Section 19 Flood Investigation Report

Wood Green

London Borough of Haringey

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WATER & ENVIRONMENTAL CONSULTANTS

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DISCLAIMER

This document has been prepared solely as a Section 19 Flood Investigation Report for Haringey Council at the instruction of the party named in this document control sheet. McCloy Consulting Ltd accepts no

Abbreviations used within the report

CDA	Critical Drainage Area
DWMP	Drainage and Wastewater Management Plan
FEH	Flood Estimation Handbook
FWMA	Flood and Water Management Act 2010
LLFA	Lead Local Flood Authority
mAOD	Metres Above Ordnance Datum
RMA	Risk Management Authority
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
TW	Thames Water

CONTENTS

1 INTRODUCTION

1.1 Terms of Reference

McCloy Consulting have been instructed on behalf of Haringey Council to undertake an investigation into flooding, in accordance with Section 19 of the Flood and Water Management Act, 2010.

1.2 Legislative background

Where a significant flood event has occurred and the responsibility for managing the future risk is unclear, Haringey Council may conduct a formal flood investigation, under Section 19 of the Flood and Water Management Act, 2010. The aim of this investigation is to identify which authority has responsibilities and whether they are proposing to respond. The results of the investigation will be published.

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

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate:

a. Which risk management authorities have relevant flood risk management functions, and

b. Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must:

a. Publish the results of its investigation, and

b. Notify any relevant risk management authorities.

Section 1 of the Flood and Water Management Act (FWMA) (2010) defines a flood as *'any case where land not normally covered by water becomes covered by water'….*

It does not matter for the purposes of subsection (1) whether a flood is caused by:

a. Heavy rainfall

b. A river overflowing or its banks being breached

c. A dam overflowing or being breached

d. Tidal waters

e. Groundwater, or

f. Anything else (including any combination of factors).

But "flood" does not include

g. flood from any part of a sewerage system, unless caused by an increase in the volume of rainwater, entering or affecting the system, or

h. a flood caused by a burst water main

1.3 Defining the study extents

Two flood events were experienced in July 2021.

- 31 reports of flooding to Haringey Council recorded following rainfall events on 12th July 2021.
- 47 reports of flooding to Haringey Council recorded following rainfall events on 25th July 2021.

Widespread flooding was experienced across Haringey for both events. Haringey Council has proposed that reported flood incidents be split into three geographic areas of Wood Green, Hornsey Crouch End and South Tottenham. These areas describe the main concentrations of flood reports across the catchment taking into account both dates. This report covers the **Wood Green** geographic area.

2 STUDY AREA

2.1 Study Location and Context

Wood Green is a suburban district in the borough of Haringey in London, England. Its postal district is N22, with parts in N8 or N15.

Figure 2-1 below shows the extent of the study area being considered within this report.

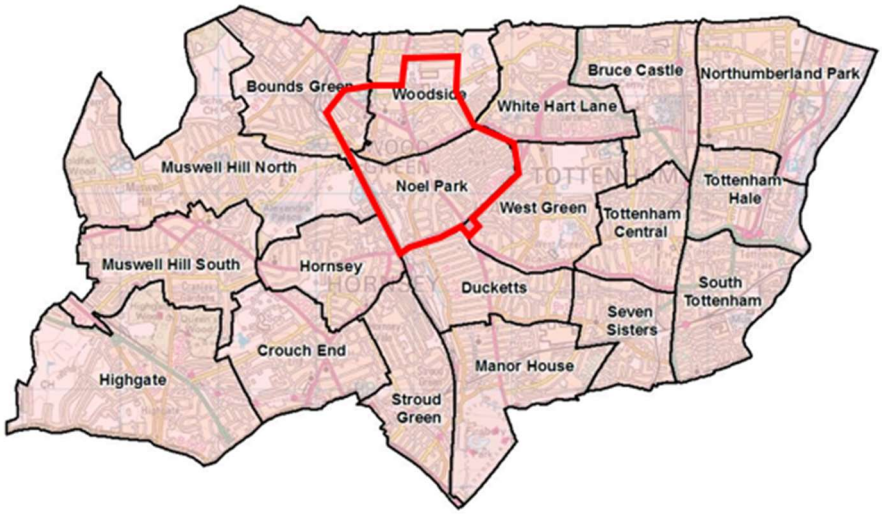


Figure 2-1 Study area extents

Wood Green is described by the London Plan as one of the metropolitan centres of Greater London, and it forms a major commercial district of North London. The A105 High Road, the main shopping spine which encompasses The Mall area, stretches from the Wood Green tube station to the next stop on the Piccadilly line, Turnpike Lane, and is lined with shops along its route. It joins with Green Lanes at both its northern and southern ends. The Great Northern Route railway line bounds the eastern extent; industrial and commercial are distributed along this boundary. The remaining areas of Wood Green are dominated by residential housing.

2.2 Topography

The topography of Wood Green, as with the wider London Borough of Haringey, generally slopes down in an easterly direction down towards the River Lee. The area slopes from circa 35m above ordnance datum (AOD) in the north west and west, to circa 20mAOD in the east.

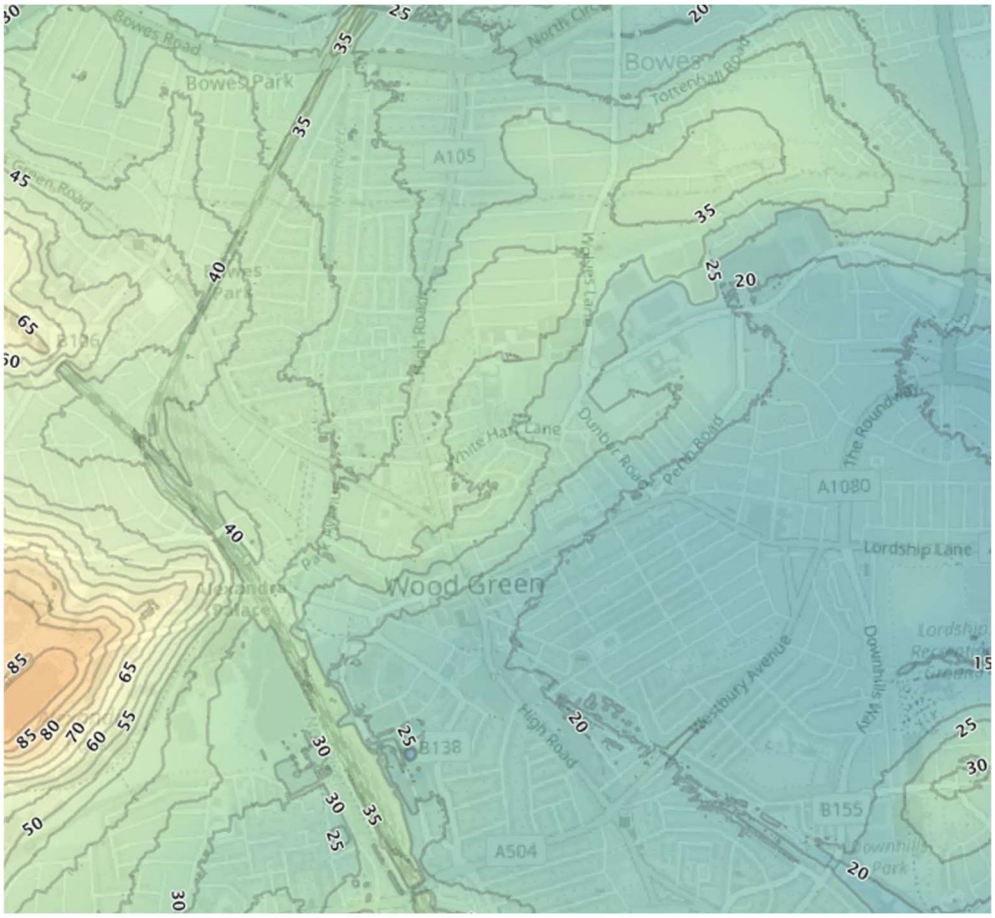


Figure 2-2 Topography of Wood Green within London Borough of Haringey

2.3 Geology and Soils

Historic borehole logs within Wood Green were reviewed using British Geological Survey (BGS) database.

Borehole Grid References TQ39SW238, TQ39SW286 and TQ38NW257 identified similar ground conditions generally described as follows;

Made Ground (silty clay with fragments of brick, concrete, rootlets and ash) was encountered to up to 1.3m below ground level (bgl), with London Clay (stiff brown silty clay) encountered beyond that to over 30m bgl.

2.4 Watercourses

Wood Green lies within the Thames Catchment, in particular drains to the Lower Lee.

Haringey's Strategic Flood Risk Assessment (SFRA)[1] details how a number of watercourses within the borough are culverted and commonly described as 'lost'.

The currently known alignment of watercourses local to Wood Green is shown in Figure 2-3. Note that the New River is a controlled waterway with Thames Water having responsibility under the FWMA.

[1] Strategic Flood Risk Assessment, 2015, Haringey Council: UK. Available at: http://www.haringey.gov.uk/sites/haringeygovuk/files/2012s6315_haringeycouncil_sfra_v4.0_0.pdf Accessed on 24/08/2017.

