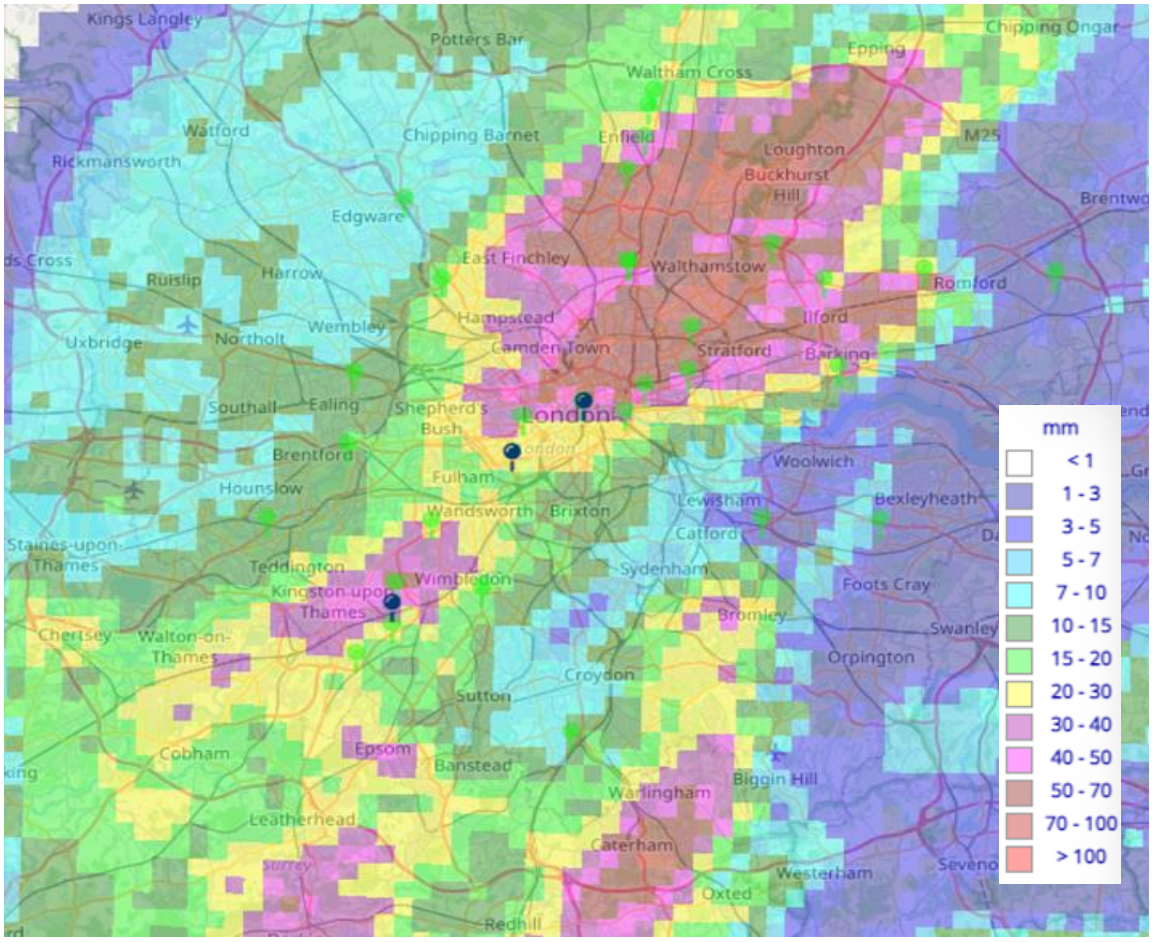
London Borough of Waltham Forest

Flood Investigation Report

Borough-wide, Sunday 25th July and 7/8th August 2021



Revision Schedule

London Borough of Waltham Forest

22nd October 2021 Draft

Rev	Date	Details	Author	Checked and Approved by
1.0	21/01/2022	Draft	I.Stretton	D.Lynch and V.Valavan
1.1	04/03/2022	Draft	I.Stretton	D.Lynch and V.Valavan
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1.3				
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Checked and Approved By

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Environment Portfolio Holder
(Deputy Leader of the Council)

Acknowledgements

London Borough of Waltham Forest would like to acknowledge the following organisations and groups for providing information and input into this Section 19 Flood Investigation Report; local residents and businesses who were impacted by the flooding, Thames Water, The Environment Agency, Hydromaster.com and DTN.com.

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Executive Summary

Waltham Forest Council is the Lead Local Flood Authority (LLFA) for the London Borough of Waltham Forest (LBWF). As a LLFA the Council has a number of duties as set out in the Flood and Water Management Act 2010, including a requirement to investigate certain instances of flooding and to publish the findings.

On 25th July 2021, during and following an intense period of torrential rainfall, the borough was subject to widespread flooding. The most affected parts of the borough were Walthamstow, Wood Street, Leyton and Leytonstone, focused on the alignment of the Fillebrook and its associated catchment area. Subsequent rainfall on 7th and 8th August 2021 triggered further flooding in these areas.

A large number of people have been significantly impacted by the flooding, with water entering in excess of 200 homes and 28 local schools, as well as range of businesses and Whipps Cross Hospital. Eyewitness reports in the worst hit areas indicated water levels reaching up to 700mm in places, resulting in vehicles being submerged and widespread loss of power.

Following the initial flooding on 25th July, political leaders and senior Council officers met with a range of affected residents and stakeholders to see the impact of the flooding first hand. In a number of cases, almost six months on, some residents are still unable to return to their properties due to the extent of the flood damage, creating stress and anxiety in already challenging times.

In immediate response to the floods, the Council developed a high level 10 Point Action Plan. This included a range of actions such as lobbying various governmental departments to raise the issues of the flooding in Waltham Forest as well reviewing internal procedures. A Flooding Response Task and Finish Group was established to oversee and ensure delivery of the Action Plan.

Alongside implementation of the Action Plan, the Council, as LLFA, has completed a more detailed investigation into the flooding, in accordance with its duties as set out in Flood and Water Management Act 2010. The investigation focuses on the events and circumstances leading to the flooding, the functions of the various Risk Management Authorities (RMA's) involved - including relevant Waltham Forest Council Service's, Thames Water (TW) and the Environment Agency (EA) amongst others – and where further improvements can be made in the future to better mitigate against flood events.

