater-London/>



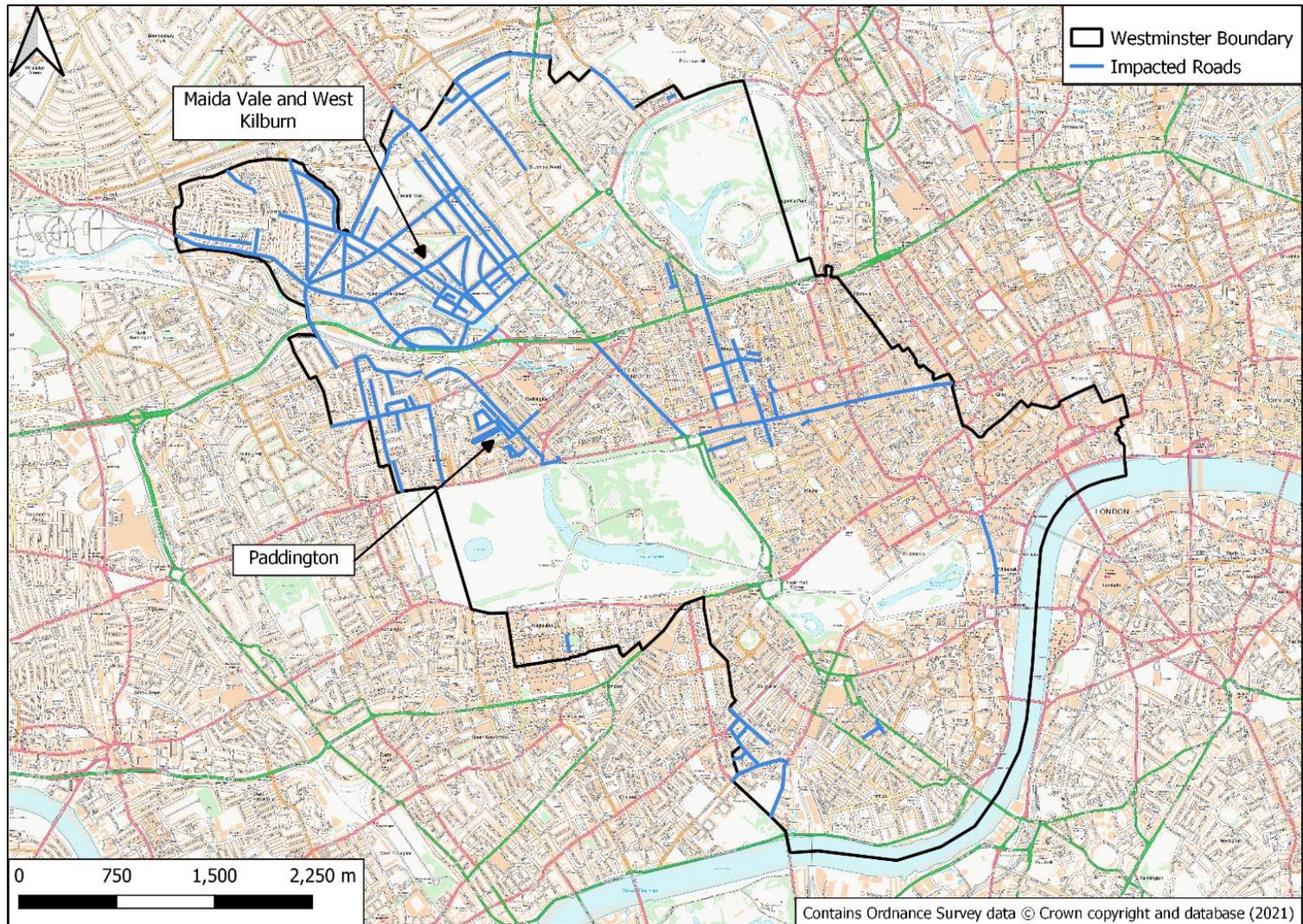
Annex 2-A Extract from WCC Flood Risk from Surface Water map Maida Vale, Paddington, Westbourne Green and West Kilburn