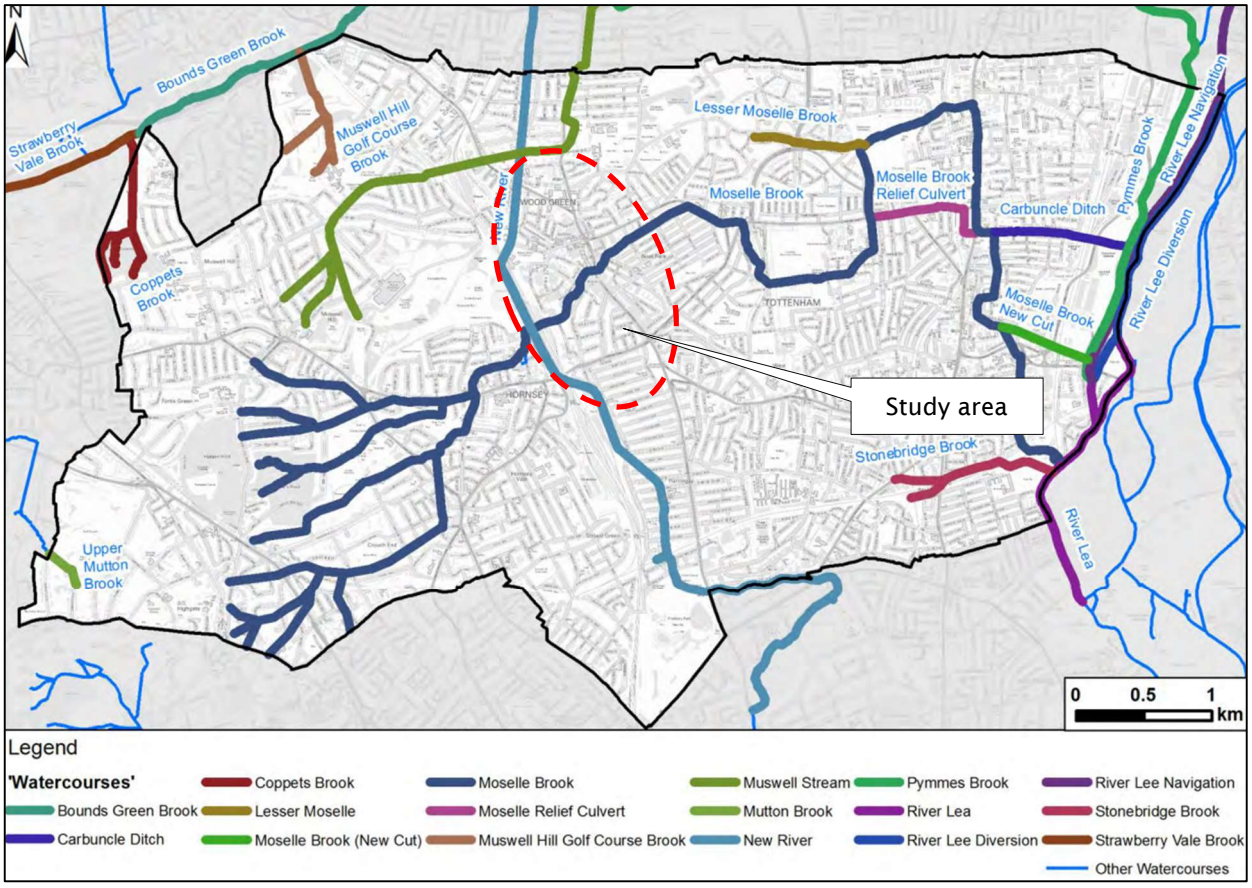


Figure 2-3 Overview of watercourses in Haringey and surrounding areas (from Haringey SFRA)

The following table indicates who is responsible for watercourses in Haringey;

Table 2-1 Watercourse responsibility in the London Borough of Haringey[2]

Watercourse	Classification	Responsibility under the FWMA
Moselle Brook	Main River	Environment Agency
Stonebridge Brook	Main River	
Pymmes Brook	Main River	
River Lee/River Lee Navigation	Main River	
Unnamed ditches / Watercourses not classified as Main River	Ordinary Watercourse	Haringey Council
New River	Artificial Watercourse	Thames Water

[2] Surface Water Management Plan (SWMP), 2011, Haringey Council: UK. Available at: https://www.haringey.gov.uk/sites/haringeygovuk/files/dlt2_gp4_haringey_swmp_draft_v2.0_0.pdf Accessed on 02/11/21

2.5 Sewerage

The majority of the Wood Green area is urban development of residential and commercial properties. The area therefore has a high percentage of impermeable area due to buildings, car parks, hard standings and highways.

The sewer network in the Wood Green area is separate, with a percentage of storm runoff contributing to the foul system. The public sewers in Wood Green are owned and maintained by Thames Water.

For the purposes of the Section 19 investigation, Thames Water has provided access to the Practitioner Portal of the Drainage and Wastewater Plan (DWMP). The DWMP portal provides modelling outputs from Thames Water's Capacity Assessment Framework, which includes identifying areas where sewers would be at capacity during a 2 year storm, where potential escapes from manholes would occur during a 30 year storm and the risk of flooding during a 50 year storm. This information has been used to further analyse the possible flood mechanisms across the study area.

2.6 Highway Drainage

The public highway generally drains to the public sewer network in this area via road gullies and pipework owned and maintained by Haringey Council as the local highway authority.

2.7 Flood Risk Mapping

The Environment Agency (EA) online maps provide readily available flood risk data within the study area. No new flood risk mapping has been produced to support this assessment.

2.7.1 Risk of Flooding from Rivers and Sea

The entire Wood Green district is within Flood Zone 1 whereby the annual risk of flooding, from either rivers or the sea, is less than 0.1%.

2.7.2 Risk of Flooding from Surface Water

The surface water Long-Term Flood Risk Map is shown in Figure 2-4. There are areas of high-risk flooding on main vehicular routes throughout the borough, notably: along the A1080 Turnpike Lane close to Turnpike Lane underground station; the A105 High Road in the vicinity of The Mall and Coleraine Road junction; the A109 Bounds Green Road adjacent Trinity Gardens. Further areas of flood risk are shown throughout residential streets of Noel Park in the east of the borough, as well as throughout the commercial areas east of the railway line.

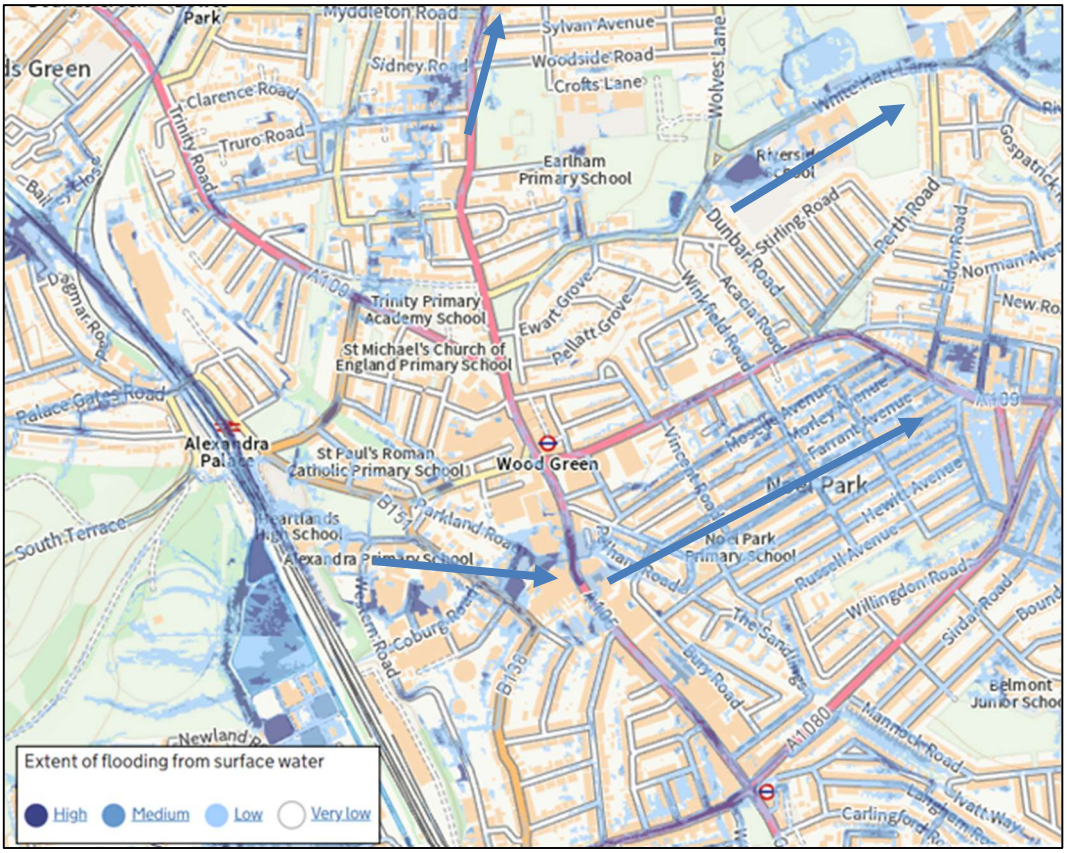


Figure 2-4 Surface Water Long Term Flood Risk Map

3 RISK MANAGEMENT AUTHORITIES

3.1 Haringey Council

Haringey Council is the LLFA for the area and the highway authority. The Flood and Water Management Act 2010 gives LLFAs powers and duties for the strategic overview of local flooding and for some flood risk management functions including:

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

As the highway authority, Haringey Council is responsible for the maintenance and operation of drainage gullies and the pipework connecting these to the public sewers for the proper function of highways and safety of highway users.

Haringey Council has contracted Marlborough Highways to support it on all aspects of highway infrastructure including carriageway, footway and cycleway maintenance, junction improvements, traffic calming measures, gully, drainage works and sustainable drainage systems (SuDS). The five year contract began in 2020.

3.2 Environment Agency

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

3.3 Statutory Undertaker for Public Sewers

Thames Water has a duty as a sewerage undertaker under Section 94 of the Water Industry Act 1991, to provide and maintain sewers for the drainage of buildings and associated paved areas within property boundaries. It has responsibility for any flooding which is directly caused by its assets i.e. its water or sewerage pipes. It also has a duty to cooperate with other relevant authorities in the exercise of flood risk management functions, which may include the sharing of information with other relevant authorities.

3.4 Transport for London

Transport for London (TfL) is responsible for the primary roads, underground, rail networks (London Overground and TfL Rail), buses, taxis, trams and river services in London. In Haringey, the primary roads, or 'Red Routes' which TfL is responsible for include the A406, the A10 and parts of Archway Road and Seven Sisters Road.

3.5 Riparian Landowners

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

3.6 Residents and Property Owners

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

Residents and property owners who know they are at risk of flooding have the responsibility to mitigate the risk of flood damage to their property as far as is reasonably practicable[3]. They should take measures to protect themselves and their property when flooding is imminent. Residents and property owners have the right to defend their property as long as they do not increase the risk of flooding to other properties.

Business owners should make a flood plan for their business. There are measures that can be taken to reduce the amount of damage to business premises caused by flooding and properties at risk should be insured.

[3] Living on the Edge. Environment Agency, 2015, available at https://www.wlma.org.uk/uploads/EA_Guide_to_rights_and_responsibilities_of_riverside_ownership.pdfhttps://www.wlma.org.uk/uploads/EA_Guide_to_rights_and_responsibilities_of_riverside_ownership.pdf, accessed 15th November 2021

4 SUMMARY OF RAINFALL EVENTS

4.1 12th July 2021

At 10:04 on 11th July 2021 (and updated 08:54 on 12th July 2021), the Met Office issued a Yellow warning of Rain expected between 10:00 and 23:59 on 12th July 2021. The warning covered the East of England, London, South East England and South West England.

Rainfall data was obtained from the EA for review from gauges located in Hornsey (grid reference TQ30557 89795), Brent, (grid reference TQ20836 87013) and Wanstead (grid reference TQ 41544 88234).