The investigation has shown that in some places the intensity and severity of the rainfall, particularly on 25th July 2021, equated to a 1 in 170-year return period, far exceeding the design capacity of the drainage system and acting as the underlying catalyst for the widespread flooding that occurred. However, the investigation also highlights specific areas of the borough that are particularly sensitive and prone to flooding, in no small part due to the challenges of a Victorian-era drainage system.

It recognised that there is unlikely to be one single action that will mitigate all flood risk within LBWF in the future, certainly to the degree of that witnessed on July 25th 2021, and climate change is clearly one of the most prominent contributory factors. However, there are a number of steps that can be taken in the short, medium and long term to reduce flood risk across the borough. These will undoubtedly require significant investment to build community resilience and improve, increase and enhance surface water network capacity, and all RMAs will need to actively consider a combination of flood mitigation options, including community Sustainable Urban Drainage Schemes (SUDS), alongside any future surface water sewer upgrades.

1. Introduction

1.1 Scope and Purpose of the Report

Waltham Forest Council is the LLFA for LBWF. As the LLFA we have a duty to investigate certain instances of flooding, to the extent that we consider it necessary. These duties are outlined within the Flood and Water Management Act 2010, Section 19. More specifically, Section 19 of 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.

This report investigates and summarises the extent, impact and mechanisms involved in the flooding that took place in Waltham Forest on 25th July and then 7th and 8th August 2021. The report considers the main overarching circumstances and factors leading and contributing to the two flood events and provides a summary of the key impacts. The report does not examine the specific factors or impacts associated with each individual property and is not intended to provide an in-depth analysis of the flood risk and flood mechanisms in every location. Similarly, the report is not intended as a comprehensive review of the Councils overall Flood Risk and Mitigation Strategy.

The report sets out the functions and response of each relevant RMA to the July and August events, and includes a series of recommendations intended to ensure that flood warning, management and response is improved going forward, as far as practical. It is imperative that all RMAs are involved and work collectively to take forward these recommendations and mitigate future flood risk as far as possible.

1.2 Key Stakeholders - Rights and Responsibilities

Flood events and incidents, and water and flood risk management more generally, involve a wide range of stakeholders ranging from local communities to nationwide organisations such as RMA's and the emergency services. Some of the key ones and their roles and responsibilities are set out below.

Risk Management Authorities

1.2.1 Lead Local Flood Authority (LLFA)

Waltham Forest Council is the LLFA within the borough. We work in partnership with the Environment Agency, Thames Water and other stakeholders to manage local flood risk from surface water, groundwater and ordinary watercourses. We also ensure cooperation between RMAs within the borough.

1.2.2 Environment Agency (EA)

The EA has a national strategic overview from all sources of flooding and coastal erosion. They are responsible for Flood and Coastal Erosion Risk Management (FCERM) activities on main river watercourses, the coast and they regulate reservoir safety. They provide flood forecasting and warnings through collaboration with the Met Office.

1.2.3 Local Authority Highway Authority

LBWF is the local Highway Authority in this area. The Council assumes the lead responsibility for providing and managing highway drainage and roadside ditches under the Highways Act 1980. We manage local gully cleansing operations within the borough and oversee highway flooding on all non-Transport for London and Highways England roads.

1.2.4 Local Authority Civil Protection Service

The Civil Protection Service supports the Council's emergency arrangements in responding to Major Incidents in support of our residents and businesses, under the Civil Contingencies (Act 2004), as well as supporting our multi-agency partners.

1.2.5 Water Utilities - Thames Water Utilities (TWU)

TW manage the risk of flooding to water supply and sewerage facilities and flood risks from the failure of their infrastructure. Under section 94 of the Water Industry Act 1991 they have a duty to ensure that the area they serve is "effectually drained". This includes drainage of surface water from the land around buildings as well as provision of foul sewers. Where there is frequent and severe sewer flooding when rainfall is not extreme, sewerage undertakers are required to address this through their capital investment plans, which are approved and regulated by Ofwat.

Partners and Stakeholders

1.2.6 London Resilience Group (LRG)

The London Resilience Group (LRG), is a central team which supports the partner organisations who each have specific responsibilities for preparing for and responding to emergencies such as flooding. The LRG is jointly funded by the London Fire Brigade, London local authorities and the Greater London Authority. The Group is based within the London Fire Brigade.

1.2.7 Riparian Landowners

Riparian landowners are those that have a watercourse or ditch running through, adjacent or beneath their property. They have responsibilities such as: ensuring the unobstructed flow of water, maintaining the bed and banks, and keeping structures such as culverts and trash screens free from obstruction.

1.2.8 Residents and Businesses

Residents and businesses have a key role to play in managing local flood risk. People and properties in any known areas of flood risk should be prepared for flood incidents and have robust flood plans in place. Where suitable, this should include the installation of Property Flood Resilience measures (PFR) such as flood barriers for doors and anti-flood air bricks. Whilst RMAs have a strategic overview of flood reduction, building community resilience across a wide area is also an essential part of mitigating local flood risk. Residents have many options available to them such as SUDS retrofitting, property rainwater attenuation tanks and PFR measures. In addition, it is key that local residents and businesses report any incidents of flooding of property, open spaces and roads. This is an essential in helping build greater knowledge of patterns of flooding, which can then help with future risk management and investment.

Emergency Services

Emergency services such as the Metropolitan Police (Met), London Fire Brigade (LFB) and London Ambulance Service (LAS), are typically tasked with protecting life and people's safety during flood incidents. Key duties include:

1.2.9 Metropolitan Police (MET)

Lifesaving; evacuation and cordoning; traffic control and diversion; security of scene / properties.

1.3.1 London Fire Brigade (LFB)

Lifesaving, search and rescue; assistance with pumping water; priority to flooding involving a risk to life, fire or explosion; calls from hospitals, residential care homes for the elderly, public utilities and food storage depots; environmental issues.

1.3.2 London Ambulance Service (LAS)

Lifesaving, treatment and care; transportation of medical personnel and patients; evacuation of vulnerable persons (where possible depending on operational constraints), hospital evacuation, provision of senior officer to liaise with consultants regarding transport for critically ill patients.

2. Flood Risk Background

2.1 Geographic Context

The LBWF is located in outer north-east London, and is shown in Figure 1 below. The borough has administrative boundaries with London Borough of Redbridge to the east, London Borough of Newham to the south-east, London Borough of Hackney to the south-west and London Boroughs of Haringey and Enfield to the west and north-west respectively. To the north and north-east is Epping Forest administrative area.