Annex 2-B Extract from WCC Flood Risk from Surface Water map Maida Vale, Marylebone, Paddington and St John's Wood



Annex 2-C Extract from WCC Flood Risk from Surface Water map Belgravia, Pimlico and Victoria



Annex 3 Flood Locations map 12th July 2021



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
Abbey Road	39	38	1	50.49%	1PA	27/07/2021
Avenue Road	35	18	3	60.00%	1PA	07/06/2021
Baker Street	38	35	3	48.65%	1PA	20/10/2020
Blandford Street	17	13	4	55.45%	1PA	20/10/2020
Blenheim Street	5	5	0	34.00%	1PA	15/10/2020
Blomfield Road	27	16	11	67.06%	1PA	01/03/2021
Bourne Street	11	7	4	72.86%	1PA	12/05/2020
Bristol Gardens	4	4	0	60.00%	1PA	09/07/2021
Castellain Road	35	22	13	70.91%	1PA	02/07/2021
Chester Row	21	19	2	61.58%	1PA	02/10/2020
Chippenham Road	12	3	9	60.00%	1PA	28/06/2021
Clarendon Gardens	2	0	2	50.00%	1PA	07/07/2021
Cleveland Square	13	8	5	43.33%	1PA	18/03/2021
Clifton Hill	21	14	7	22.31%	1PA	14/07/2021
Clifton Gardens	15	6	9	70.00%	1PA	05/07/2021
Clifton Villas	7	5	2	60.00%	1PA	25/06/2021
Cliveden Place	6	1	5	60.00%	1PA	18/03/2021
Delaware Road	29	20	9	60.00%	1PA	25/05/2021
Devonshire Terrace	13	12	1	55.00%	1PA	21/09/2020
Ebury Bridge Road	23	17	6	58.82%	1PA	18/11/2020
Elgin Avenue	69	56	13	67.20%	1PA	21/06/2021
Ennismore Street	3	3	0	70.00%	1PA	19/05/2020
Essendine Road	16	8	8	53.75%	1PA	05/05/2021
Formosa Street	17	11	6	64.00%	1PA	21/07/2021
Garway Road	5	4	1	57.50%	1PA	22/07/2021
Gloucester Terrace	53	28	25	56.30%	1PA	28/10/2020
Graham Terrace	17	11	6	70.00%	1PA	19/05/2020
Harrow Road	244	162	82	50.92%	2PA	08/06/2021
Huntsworth Mews	10	9	1	20.00%	1PA	15/06/2021



Kilburn Park Road	25	12	13	60.00%	1PA	11/05/2021
Lanark Road	46	41	5	59.76%	1PA	23/07/2021
Lanhill Road	9	4	5	68.00%	1PA	17/05/2021
Maida Vale	64	56	8	50.41%	1PA	24/04/2020
Manchester Street	12	8	4	60.00%	1PA	15/10/2020
Marylebone Lane	31	30	1	50.71%	1PA	15/10/2020
Montpelier Square	17	11	6	40.00%	1PA	18/03/2021
Newton Road	8	6	2	50.00%	1PA	09/07/2020
Palace Court	14	11	3	75.45%	1PA	02/07/2020
Queen's Gardens	9	6	3	55.00%	1PA	08/07/2020
Randolph Avenue	62	23	39	68.70%	1PA	17/05/2021
Randolph Crescent	20	11	9	73.33%	1PA	07/07/2021
Randolph Road	8	5	3	70.00%	1PA	07/07/2021
Second Avenue	7	5	2	52.00%	1PA	13/04/2021
Shirland Road	71	62	9	61.85%	1PA	22/07/2021
ST Christopher's Place	4	4	0	25.00%	2PA	30/04/2021
Sutherland Avenue	64	37	27	60.59%	1PA	15/07/2021
Thayer Street	9	8	1	51.43%	1PA	19/10/2020
Torquay Street	4	4	0	66.67%	1PA	11/02/2021
Upbrook Mews	7	7	0	42.86%	1PA	18/02/2021
Walterton Road	14	13	1	50.77%	1PA	09/09/2020
Warrington Crescent	28	17	11	63.53%	1PA	06/07/2021
Warwick Avenue	41	29	12	58.44%	1PA	23/07/2021
Westbourne Grove	54	41	13	36.59%	1PA	18/01/2021
Westbourne Terrace Road	4	1	3	60.00%	1PA	15/07/2021