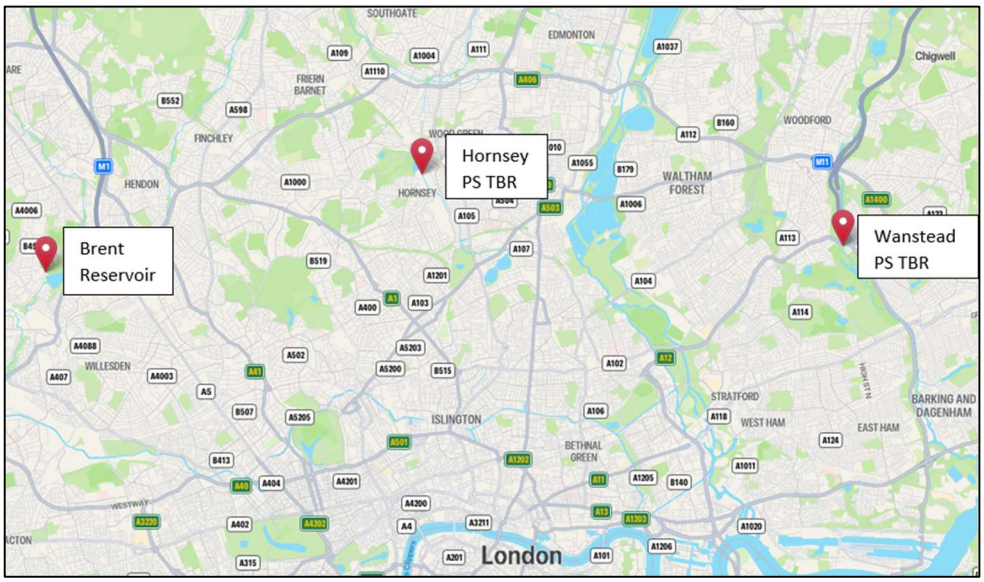


Figure 4-1 Locations of rainfall gauges

The most significant rain was recorded at Brent Reservoir between 17:00pm and 19:00pm, which recorded 7.6 mm of rainfall within this period. This coincides with reports of flooding observed on Turnpike Lane in the evening of 12th July. This rainfall is estimated as 1 in <2 year return event based on comparison of data obtained from the Flood Estimation Handbook. A total of 11.6mm was recorded for the whole day, with 10.2 mm of this falling over 3.5 hours. The rain gauge at Wanstead recorded 8mm over 24 hours, and the gauge and check gauge at Hornsey gave unreliable readings on the day due to apparatus blockages.

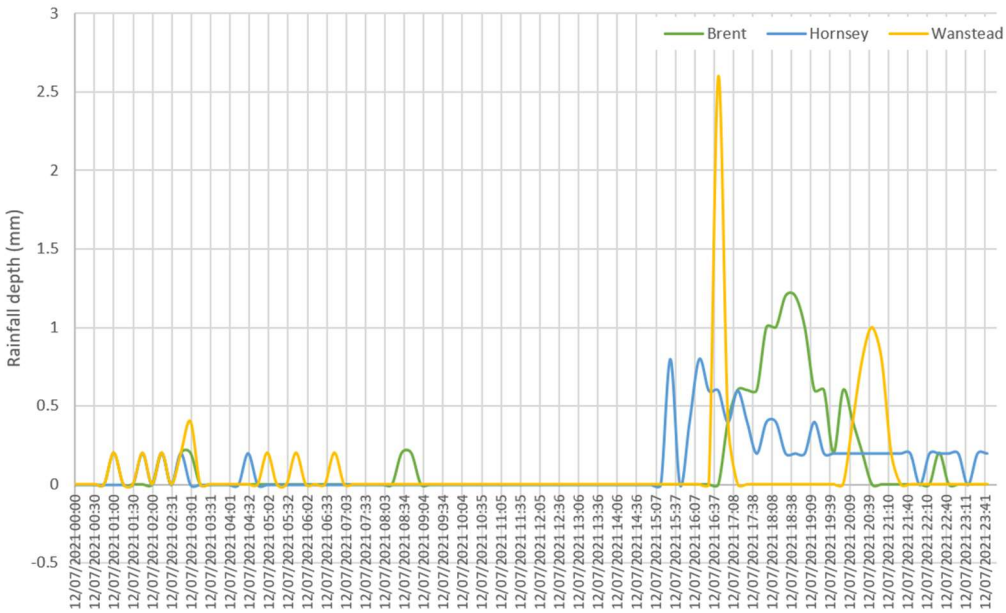


Figure 4-2 Rain gauge data, 12th July 2021

The relatively low rainfall recorded above is not consistent with the flood reports and anecdotal evidence provided from the area. The Hornsey gauges were blocked on retrieval of data and the recordings conflict with the Thames Water analysis of the event, which was presented at a recent workshop related to the floods[4], and indicated that the district received rainfall return periods ranging from a <10 year to a <30 year event. The areas in which the gauges are located in Brent (Borough) and Wanstead (London Borough of Redbridge) did not experience the same intensity of rainfall experienced elsewhere, which concurs with the relatively low estimated rainfall return period derived from the rain gauge data for these locations.

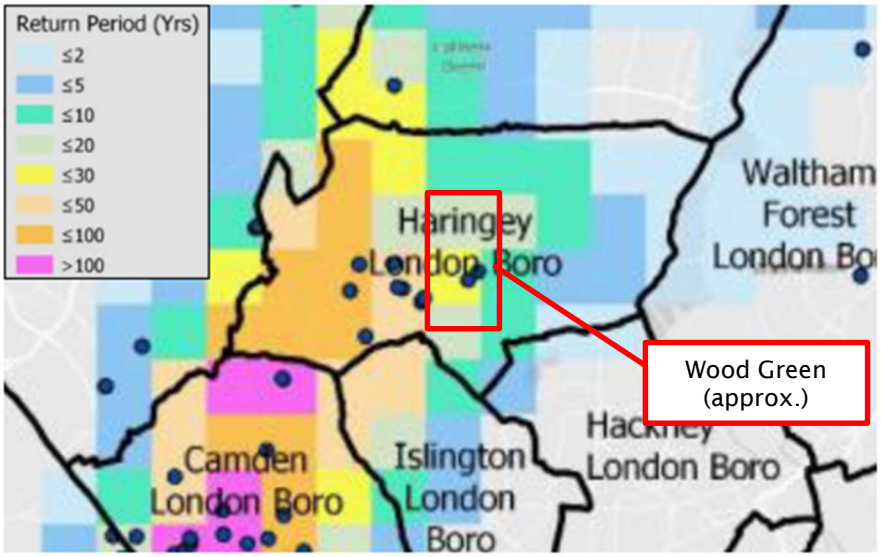


Figure 4-3 Rainfall Return Period and Report Flooding Incidents, 12th July 2021 (RaRa data using FEH99).

4.2 25th July 2021

The Met Office issued an Amber warning of Thunderstorm at 14:33 on 25 July 2021, expected between 14:33 and 19:00 on 25th July 2021, covering East of England, London and South East England.

The most significant rain being recorded at the selected gauges was between 14:15 and 15:45 at Wanstead. The rain gauge recorded 49 mm of rain within this time period, which was estimated to be a 1 in 70 year rainfall return event. A total of 54 mm was recorded for the whole day. The rain gauges at Brent Reservoir and Wanstead recorded 7.6mm and 22.8mm, respectively on this date.

[4] Supporting Section 19 Investigations, Workshop, 28th September 2021. Thames Water: UK

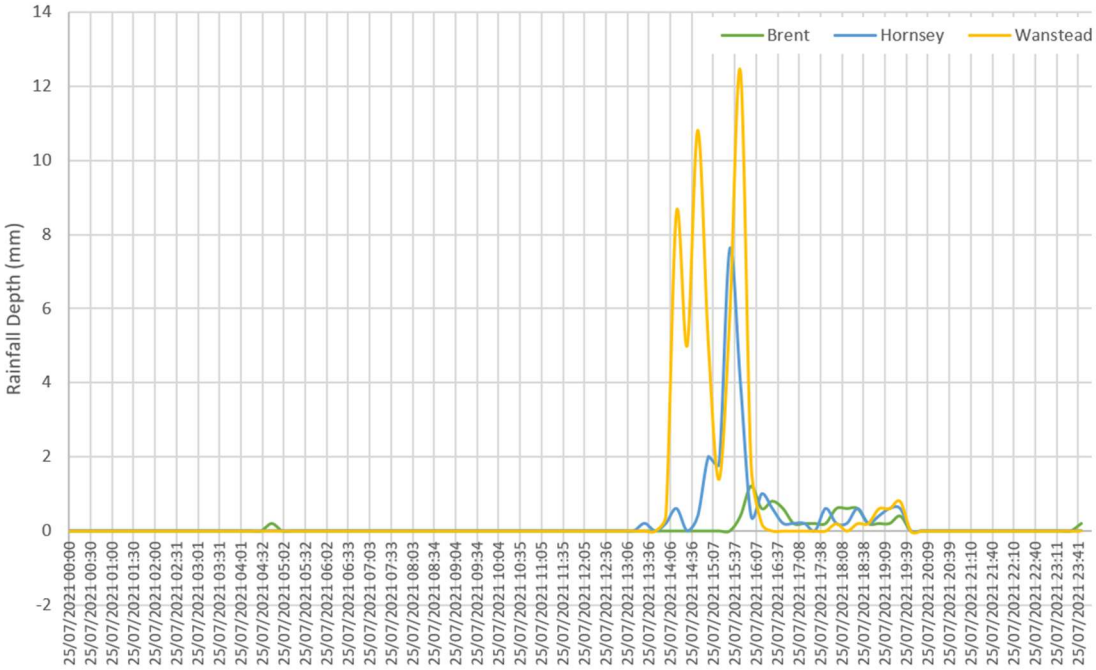


Figure 4-4 Rain gauge data, 25th July 2021

The Thames Water workshop presented and indicated that the district received rainfall return periods ranging from a <5 year to a <30 year event.

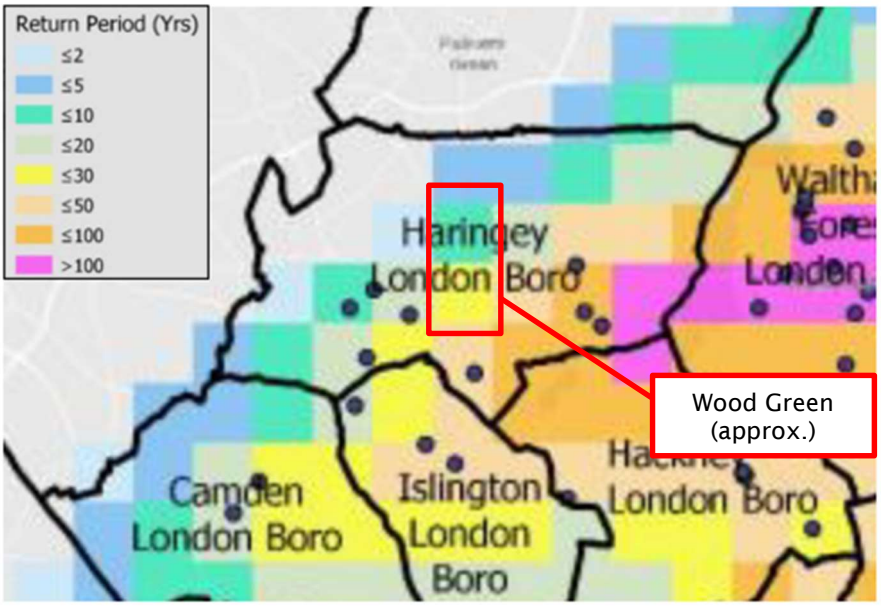


Figure 4-5 Rainfall Return Period and Report Flooding Incidents, 12th July 2021 (RARA data using FEH99).

5 ANALYSIS OF THE FLOOD EVENTS

5.1 Records of Incidents

Table 5-1 summarises the reports of flooding received by Haringey Council, and reactionary works that were undertaken by Haringey Council.