LBWF covers an area of approximately 3,800ha. While predominantly comprising built-up urban development, ranging from lower density in the north to higher density in the south, there are notable areas of open space including a number of parks and sports grounds. Along the western edge of the borough is the Lower and Upper Lee Valley, incorporating the River Lee as shown in Figure 2 below. The land along the River Lee includes a mixture of marsh and parkland, forming a green and blue corridor along one side of the borough. A number of major reservoirs are located along this western edge in the centre and north of the borough.

The historical Fillebrook river rises near Lea Bridge Road and Wood Street and flows in a south easterly direction. The watercourse has largely been lost due to catchment urbanisation and it flows through the council wards of Wood Street, Forest, Leytonstone, Grove Green and Leyton. It now forms an integral part of the Thames Water sewer network. The brook then drains to the south west, flowing in an open channel to the confluence with the River Lea, near Leyton Sewage Works.

Epping Forest is located along the boroughs eastern edge, running between Wanstead flats in Leytonstone in the south to Whitehall Plain and the main body of the forest in Chingford in the north. The Ching Brook (Figure 2) - a tributary of the River Lee - flows along some of the boroughs eastern edge in Chingford and Highams Park, before flowing east-west through the borough just north of the A406 (North Circular) Other water courses of note include the Dagenham Brook (Figure 2), which is also a tributary of the River Lee. It flows from the River Lee Flood Relief Channel in the vicinity of the North Access Road to merge with the Old River Lee near New Spitalfields Market before re-joining the River Lee Navigation below Old Ford Lock. (LB Waltham Forest Level 1 SFRA, AECOM, 2018).