Totals	Total number of gullies =1439	Total number of gullies cleaned =1007 (70% of total)	Total number of gullies not cleaned =418	A number of the gullies in the affected road were cleansed in a two week period after the 12 th July flood event. This was to clear debris which washed into gully pots due to the high velocity water.
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Annex 4 Affected Road Gullies Cleansing Record

ANNEX 5

SUMMARY OF IMPROVEMENTS SINCE THE FLOOD EVENTS OF JULY 2021

1. **Drainage Improvements** – An additional £600,000 of funding has been made available to accelerate the programme of gully replacements, this is to replace gullies which are age expired or have known defects which could impair their function.
2. **SuDs Programme** – Westminster has made funding available for Sustainable Urban Drainage Systems (SUDs). SUDs schemes will help to reduce run off from paved areas, slowing down the surface water trying to enter the sewer system. SUDs will have additional benefits including improving air quality and reducing carbon emissions.
3. **Flood Modelling** – the rainfall events of July 21 have provided an opportunity to update the Westminster Flood Model with rainfall data from a real event. This will help to improve the accuracy of the model and understand the most vulnerable areas across the borough which are susceptible to the impact of surface water flooding and allow action to be taken to reduce the risk.

4. **Body set up to look at London Surface Water Flooding** - Following July 2021 intense rainfall events, there has been a considerable amount of work taking place, both locally and strategically, to ensure London is as resilient as possible to future events.

A number of strategic and tactical meetings with the Mayor, London Resilience Forum, Ministers, MPs and others have taken place. Consequently, a Task and Finish Group representing London partners has been set up to consider what is required to ensure London is as well prepared as possible to manage surface water. The work being done does not supersede any local strategies, plans, or actions, but looks to strengthen the existing good work already happening, support others who haven't been able to do as much as they would like to and ensure that flood risk is managed holistically across London.

5. **Thames Water Sewer Resilience Funding** - Thames Water have introduced a Sewer Resilience programme to help residents affected by the flooding in July 21 to help them protect their properties (if they qualify) from wastewater backing up into properties through the introduction of non-return valves known as FLIPS. Thames Water have confirmed that they will soon commence surveying of over 500 properties to see if they are eligible for FLIPS
6. **Emergency Planning** – In the immediate aftermath of the flooding in July 2021, an external Emergency Planning Consultant was commissioned to conduct a review to identify any urgent improvements required to improve confidence in the service. The Westminster multi-agency Flood Plan is based on the London flood response framework and is owned by the Borough Resilience Forum. The final plan will be signed off at the Forum meeting in December 2022. The wider management and organisational structures are being considered as part of the Emergency Preparedness Review. An internal Resilience Hub has been created, bringing together organisational resilience and business continuity, emergency preparedness and humanitarian assistance into a single place. This is being used to engage and encourage staff to volunteer for training enabling them to support our response to major incidents. This includes strategic and tactical controllers, emergency centres, crisis support and borough emergency control centre staff. This will continue as an ongoing piece of work.
7. **Gully Sensor Trial** – The council has installed 20 Gully sensors in Westminster in 2021/22, The gully sensors measure water depth, blockages and can also sense tampering. It is unlikely sensors will be installed in all of Westminster's gullies, the aim is to install up to fifty more in challenging (at risk) locations across the borough to improve our overall response to our residents/customers.