It is noted that the following have been screened out of further investigation;

- flood reports from single properties (not in proximity to other properties)
- locations where it is clear from the report that flooding was caused by internal drainage failure (for example a leaking roof).

Flood reports that have been screened out have been denoted by * beside the location name in the following table.

To support this investigation, Haringey Council has been provided with flood reports collated by London Fire Brigade (LFB) and Thames Water.

LFB received a total of 99 calls on 12th July 2021 and 58 calls on 25th July 2021 across the borough. Thames Water received 17 calls on 12th July 2021 and 13 calls on 25th July 2021 across the borough. LFB and Thames Water responses to individual flood locations are noted in the location specific sections of this report.

Table 5-1 Schedule of report flood incidents in Wood Green

Location	Date of Report	Details of Flooding	Response to Flooding	Critical Drainage Area (CDA)
Bounds Green Road				
Trinity Road / Partridge Way / Nightingale Road jct	12/07/2021	Flooding in highway, report of blocked gullies	Marlborough Highways (MBHW) attended to unblock gullies	Group 4_010
Civic Centre*	12/07/2021	Leaking roof	Being addressed by others	Not applicable
The Mall Area				
High Road under The Mall bridge, outside gym	12/07/2021	Major flooding in the highway	Marlborough Highways (MBHW) attended to unblock gullies	Not in CDA
Shops in The Mall area of High Road (Metro Bank, New Look, Perfect Carpets)	12/07/2021	Flooding of premises	Being handled by insurance team	Not in CDA

Location	Date of Report	Details of Flooding	Response to Flooding	Critical Drainage Area (CDA)
Turnpike Lane				
Turnpike Lane / Willoughby Road jct	12/07/2021	Flooding in highway, reports of numerous blocked gullies and water emerging from manhole	Marlborough Highways (MBHW) attended to unblock gullies	Not in CDA
Turnpike Lane Station	25/07/2021	Flooding	None recorded	Not in CDA
37-71 Turnpike Lane	26/07/2021	Flooding of gullies, numerous blocked drains	None recorded	Not in CDA
Other Locations				
Bury Road Car Park	12/07/2021	Flooding in car park	Water had receded at time of crew attendance, no action taken	Not in CDA
Gladstone Avenue	12/07/2021	Flooding in highway	MBHW are adding a new drainage location	Not in CDA
Lordship Lane Primary School*	13/07/2021	Longstanding flooding/drainage issue	No action taken	Group 4_075

Figure 5-1 presents an overlay of flood reports from Haringey Council's Reported Flooding Impacts Mapping and highlights the areas of interest where an increased number of flood incidents were reported. Note that screened out locations also appear in this figure.

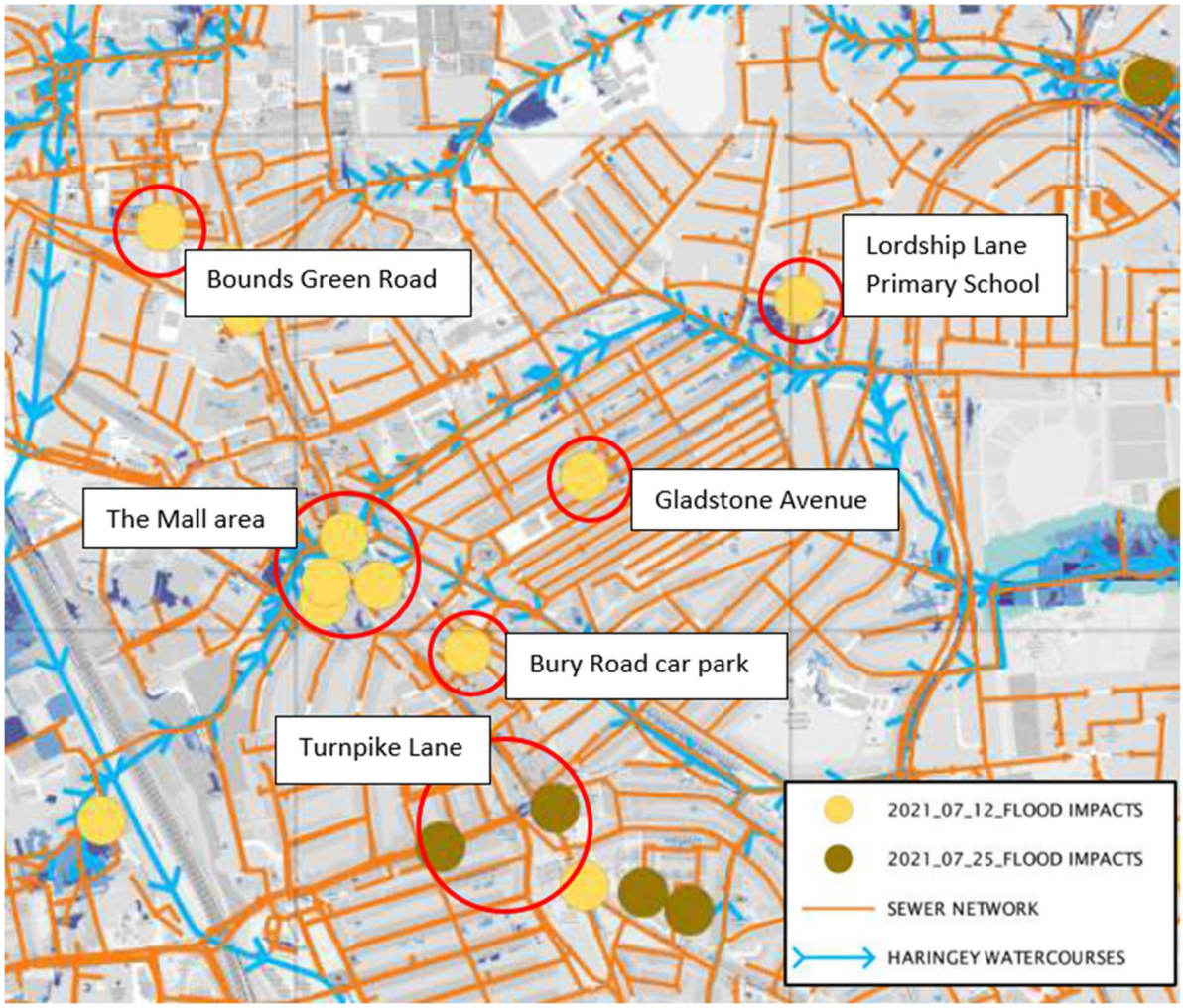


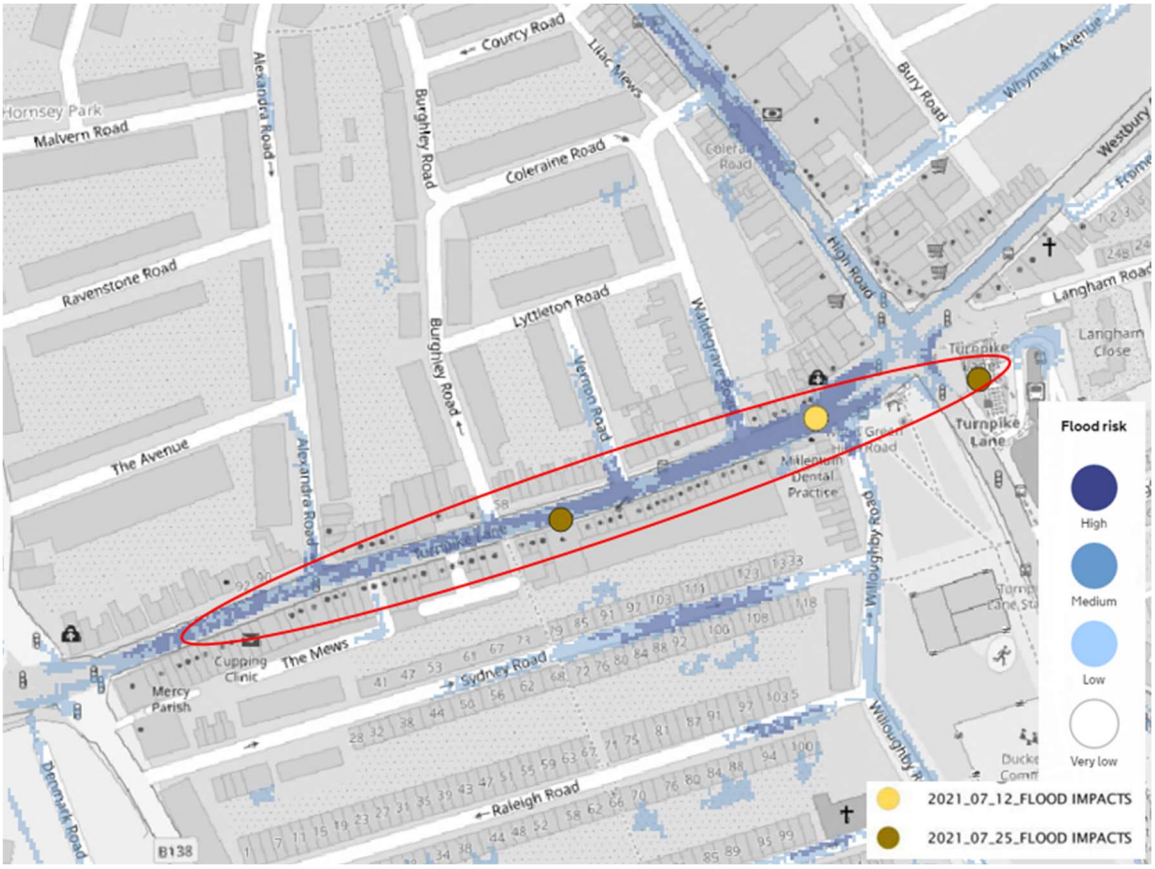
Figure 5-1 Recorded flood impacts and areas of interest in Wood Green, 12th July 2021

5.2 Turnpike Lane

Figure 5-2 Site Location

Location	Turnpike Lane

Location Plan:



5.2.1 Summary of Impact

12th July 2021

Video footage was received of Turnpike Lane near its junction with Willoughby Road at 19:21pm on 12th July 2021. The footage shows the carriageway and part of the adjacent footways inundated with water up to up to approximately 400mm deep. Pedestrians are observed ankle deep in water, with one observed attempting to unblock a drain along the main road. Vehicles continue to pass creating bow waves which wash the flood waters further onto the footways. Commentary in the video indicates that the flood water is being washed into adjacent shops. A second video shows the flood waters covering the entire footway outside numbers 6-18 Turnpike Lane. Flood waters can be observed flowing into business premesis at No. 16 Turnpike Lane. A social media report from the business owner of No. 1 Turnpike Lane described how flooding occurs from the manhole outside the business premises.

A flooding report was made to LFB from a commercial property near the junction of Turnpike Lane with Wightman Road, but no further details are given as to the nature of the flooding.

TfL confirmed via email that Turnpike Lane station was closed for periods on the 12th July due to flooding. No further details have been provided at time of writing.