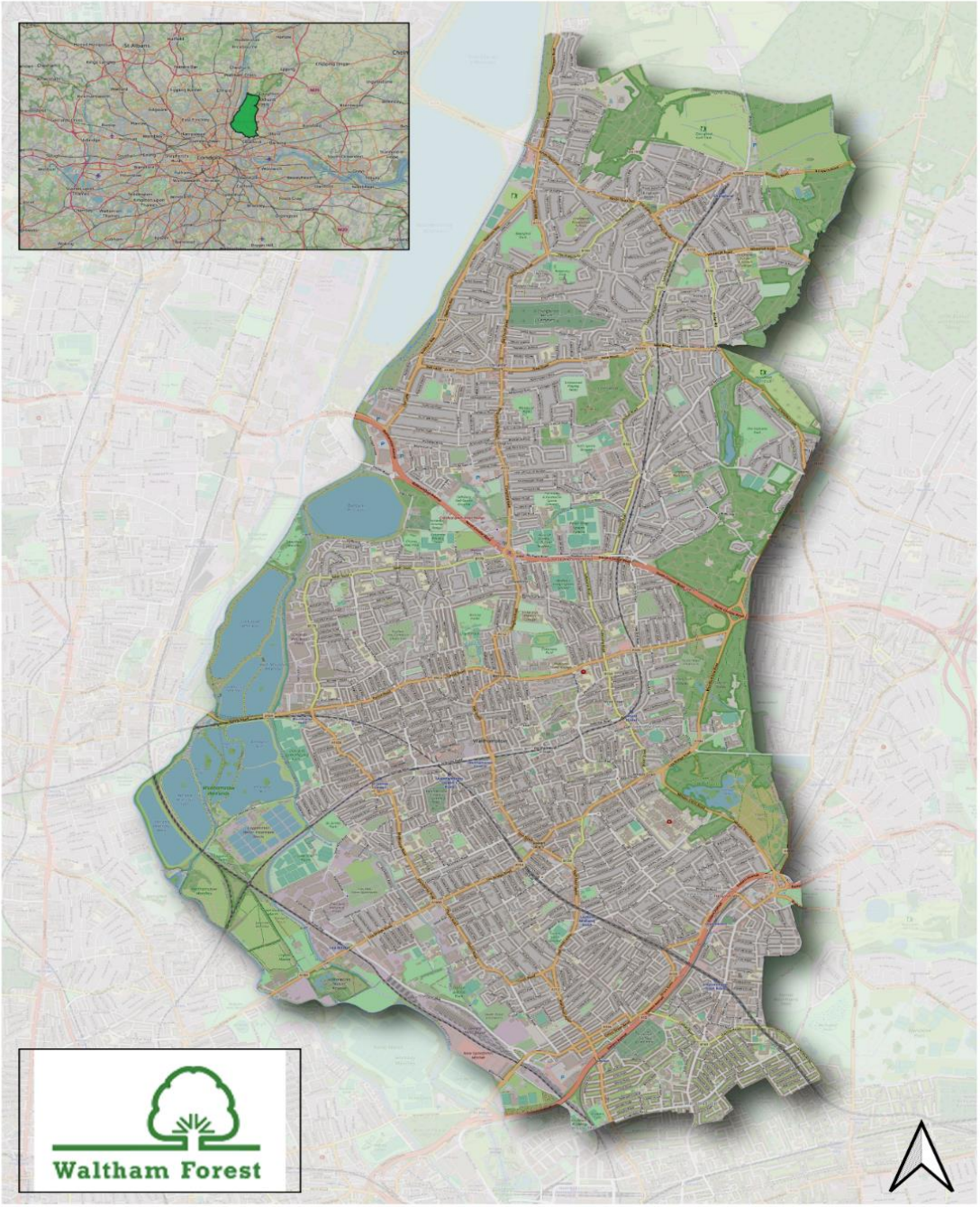


Figure 1: London Borough of Waltham Forest

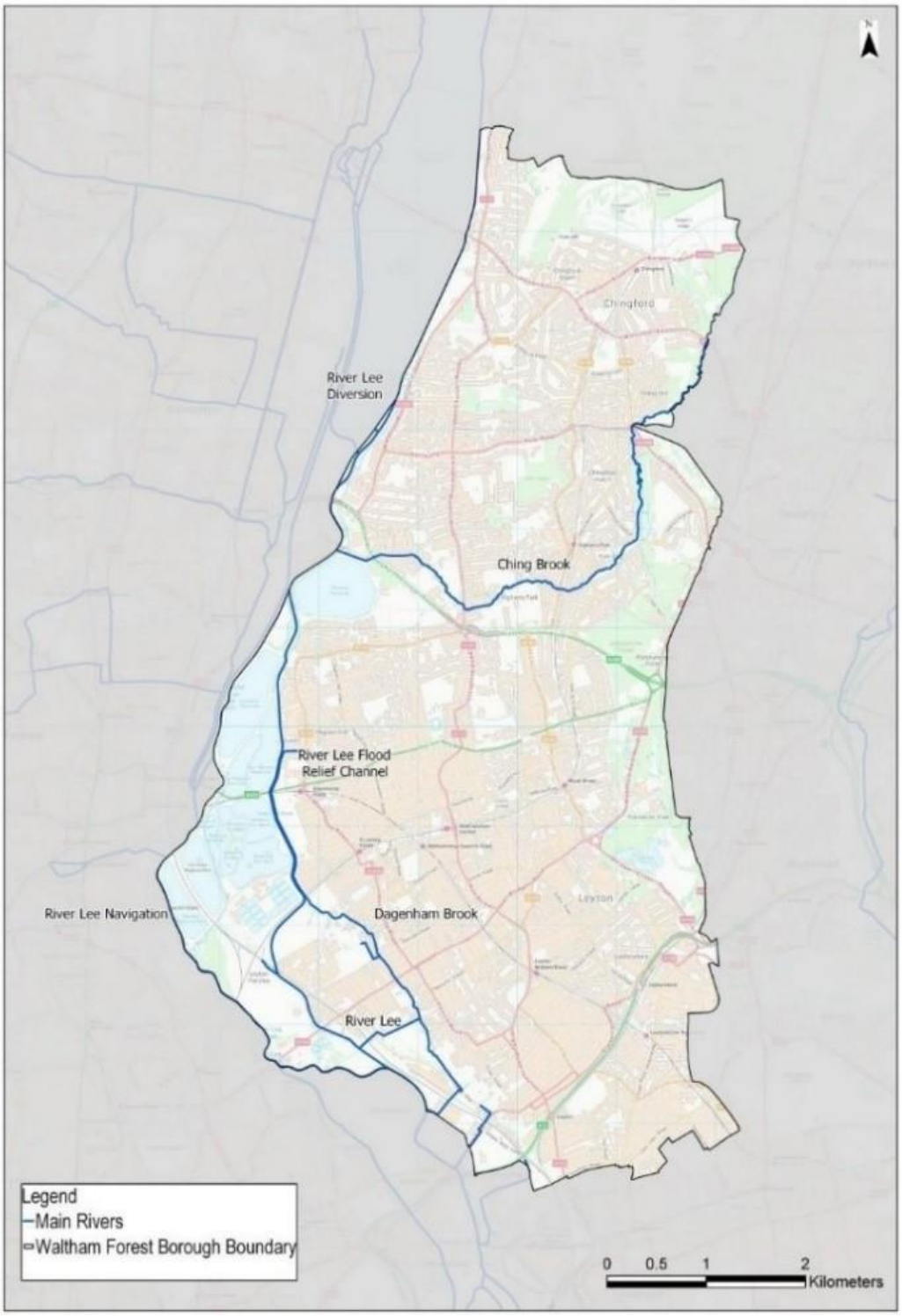


Figure 2: Main river network within LBWF

2.2 Borough Flood Risk Characteristics

There are two predominant sources of flood risk within the borough;

- River flooding (fluvial)
- Surface water flooding (pluvial)

The definition of each including key differences is set out in Table 1 below

Type of Flooding	Definition
Rivers (fluvial)	Flooding caused by rivers, streams or lakes as a result of overtopping due to intense prolonged rainfall.
Surface Water (pluvial)	Flooding caused as a result of intense rainfall which exceeds the capacity of drainage and surface water sewers.

Table 1 – Sources of flooding

2.3 Fluvial Flood Risk

As detailed in section 2.1 and Figure 2 (page 13), there are three main rivers or watercourses within the borough – River Lea, Ching Brook and Dagenham Brook. The latter two being tributaries of the River Lea. These three rivers are the main source of fluvial flooding within the Borough.

The historical Fillebrooke is largely culverted throughout its length, however there are open channel sections at the downstream extent, which could contribute to localised fluvial flooding. The upstream culverted sections of the river will impact heavily on surface water flooding as the brook itself plays an integral part of the Thames Water sewer network.

2.4 Pluvial Flood Risk

There are 13 identified Critical Drainage Areas (CDA's) within the Borough. A CDA is an area that has been identified as being at a higher risk of surface water flooding, often in combination with other sources of flooding.

Of the 13 areas, 5 have been identified as the main CDA's at most risk. These are presented in Figure 3 below. The chief mechanisms for defining the CDA's within LBWF can be broadly divided into the following categories:

- River Valleys (current and historical) - across the study area, the areas particularly susceptible to overland flow are formed by narrow corridors associated with topographical valleys which represent the routes of the 'lost' rivers of London, such as the Fillebrooke
- Topographical low-lying areas - areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding
- Railway Cuttings: stretches of railway track in cuttings are susceptible to surface water flooding and, if flooded, will impact on services
- Railway Embankments - discrete surface water flooding locations along the upstream side of the raised rail embankment
- Topographical Low Points – areas which are at topographical low points throughout the borough which result in small, discrete areas of deep surface water ponding
- Sewer Flood Risk – areas where extensive and deep surface water flooding is likely to be the influence of sewer flooding mechanisms alongside pluvial and groundwater sources; and
- Fluvial Flood Risk - areas where extensive and deep surface water flooding is likely to be the influence of fluvial flooding mechanisms (alongside pluvial, groundwater and sewer flooding sources)

CDA ID	Location
Group4_064	Large catchment area in North Waltham Forest from Hale End in the east through to the River Lea in the west.
Group4_067	The A406 North Circular at the Cooked Billet Roundabout area and Walthamstow east.
Group4_054	Catchment area north of central Walthamstow including areas such as Heron Close near the intersection of Priors Croft and North Countess Road.
Group4_048	Extensive Fillebrooke drainage catchment beginning in Upper Walthamstow through to Leyton.
Group4_047	Leyton Grange and Primrose Road, Leyton catchment area.

Locations of the 5 main CDA areas as illustrated in Figure 3 below.

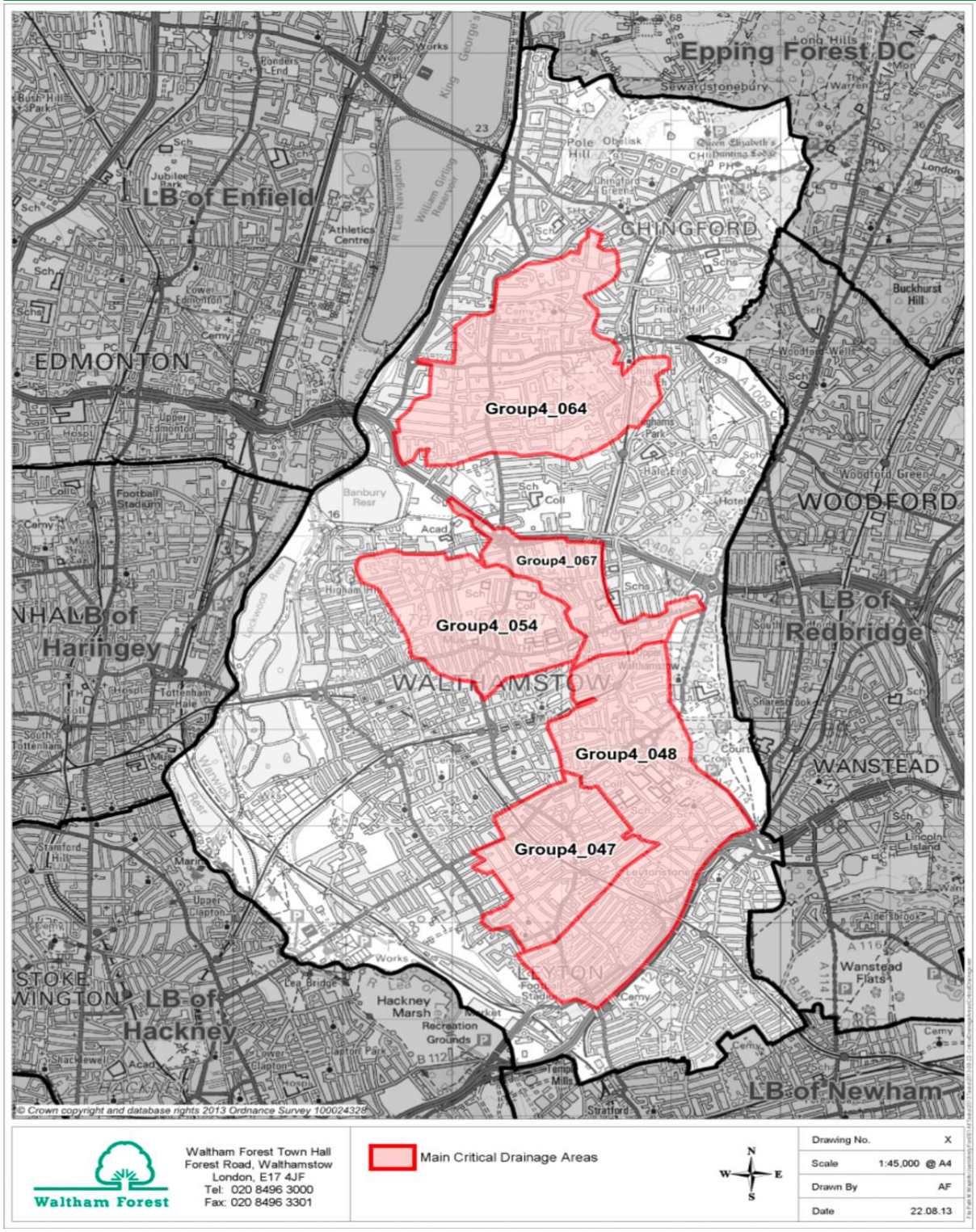


Figure 3: Main Critical Drainage Areas within LBWF

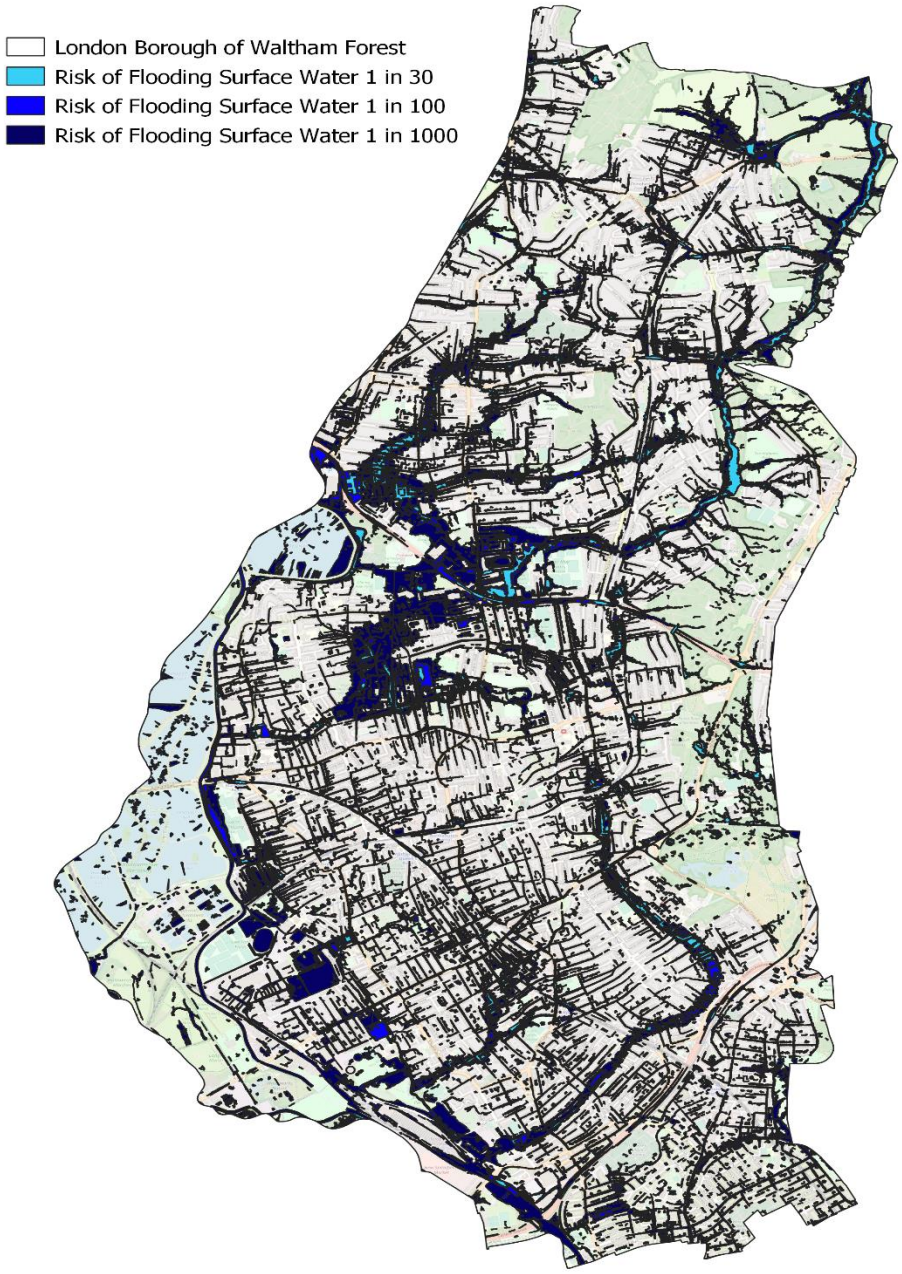


Figure 4: Risk of flooding from surface water, Environment Agency data set

The map above shows indicative areas at risk of surface water flooding during a 1 in 30, 1 in 100 and 1 in 1000-year flood event. A description of flood event return periods can be found in Appendix A. As this map only gives indicative surface water flood risk across the borough, it is not suitable to determine individual property level flood risk.

The dataset used in this map has been provided by the Environment Agency.

2.5 Historic Flood Records

Since 2006 the Council has maintained a detailed record of all reported flooding incidents in the borough. Based on this data, records indicate that there were flood events of significance in 2007, 2009, 2012 and 2016, where multiple locations were affected at the same time. The locations of flooding in 2007 and 2009 are detailed within the 2011 Level 2 Strategic Flood Risk Assessment (SFRA). This is currently in the process of being updated by the local plan to take into consideration future development sites and the flood events of significance that have taken place since 2011. However, it should be noted that the above-mentioned flood events are generally very localised to smaller specific areas and widespread borough-wide flood events are not commonplace.

All reported incidents of flooding in July and August 2021 are shown in Figure 5 below. High concentrations can clearly be seen in the centre and south of the borough, particularly around the Wood Street and Upper Leytonstone areas which are located along the route of the Fillebrook, a culverted watercourse that discharges into the River Lea in the southwest of the borough. Other areas with high concentrations of flooding incidents can be seen along the western edge of the borough in the Coppermill and Leyton areas, within the River Lea and Dagenham Brook catchments, and in the area north of Forest Road in the vicinity of Lloyd Park.

Of the locations reported to have been affected by property flooding in July and August 2021, at least 14 of these have been affected by flooding in the past, based on the Councils historic records. These locations are shown in yellow in Figure 5, and are mainly concentrated around the Wood Street and Upper Leytonstone areas within the Fillebrook CDA. This includes locations such as Brooke Road, Oliver Road, Peterborough Road, Wadley Road, Esther Road and Kings Passage, which have featured prominently in previous flood events. Beyond official Council records there is further historic evidence to support flooding incidents in these locations in the past, as well as anecdotal evidence from residents and stakeholders in these areas, suggesting that flooding has occurred repeatedly over a large number of years.

It is however important to note that there are many locations across the borough that had been subject to previous flood events, based on Council records, that did not flood in July and August 2021.