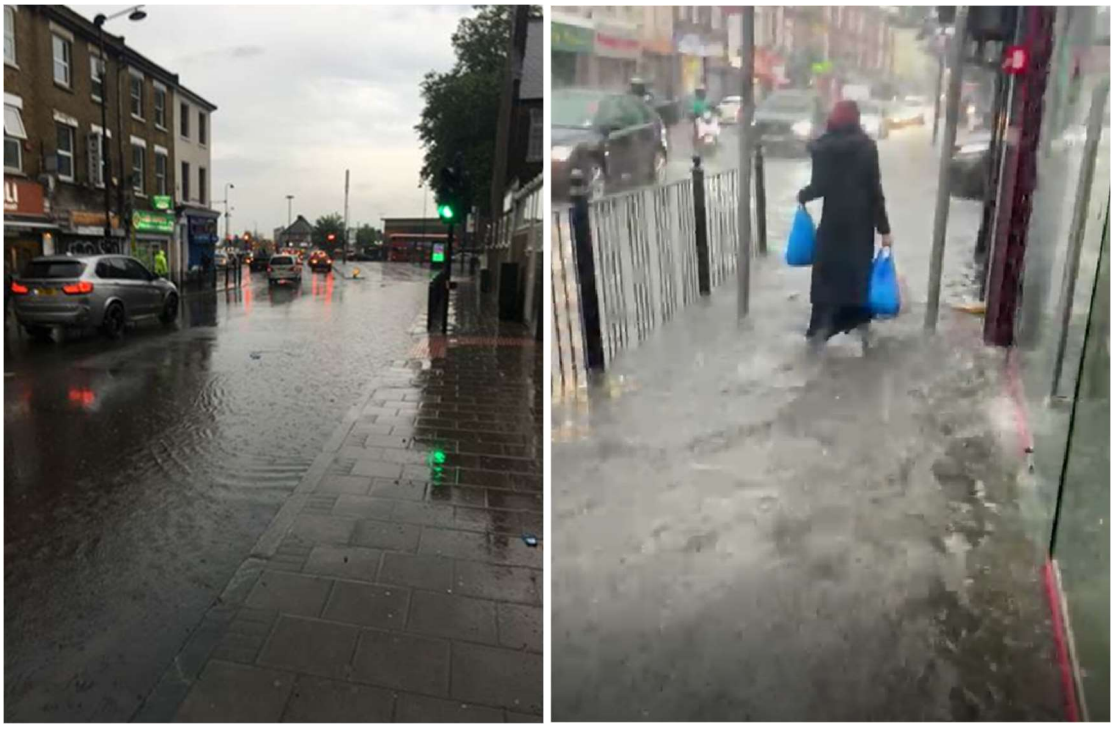


Figure 5-3 Flooding on Turnpike Lane, 12th July 2021

25th July 2021

Reports of flooding were received from Turnpike Lane on 25th July 2021. An emergency call was made to London Fire Brigade at 16:56pm citing flooding at 1 Turnpike Lane, with flooding also reported at the underground station and businesses at 37-71 Turnpike Lane. Reports of flooding were not received north of Turnpike Lane, consistent with Thames Water analysis that the more intense rainfall missed most of the district.

TfL confirmed via email that Turnpike Lane station was closed during the 25th July from 17:55 for the rest of the day due to flooding. TfL confirmed that the flooding was partially the result of surface water flowing into the ticket hall area from the street, and partially from sewage backing up through the toilets and wash basins within the station.

Video footage provided by Haringey Council of its response works outside 57 Turnpike Lane (close to the junction of Burghley Road). Surface water can be seen backing up the gully lead and back into the gully pot. The clerk of works attending the site surmised that the water must be backing up from a surcharged sewer.

During a site walkover visit on 26th October 2021, businesses owners indicated that highway flooding frequently occurs along Turnpike Lane, though they have rarely experienced internal flooding of their premises as a result.

5.2.2 Site Context

The eastern extent of Turnpike Lane, between the junctions with Burghley Road and Willoughby Road, is the lowest section along the Lane at approximately 23.0mAOD. Turnpike Lane falls from circa 34mAOD near the railway bridge in the west to this point. Further east the road rises again to the junction with Westbury Avenue, Green Lanes and High Road. The surface water flood map in Figure 5-2 indicates the risk in this area is due to the number of flow routes converging in this area, with limited ability for the water to flow away over the ground.

5.2.3 Existing Drainage and Watercourses

Asset records indicate parallel stormwater sewers running along Turnpike Lane of 229mm and 305mm diameter respectively. The location is not within a critical drainage area.

The DWMP model indicates that surface water sewers on the western stretch of Turnpike Lane (i.e. from the railway underpass to the junction with Burghley Road) would surcharge during a 1 in 2 year storm, and a risk of water escaping from manholes during a 1 in 30 year event is indicated at the junction with Burghley Road. No output is shown for the eastern stretch between Burghley Road and Turnpike Lane underground station.

There are no watercourses identified in close proximity to this location.

Haringey have noted (by email dated 13th January 2022) that there is a foul sewer connection to the stormwater drain within Turnpike Lane.

5.2.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records two instances of flooding in the Turnpike Lane area. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N8 0 postcode area, as of 2010. Flooding also occurred in 2008 and in April 2021 (noted as being due to burst water mains).

5.2.5 Potential Flood Mechanisms

The video and anecdotal evidence strongly suggests that the primary cause of the flooding was excessive rainfall which exceeded the capacity drainage network in this area. The intensity of the rainfall meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low points, which reached sufficient depths to enter property. The DWMP model outputs suggest that the limited receiving capacity of the sewers would have been the primary cause of flooding. This is supported by anecdotal evidence from a local business describing water escaping from a manhole on Turnpike Lane[6]. Further investigation would be required in the east of Turnpike Lane to identify whether the capacity issues were primarily due to the receiving capacity of the highway drains, the public sewer or both. It is also understood by Haringey Council that the sewers in this part of Turnpike Lane are relatively shallow; this would need to be confirmed by Thames Water. Other contributing factors to the extent (depth and magnitude) of flooding include:

- **Sewer incapacity**

  Flooding was observed from manhole at No. 1 Turnpike Lane. Haringey Council have indicated that the 9 inch sewer along Turnpike Lane is very shallow with invert of the sewer just lower than the outlet from the gully pots. Haringey have noted via email (20/01/22) that that have been informed that during heavy rainfall, runoff cannot enter the gully pots as the sewer system is already in surcharge status. Potential for a foul connection has been identified by Haringey. Capacity of the storm sewer will be further compromised where there is a foul connection.

- **Blocked gullies**

  One of the business owners on the eastern extent of Turnpike Lane (No. 1) contacted the Council through social media to highlight that local gullies had been blocked for at least 5 weeks leading up to 12th July, but received no response from the Council or Thames Water. A site walkover on 26th October 2021 showed that at least 3 no. gullies along a 120m stretch of the Lane (including outside No. 1) were blocked. Any blockages would have reduced the capacity for surface water to enter reach the public sewer.

- **Bow wave effect**

  Video footage from the 12th July flooding along Turnpike Lane indicated that larger vehicles moving through the flood water caused a bow wave effect. Anecdotal reports from local business confirmed that this led to further movement of water onto the footway and into properties.

- **Threshold Heights**

  During the site walkover it was noted that a number of properties in the affected area had flush front door thresholds. The flush threshold is a requirement for accessibility. This arrangement would allow for surface water to quickly enter properties once the footway had been submerged.

[6] Twitter, 2021, https://twitter.com/haringeycouncil/status/1415038111164289030

5.2.6 Responses to Flooding

Haringey Council:

- Instructed Marlborough Highways to unblock gullies along the road. It is not stated in the flood report schedule how many gullies were cleaned, but a site walkover on 26th October 2021 showed that at least 3 no. gullies along a 120m stretch of the Lane were blocked.
- Provided a schedule of all gully cleaning works that have taken place in Wood Green between 12th July and 30th September 2021. A total of 79 jobs were raised for gully clearance between these dates. Confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- The issue of the underground station flooding was raised at the London Assembly on 15th October 2021[7], in which the Mayor confirmed that TfL was aware of the issue. A flood detecting system with remote alarm panel and an anti-flood valve to prevent backflow were both installed. While the anti-flood system is now fully tested and operational, the existing anti-flood system was found to be no longer fit for purpose following the last flood incident on Sunday 25 July 2021, and a modern replacement system has been ordered and will be installed by the end of November.
- TfL outlined via email the procedures staff are required to undertake during extreme weather. This includes physically monitoring water levels at street and station level every 30 minutes. Once levels begin to rise, additional drain clearance is instructed. Floodsax are placed to direct water down the exit corridors away from access gates, escalators and staff areas.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- Attended 1 Turnpike Lane on 25th July 2021 having received a call at 16:56pm. No details are given of the remedial works carried out.

5.2.7 Next Steps

The EA surface water flood maps indicate that Turnpike Lane is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

- Thames Water to investigate presence of foul drainage connection to storm sewer and remove (if connection is identified) to reduce hydraulic load on storm sewer network. Given the observed surcharge status of the sewer and the manhole flooding outside No.1 Turnpike Lane, increase of sewer capacity at this location should be investigated by Thames Water.
- Haringey Council have noted that they will be undertaking increased frequency of gully pot cleaning along Turnpike Lane.
- Haringey Council to consider implementation of SuDS measures in the upslope catchment to reduce the amount of runoff reaching the location of flood risk.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- TfL to work with other RMAs / LLFA to investigate strategies for preventing flooding of the underground station in future events.