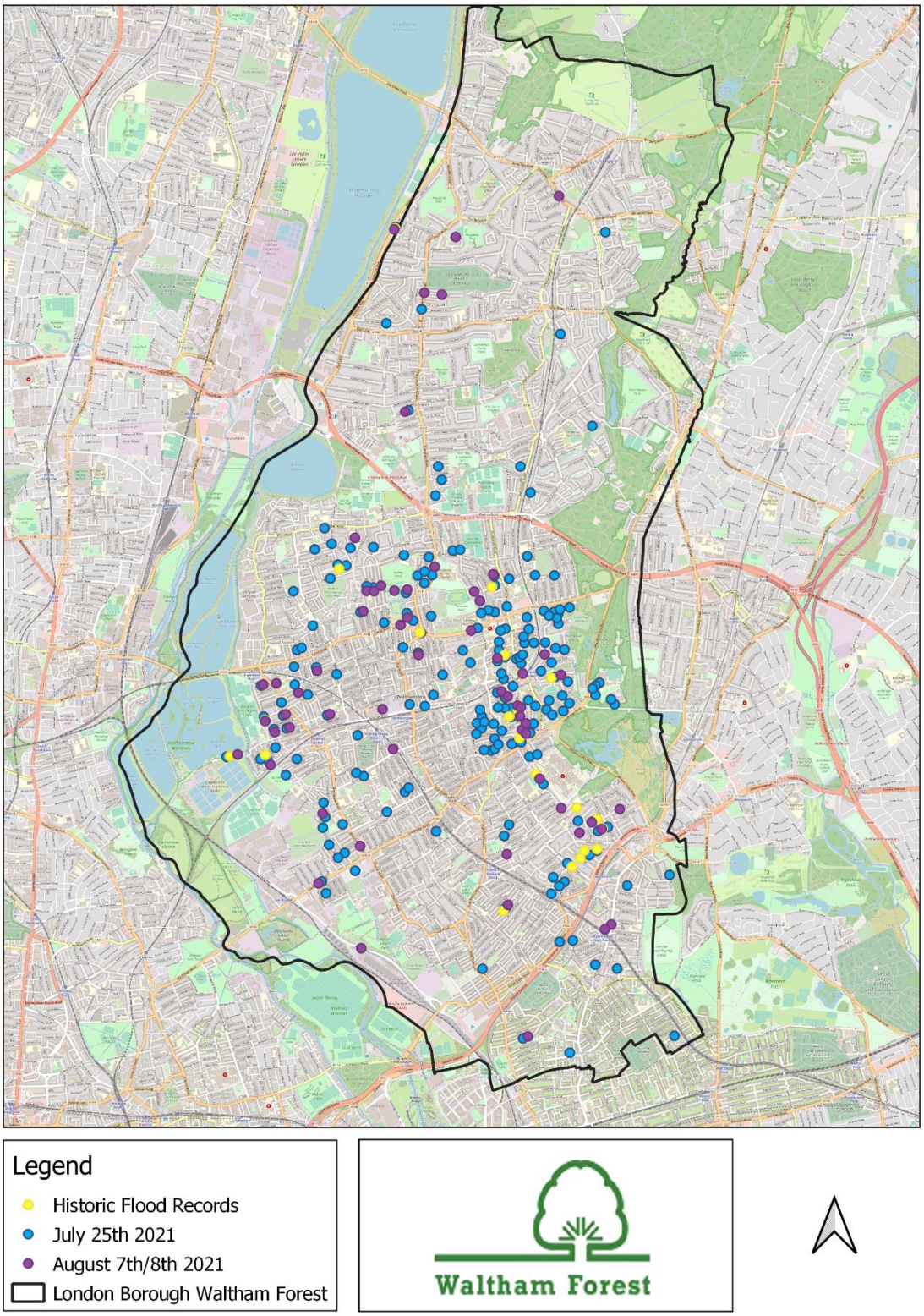


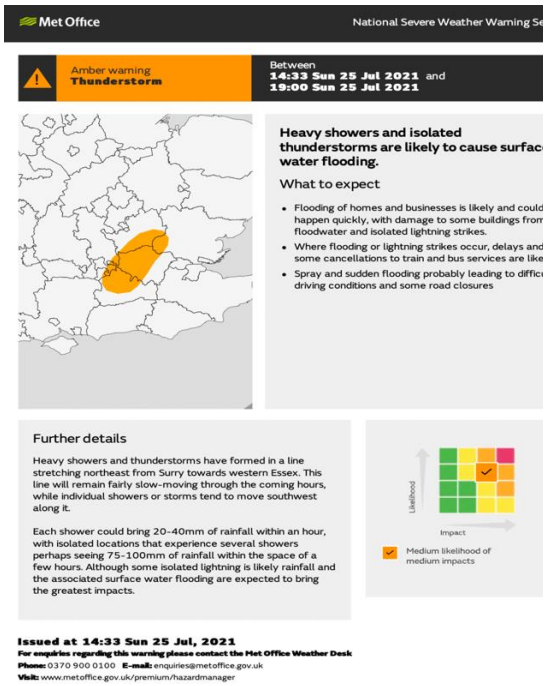
Figure 5: Relevant historic flood records and 2021 reports received

3. Flood Investigation

3.1 Weather Conditions and Rainfall Data

The UK's official weather service, the Met Office, is responsible for issuing weather warnings, which provide as much advance notice of severe weather events as possible. This includes the likely level of impact that could potentially be caused by severe weather. Their warnings are designed to let communities, RMA's and emergency responders understand what those impacts will be. This is the primary source of information for the LLFA when severe weather is expected.

At 14.33 on Sunday the 25th of July, the Met Office issued an amber weather warning for thunderstorms across Greater London until 19:00 that evening.



Met Office — National Severe Weather Warning Se

Amber warning
Thunderstorm

Between
14:33 Sun 25 Jul 2021 and
19:00 Sun 25 Jul 2021

Heavy showers and isolated thunderstorms are likely to cause surfac water flooding.

What to expect

- Flooding of homes and businesses is likely and could happen quickly, with damage to some buildings from floodwater and isolated lightning strikes.
- Where flooding or lightning strikes occur, delays and some cancellations to train and bus services are like
- Spray and sudden flooding probably leading to diffic driving conditions and some road closures

Further details

Heavy showers and thunderstorms have formed in a line stretching northeast from Surry towards western Essex. This line will remain fairly slow-moving through the coming hours, while individual showers or storms tend to move southwest along it.

Each shower could bring 20-40mm of rainfall within an hour, with isolated locations that experience several showers perhaps seeing 75-100mm of rainfall within the space of a few hours. Although some isolated lightning is likely rainfall and the associated surface water flooding are expected to bring the greatest impacts.

Likelihood
Impact
Medium likelihood of medium impacts

Issued at 14:33 Sun 25 Jul, 2021
For enquiries regarding this warning please contact the Met Office Weather Desk
Phone: 0370 900 0100 **E-mail:** enquiries@metoffice.gov.uk
Visit: www.metoffice.gov.uk/premium/hazardmanager

Source: Metoffice.gov.uk

The amber warning indicated that multiple slow-moving thunderstorms were likely to cause flooding to homes and businesses in a very short space of time. The warning advised of sudden flooding to roads and infrastructure and that there would potentially be delays to public transport services, along with possible road closures.

The warning advised that individual storms could bring between 20-40mm of rainfall within the space of an hour, and areas experiencing more than one storm could see as much as 75-100mm of rainfall within a few hours.

Due to the uncertainty around the locations likely to be impacted and precise anticipated rainfall totals, the amber warning was only issued at 14.33. The ability to predict precise locations that will be impacted and to what degree, is a key challenge. Often with thunderstorms there can be less confidence of the impact and precise locations until closer to the event itself. This can make it difficult for RMA's to plan and prepare incident response.

Between the hours of 14:00 and 17:00 on Sunday 25th July some areas of the borough experienced over 80mm of rainfall based on available radar data. During the most intense parts of the storm, over 26mm of rain fell within a 15-minute period This overwhelmed the surface water sewer network in many places, which in turn resulted in areas being inundated with flood water.

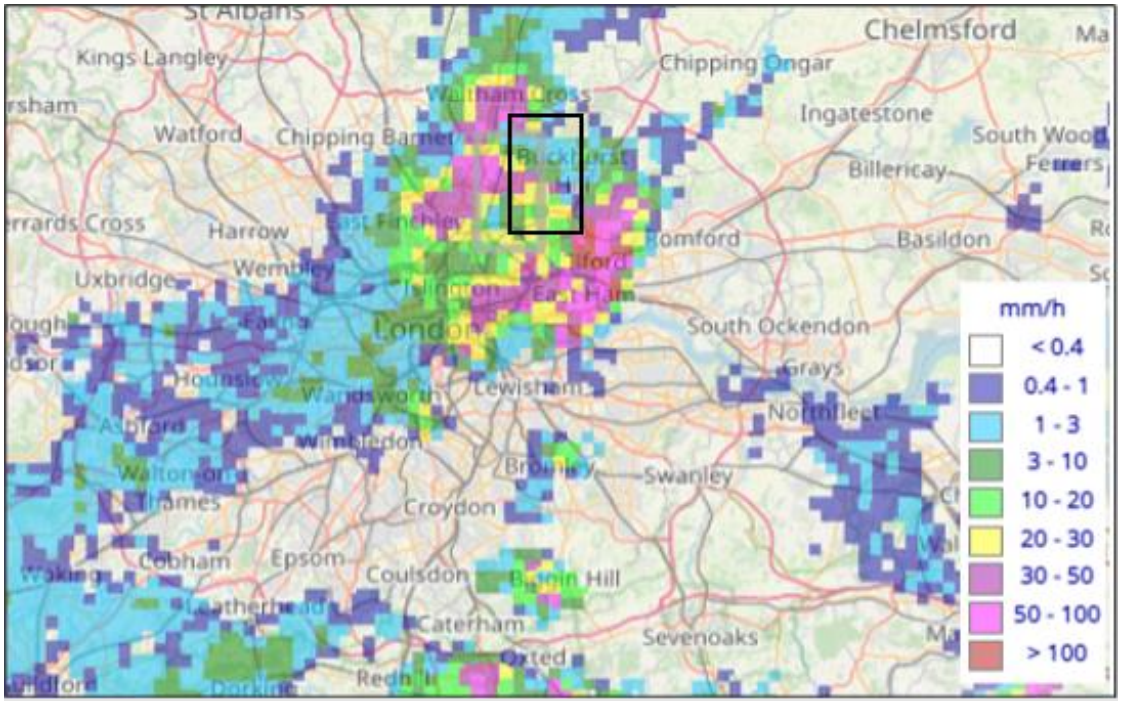
Environment Agency rainfall data at their Chalk Bridge gauge, indicates the flooding which occurred in July, was a 1 in 17-year frequency storm event, or approximately a 6% AEP (Annual Exceedance Probability). The Annual Exceedance Probability is the chance or probability of a natural hazard event, such as rainfall or a flood event occurring annually and is usually expressed as a percentage. A full explanation is illustrated in Appendix A.