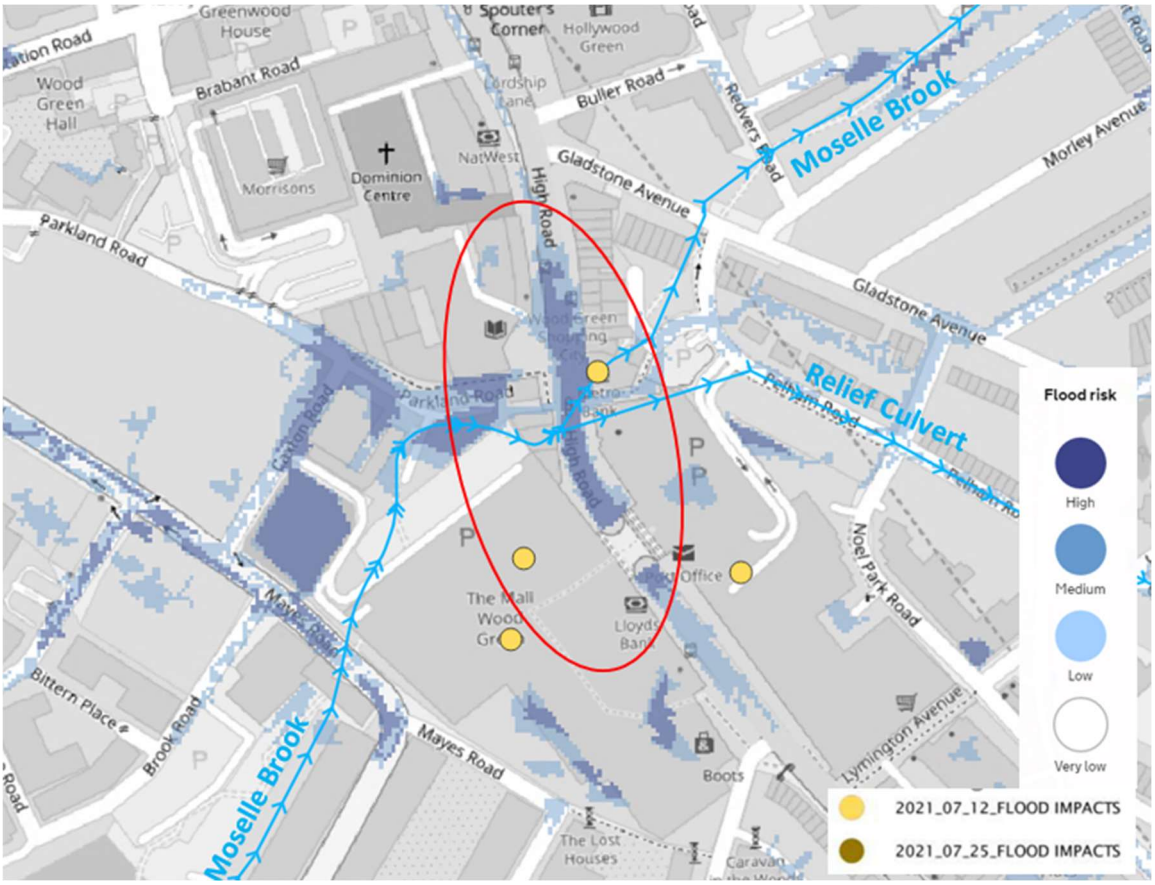
[7] Turnpike Lane Flooding – 2021/3504, available at Turnpike Lane Flooding | Mayor's Question Time (london.gov.uk), London:UK

5.3 The Mall

Figure 5-4 Site Location

Location	The Mall

Location Plan:



5.3.1 Summary of Impact

12th July 2021

Reports of flooding were received from businesses in The Mall area of High Street, where major flooding of the highway was reported, and several businesses had contacted their insurance companies to deal with flood related damage. Photographs and videos circulated on social media indicated the spread and depth of flooding under the bridge within The Mall area. At 17:53pm on 12th July The Mall itself announced via social media that it had closed the centre due to the weather[8].

[8] Twitter, 2021 https://twitter.com/MallWoodGreen/status/1414628905877712912

Figure 5-5 Flooding at The Mall, 12th July 2021

25th July 2021

The only recorded flood report from 25th July in The Mall area was a business at 83 Mayes Road, on the west of The Mall centre. No further information was available from the flood report schedule and the property could not be contacted.

5.3.2 Site Context

High Road, which passes through The Mall under a pedestrian bridge (see Figure 5-3) falls in a southerly direction from a high area (circa 40mAOD) near the junction with Bounds Green Road in the north. The High Road generally falls all the way to its junction with Westbury Avenue and Turnpike Lane (20mAOD), but there is a localised low spot in the vicinity of The Mall at the pedestrian bridge underpass. The highest surface water risk, as shown on the surface water flood map in Figure 5-4, is consistent with this section. The carriageway under the pedestrian bridge is lower than the surrounding footways by up to 500mm and a total of 5 gullies are present over the 30m section of road under the bridge. Raised pedestrian crossings are located to the south and north of the pedestrian bridge, further confining surface water runoff within the underpass section. To the north and south of the underpass section, kerbs are either flush or have a 6-25mm high upstand from the carriageway.

5.3.3 Existing Drainage and Watercourses

Asset records indicate that two surface water sewers within High Road in The Mall area. A 229mm diameter pipe runs from the north along High Road; the other is located south of the pedestrian bridge but there is no further information on the asset records of this.

Surface water sewers in Mayes Road and Parkland Road adjacent to The Mall, are indicated by the DWMP modelling outputs to be at risk of surcharging during a 1 in 2 year storm. The DWMP model also predicts that during a 1 in 30 year event there is a risk of manhole flooding at the junction of Mayes Road and Coburg Road.

A culverted section of the Moselle Brook passes through The Mall area, crossing High Road and continuing through Parkland Road. A relief culvert for the Moselle Brook branches from the main alignment within Parkland Road and continues along Pelham Road east of The Mall area. Planning permission for a significant extension on the western side of The Mall was granted in 2007, despite concerns being raised that the extension would be vulnerable to flooding from the Moselle. Asset records indicate that local surface water sewers connect into the culvert; the extent and nature of these would need further investigation.

5.3.4 Flood History

The Haringey SWMP does not record any instances of flooding at The Mall specially. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N22 6 postcode area, as of 2010.

5.3.5 Potential Flood Mechanisms

The photographic evidence, local topography and available flood reports suggest that the primary cause of the flooding was excessive rainfall which exceeded the capacity drainage network in this area. The intensity of the rainfall meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low points on High Road within the vicinity of The Mall, causing flooding of the highway. Any surcharging or flooding of the Moselle Culvert may have increased flooding on the carriageways and footways. Further investigation would be required to identify whether the capacity issues were primarily due to the receiving capacity of the highway drains, the public sewer, the Moselle Brook Culvert, or a combination.

On Mayes Road, the flood report location corresponds to the DWMP modelled 1 in 30 year risk of manhole flooding.

Further items were identified that may have affected the depth and magnitude of the flooding, including:

- **Kerb Heights**

  It was noted that kerb sections to the north and south of The Mall were flush or 6-25mm high upstands adjacent the carriageway. Any excess surface water may quickly pass onto footways and then to properties.

5.3.6 Responses to Flooding

Haringey Council:

- Instructed Marlborough Highways to unblock gullies along the road. It is not stated in the flood report schedules how many gullies were cleaned, but a site walkover on 26th October 2021 showed that at least 2 no. gullies within The Mall underpass were blocked, and at least 1 no. gully was blocked near the High Road junction with Alexandra Road.
- The flood report schedule indicates that the businesses within The Mall area had contacted their insurance companies to deal with the flood damage.
- Provided a schedule of all gully cleaning works that have taken place in Wood Green between 12th July and 30th September 2021. A total of 79 jobs were raised for gully clearance between these dates. Confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No calls were recorded by LFB for this location.

5.3.7 Next Steps

The EA surface water flood maps indicate that The Mall is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

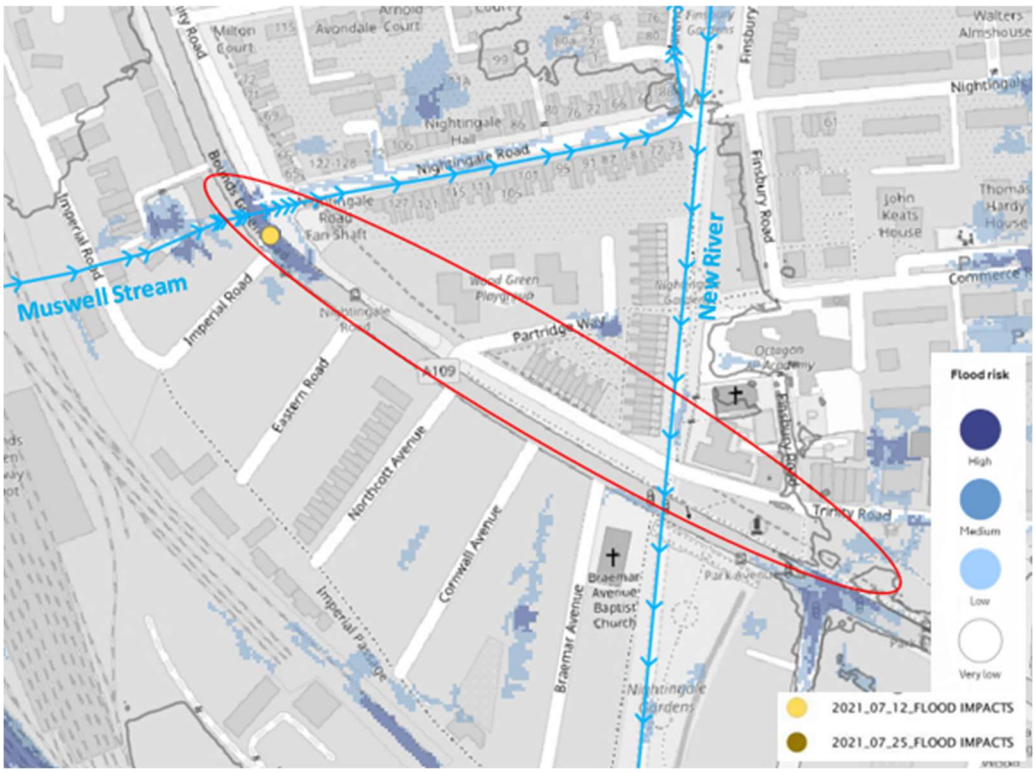
- Haringey Council to programme and undertake gulley cleaning along High Road and through The Mall underpass.
- Haringey Council to consider implementation of SuDS measures in the contributing catchment to reduce the volume and rate of runoff reaching the area at risk and reduce the load on the drainage infrastructure at this location. In particular, a number of flat pitched buildings may potentially be able to accommodate green roofs, subject to residual space and loading capacity.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Inspection of the Moselle Brook Culvert and the downstream relief culvert to ensure it is working at maximum operating capacity.

5.4 Bounds Green Road

Figure 5-6 Site Location

Location	Bounds Green Road

Location Plan:



5.4.1 Summary of Impact

12th July 2021

Flooding of the highway on Bounds Green Road was reported on 12th July, to which Haringey Council responded. The initial report was recorded as flooding having occurred outside 18 Trinity Road and at the junction of Bounds Green Road and Partridge Way. The photographic evidence of the call out indicates flooding at the junction of Bounds Green Road and Nightingale Road, near Bounds Green Ambulance Station.

Figure 5-7 Flooding at Bounds Green Road (jnct Nightingale Road), 12th July 2021

25th July 2021

There was no flooding reported on 25th July in this area.

5.4.2 Site Context

Bounds Green Road generally falls from the Bowes Park railway overpass (circa 45mAOD) to its junction with High Road (32mAOD). There is a topographical low spot at its junction with Park Avenue. The EA maps (Figure 5-6) show two areas of high surface water risk along this section of Bounds Green Road; the junction with Park Avenue and junction with Nightingale Road. Bounds Green Road is a local distributor road with an average width of 12.5m in the area of interest.

5.4.3 Existing Drainage and Watercourses

Asset records indicate that 229mm diameter surface water sewers within this section of Bounds Green Road, which increases to 305mm diameter east of the junction with Braemar Avenue.

The DWMP model shows that surface water sewers throughout Bounds Green Road is at risk of surcharging during a 1 in 2 year storm.

A culverted section of the Muswell Stream crosses Bounds Green Road and continues along Nightingale Road. Asset records indicate that local surface water sewers may connect into the culvert; the extent and nature of these would need further investigation.

5.4.4 Flood History

The Haringey SWMP does not report any instances of flooding specifically along Bounds Green Road. Appendix D, Figure 9 of the SWMP records up to 6-10 instances of flooding in the N22 8 postcode area, as of 2010.

5.4.5 Previous flood studies

Bounds Green Road falls within CDA Group 4_010 ("Green Lanes (A105) and neighbouring roads, Wood Green). The CDA analysis shows surface water flows down Green Lanes, cutting through properties towards Pymmes Brook. Water is observed to pond in low points. At the junction of Bounds Green Lane and Nightingale Lane this ponding is estimated in the CDA analysis to reach 0.25 to 0.5m depth, whilst flood depths of 0.10 to 0.25m depth are estimate at the junction of Bounds Green Lane and Park Lane.

5.4.6 Potential Flood Mechanisms

The photographic evidence showing localised flooding and follow up reporting from Haringey Council suggests that the primary cause of the flooding at the Bounds Green Road / Nightingale Road junction was caused by a blocked gully limiting the rate at which surface water could enter the local drainage system.

Reported flooding is located at the crossing of the Muswell Stream Culvert. Surcharging of this culvert may have caused or exacerbated flooding locally on the carriageway and footway. Further investigation would be required to confirm.

5.4.7 Responses to Flooding

Haringey Council:

- Instructed Marlborough Highways to unblock the gullies at the junctions and for further inspection of this area to be undertaken.
- Provided a schedule of all gully cleaning works that have taken place in Wood Green between 12th July and 30th September 2021. A total of 79 jobs were raised for gully clearance between these dates. Confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No calls were recorded by LFB for this location.

5.4.8 Next Steps

The EA surface water flood maps indicate that The Mall is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

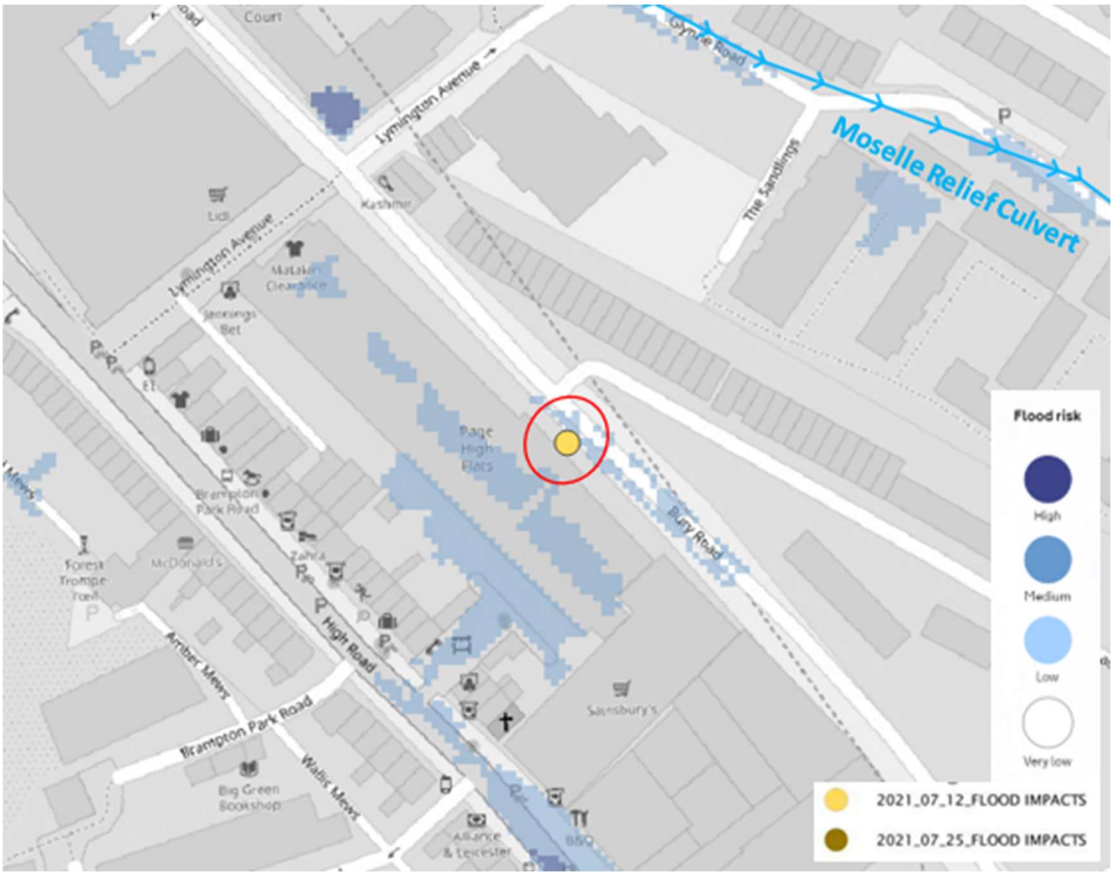
- Haringey Council to programme and undertake increased frequency gully cleaning along this high risk section of Bounds Green Road.
- Haringey Council to consider implementation of SuDS measures in the contributing catchment to reduce the volume and rate of runoff reaching the area at risk and reduce the load on the drainage infrastructure at this location. Nightingale Gardens and Trinity Gardens are identified as having existing green spaces which may be able to accommodate nature based SuDS features.
- Haringey to consider inspection of the Muswell Hill Culvert (defined as ordinary watercourse at this location) to ensure it is working at maximum operating capacity.

5.5 Bury Road Car park

Figure 5-8 Site Location

Location	Bury Road Car park

Location Plan:



5.5.1 Summary of Impact

12th July 2021

Flooding at Bury Road car park was reported on 12th July, to which Haringey Council responded. The initial report was recorded as flooding of the car park. By the time Haringey Council attended site on the evening of 12th July, most of the floodwater had dissipated, with some residual surface water noted at the car park entrance. Inspection of the gullies was instructed. The flood report schedule indicates no further action was taken.

The car park maintenance team was contacted for further information but no further information from the day was available.

Figure 5-9 Remaining flood water at Bury Road car park, 12th July 2021

25th July 2021

There was no flooding reported on 25th July in this area.

5.5.2 Site Context

Bury Road is located circa 200m southeast of The Mall area and runs parallel to High Road. The entrance to the car park lies in the topographically lowest part of Bury Road (c20mAOD), which also correlates to the only area of medium surface water flood risk on the road. The main public entrance to the car park ramps up quickly from Bury Road. The loading entrance, seen on the left in Figure 5-9 above, ramps down to a lower level within the building.

5.5.3 Existing Drainage and Watercourses

Asset records indicate that a 305mm diameter surface water runs through this section of Bury Road, which increases to 534mm diameter south the car park entrances.

The DWMP model shows that surface water sewers along Bury Road would be at risk of surcharging during a 1 in 2 year storm by 2035.

The section of carriageway adjacent to the frontage of Bury Road car park is drained by 1 no. gully, and historic photographs show that standing water along the front of the car park, where cracking and deterioration of the carriageway edge is also visible. No information has been obtained related to internal building drainage.

5.5.4 Flood History

Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N22 6 postcode area, as of 2010.

5.5.5 Potential Flood Mechanisms

The photographic evidence and follow up reporting from Haringey Council suggests that the primary cause of the flooding was excessive rainfall which exceeded the capacity drainage network in this area. The intensity of the rainfall meant that surface water was unable to enter the sewer network fast enough and accumulated along the frontage of Bury Road car park, eventually passing into the car park. Further investigation would be required to identify whether the capacity issues were primarily due to the receiving capacity of the highway drains, the public sewer, or both.

5.5.6 Responses to Flooding

Haringey Council:

- Attended Bury Road on 12th July 2021 to inspect the gullies. No confirmation of blockages on record, and upon arrival at site Haringey Council noted that the majority of the water had dispersed.
- Provided a schedule of all gully cleaning works that have taken place in Wood Green between 12th July and 30th September 2021. A total of 79 jobs were raised for gully clearance between these dates. Confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No calls were recorded by LFB for this location.

5.5.7 Next Steps

The EA surface water flood maps indicate that Bury Road car park is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

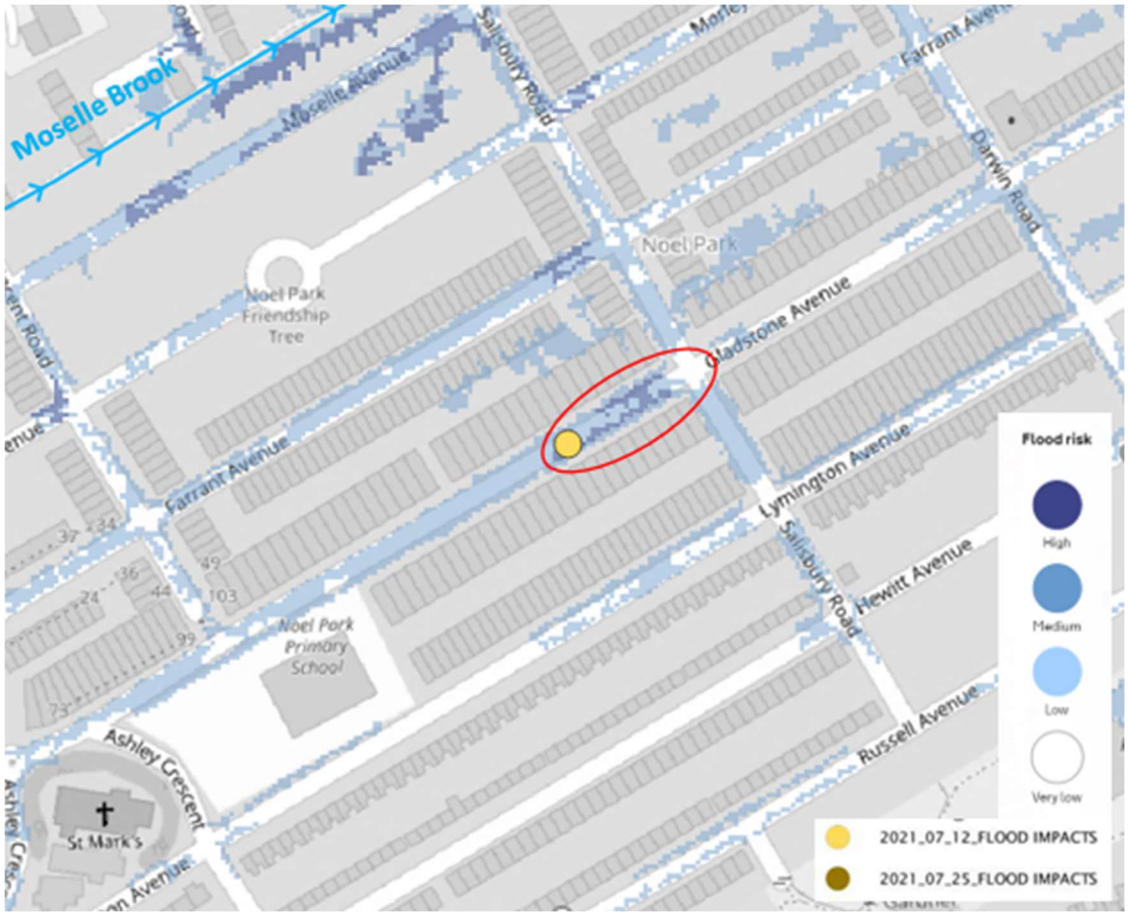
- Haringey Council to investigate the provision and performance of the gullies along Bury Road. At present there is only one gully pot evident at this location.

5.6 Gladstone Avenue

Figure 5-10 Site Location

Location	Gladstone Avenue

Location Plan:



5.6.1 Summary of Impact

12th July 2021

Flooding at Gladstone Avenue was reported on 12th July, to which Haringey Council responded. The initial report was recorded as flooding of the highway. The flood report schedule indicates that a 'new drainage location' was to be added at this location in response to the flooding.

25th July 2021

There was no flooding reported on 25th July in this area.

5.6.2 Site Context

Gladstone Avenue is a residential street which falls gently to the northeast between approximate elevations of 18mAOD and 17mAOD. The street comprises a series of speed humps along its length, and the junction with Salisbury Road is a raised table. This topography corresponds with the surface water flood risk map shown in Figure 5-10, in which it is suggested that surface water accumulates near the junction of the two carriageways.

5.6.3 Existing Drainage and Watercourses

Asset records indicate that a 381mm diameter surface water runs through this section of Gladstone Avenue, which increases to 457mm diameter near its junction with Salisbury Road. The road is drained by a traditional gully system.

The DWMP model shows that surface water sewers throughout Gladstone Avenue is at risk of surcharging during a 1 in 2 year storm.

1 no. gully is located at the foot of the raised table junction, on the southern side of Gladstone Avenue. There are no gullies at the base of the raised table junction on the northern side.

5.6.4 Flood History

Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N22 6 postcode area, as of 2010.

5.6.5 Potential Flood Mechanisms

The lack of anecdotal or photographic evidence, as well as the limited information on the Haringey flood report schedule, makes it difficult to identify flood mechanisms with any certainty. It is possible that volume of the rainfall meant that surface water was unable to enter the highway drains fast enough and accumulated on Gladstone Road at the foot of the raised table junction, flooding the carriageway. The receiving capacity of the public sewer may have contributed to the flooding based on the DWMP model output, but further investigation is required to confirm this.

5.6.6 Responses to Flooding

Haringey Council:

- No confirmation of blockages on record, and the intention is to install a new drainage location in this area.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No calls were recorded by LFB for this location.

5.6.7 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

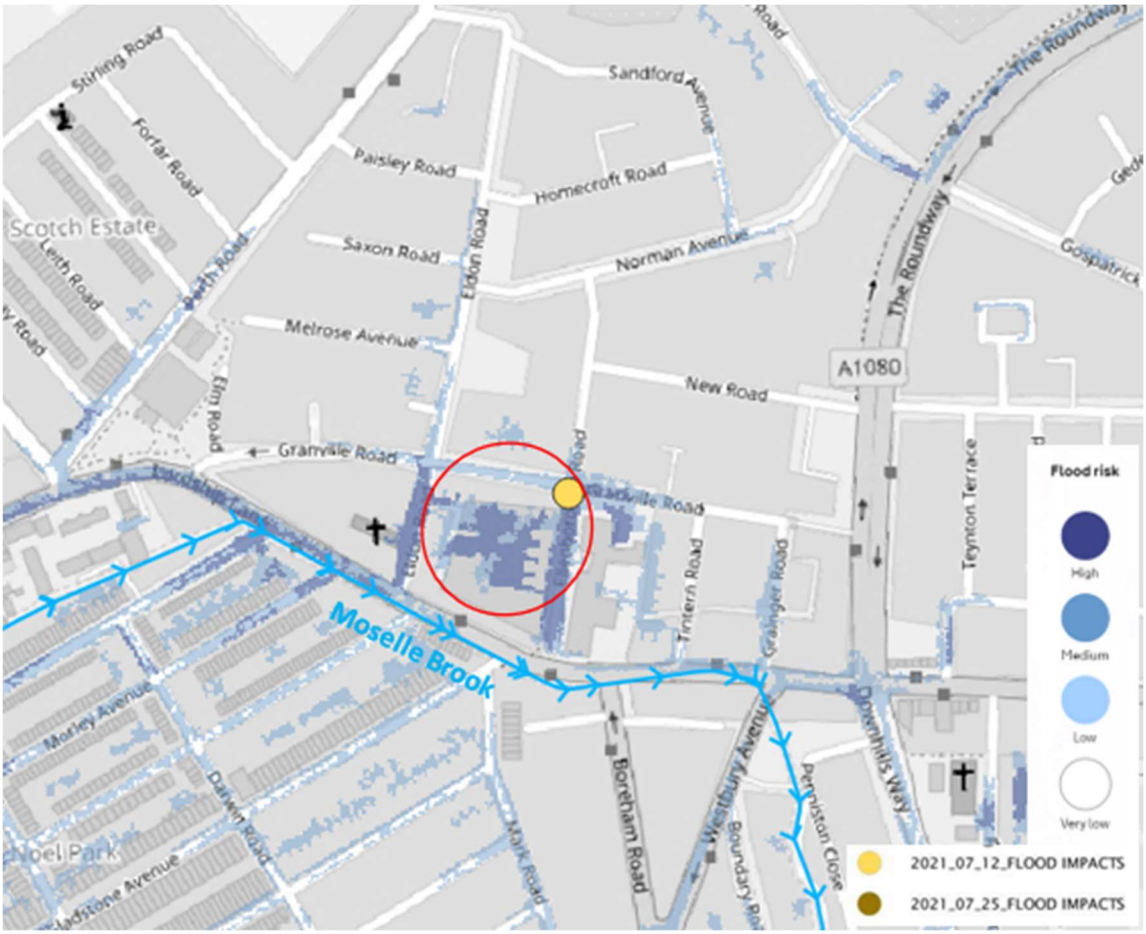
- Haringey Council should further investigate the performance of the gullies at topographic low spots along Gladstone Road to ensure that they are working at full capacity.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.
- Haringey Council to review highway drainage and evaluate requirement for gully pots to the north of the raised table.

5.7 Lordship Lane Primary School

Figure 5-11 Site Location

Location	Lordship Lane Primary School

Location Plan:



5.7.1 Summary of Impact

12th July 2021

Flooding at Lordship Lane Primary School was reported on 12th July. The initial report was recorded as 'longstanding issues' and does not indicate that any further action was taken.

The school was contacted directly for more details of the flooding. The head teacher indicated that some rooms flooded due to blocked roof gutters. The head teacher also noted that Ellenborough Road was completely flooded.

25th July 2021

There was no flooding reported on 25th July in this area.

5.7.2 Site Context

Lordship Lane Primary School is located on Lordship Lane. The EA online mapping places the school grounds, as well as the adjacent Tintern Road, Ellenborough Road and Granville Road, in an area of high surface water flood risk.

5.7.3 Existing Drainage and Watercourses

Asset records indicate 299mm and 305mm diameter surface water sewers in minor roads surrounding the school, which appear to connect to the 1013mm diameter culverted Moselle Brook running under Lordship Lane.

The DWMP model shows that surface water sewers throughout Ellenborough Road is at risk of surcharging during a 1 in 2 year storm.

The carriageways are drained by a traditional gully system. Correspondence with Haringey Council indicates that the 'longstanding issues' referred to in the initial report is referring to drainage misconnections from the school directly into the Moselle Brook culvert. Though not the primary cause of flooding in this instance, this would need to be verified and rectified as a matter of urgency.

5.7.4 Flood History

Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N22 5 postcode area, as of 2010.

5.7.5 Previous flood studies

Lordship Lane Primary School is located within CDA Group 4_075 ("Lordship Lane and Ellenborough Road, Noel Park"). The CDA analysis shows that flooding up to 0.5m depth occurs at this localised low point in topography. The CDA analysis also highlights the presence of the culverted Moselle Brook running beneath Lordship Lane on the southern edge of the CDA.

5.7.6 Potential Flood Mechanisms

The primary cause of flooding within the school building was confirmed by the head teacher to be caused by blocked roof gutters. There was no confirmation of flooding of the school grounds from surface water.

5.7.7 Responses to Flooding

Haringey Council:

- The council is aware of the longstanding issue at the school.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No calls were recorded by LFB for this location.

5.7.8 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

- Haringey Council to ensure that gully pots along Ellenborough Road are targeted for cleansing on a cyclic maintenance regime.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

6 SUMMARY

The flooding that occurred on 12th July and 25th July 2021 in Wood Green was caused by storms ranging from a 1 in 2 to a 1 in 30 year return period rainfall event, and in some locations potentially up to a 1 in 70 year return period rainfall event. Traditional pipe and gully pot drainage systems were historically not designed to deal with the rainfall intensity / severity experienced on these dates.

Other factors have been identified which may have caused flooding at the respective locations identified within this report, which include;

- Propagation of flood waters by passage of vehicles through flood waters causing bow waves.
- Blocked gully pots observed during the site visits.
- Lack of capacity within surface water sewers (as noted by recorded reports of flooding and outputs from DWMP models)

Turnpike Lane underground station was noted to be affected from closure on both dates of flooding.

Thames Water were unable to provide any location specific data or actions carried out in relation to flooding for a number of the locations considered by this Section 19 assessment.

Thames Water has undertaken an internal review, (which considers the wider London catchment) to identify the actions taken ahead of, during and after the July 2021 storm events. This review concluded that the two key areas in which customers were let down were the initial response on the ground and lack of Thames Water customer contact provision during the events.

A further Independent Review has been commissioned by Thames Water into the causes and impacts of flooding, with a detailed assessment of sewer performance, which is due to be completed by Spring 2022.

It is understood that there are no current programmes for Thames Water to invest in upgrading local drainage networks to provide additional sewer capacity in the Wood Green area.

6.1 Next steps

Haringey Council has committed to programme and undertake future gully cleaning throughout Haringey which is proposed to be completed by Summer 2022.

Other actions are recommended within the body of this report and are summarised below:

- The outcomes of the Thames Water independent review (due 2022) to be shared with other RMAs to ensure that mechanisms of flood can be better understood and any actions identified from the review can be developed jointly with other RMAs (as appropriate).
- Priority should be given by Haringey to cleaning of gully pots in areas of known surface water flood risk.
- Haringey Council should consider localised temporary road closures or diversions and barriers are recommended in high-risk areas with low profile kerbs to reduce ingress of floodwaters onto footways and into properties where risk of internal flooding is caused by bow wave affect from the movement of vehicles through flood waters.
- Homeowners and businesses should be made aware of their risk of flooding and encouraged to investigate flood resilience and resistant measures to protect affected properties. Haringey Council offers advice through its website[9]. This link also provides information on how to sign up for flood warnings.
- Haringey Council to consider further retrofitting of SuDS to manage excess storm runoff.

[9] Be prepared for flooding. Haringey Council, 2021, available at https://www.haringey.gov.uk/environment-and-waste/major-emergencies/drainage-and-flooding/be-prepared-flooding, accessed 12th November 2021.