However, it is important to note that the above storm return periods are based on the rainfall received directly at the EA Chalk Bridge rainfall gauge site, whereas the local data detailed above indicates rainfall levels of between 50-80mm, or more in some places. This equates to more than a 1 in 100-year storm return period. Thames Water's calculations also suggest that the storm return period on the 25th July far exceeded EA's estimations, and was in fact close to a 1 in 170-year event at some locations across the borough. This would have placed extreme pressure on the surface water sewer network, which is only designed to withstand a maximum of 1 in 30-year event, subsequently overwhelming it in many places.

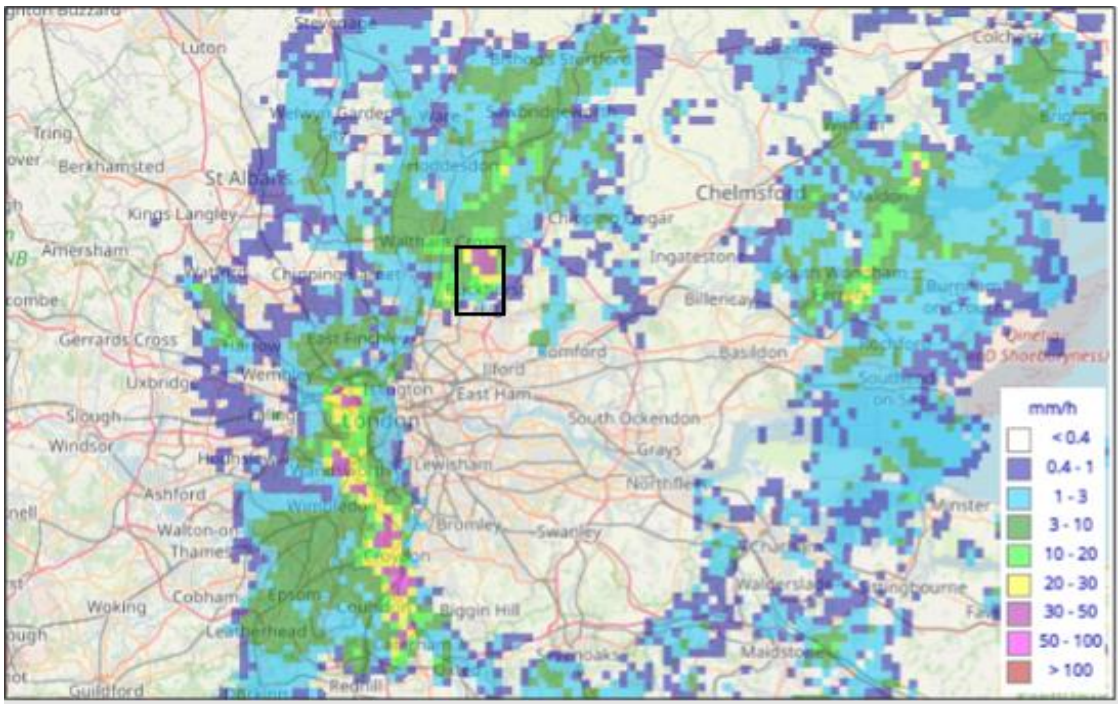
Following the 25th July event, Waltham Forest experienced further storms on the weekend of 7th and 8th August 2021. On this occasion, no formal thunderstorm or rainfall warnings were issued by the Met Office for the London Borough of Waltham Forest. Flood guidance statements were however issued by the Met Office on both mornings which indicated a low likelihood of flooding with a minor impact.

Between 05:00 and 12:00 on 7th August, some parts of Waltham Forest experienced a further 42mm of rainfall. This was followed by lighter showers into the afternoon and early morning of August the 8th. This resulted in further widespread surface water and property flooding across the borough. Thames Water calculated that the storm return period on August 7th was approximately a 1 in 7-year event.

The following radar images give an indication of the storm movement across the borough during the peak of both events, with indicative rainfall in mm per hour. A full set of images can be found in Appendix B.



July 25th 15:00 rainfall mm/h



August 7th 11:00 rainfall mm/h

3.2 Flood Locations and Extent

During and following the storm events on 25th July, and then 7th and 8th August 2021, Waltham Forest experienced widespread surface water and property flooding.

The worst affected locations within Waltham Forest were predominantly in the south and east of the borough, with Wood Street Ward being the most heavily impacted followed by parts of Leytonstone, Leyton, St James Street, Lloyd Park, Chapel End and Higham Hill, amongst others. A sizeable proportion of flooding incidents were concentrated around the path of the Fillebrook - a culverted watercourse that runs through Wood Street and Leytonstone before discharging into the River Lea in the southwest of the borough. This included numerous flooding incidents in locations such as Brooke Road, Oliver Road, Peterborough Road, Wadley Road and Esther Road, all of which were severely impacted.

A detailed record of locations subject to flooding across both storm events has been compiled from a range of sources including partner RMA's (primarily TW and the EA), reports made directly to LBWF, and community reports via local Elected Members and on social media. Flooding locations have been plotted as shown on Figure 6 below. A full list of locations is also included in Appendix C.

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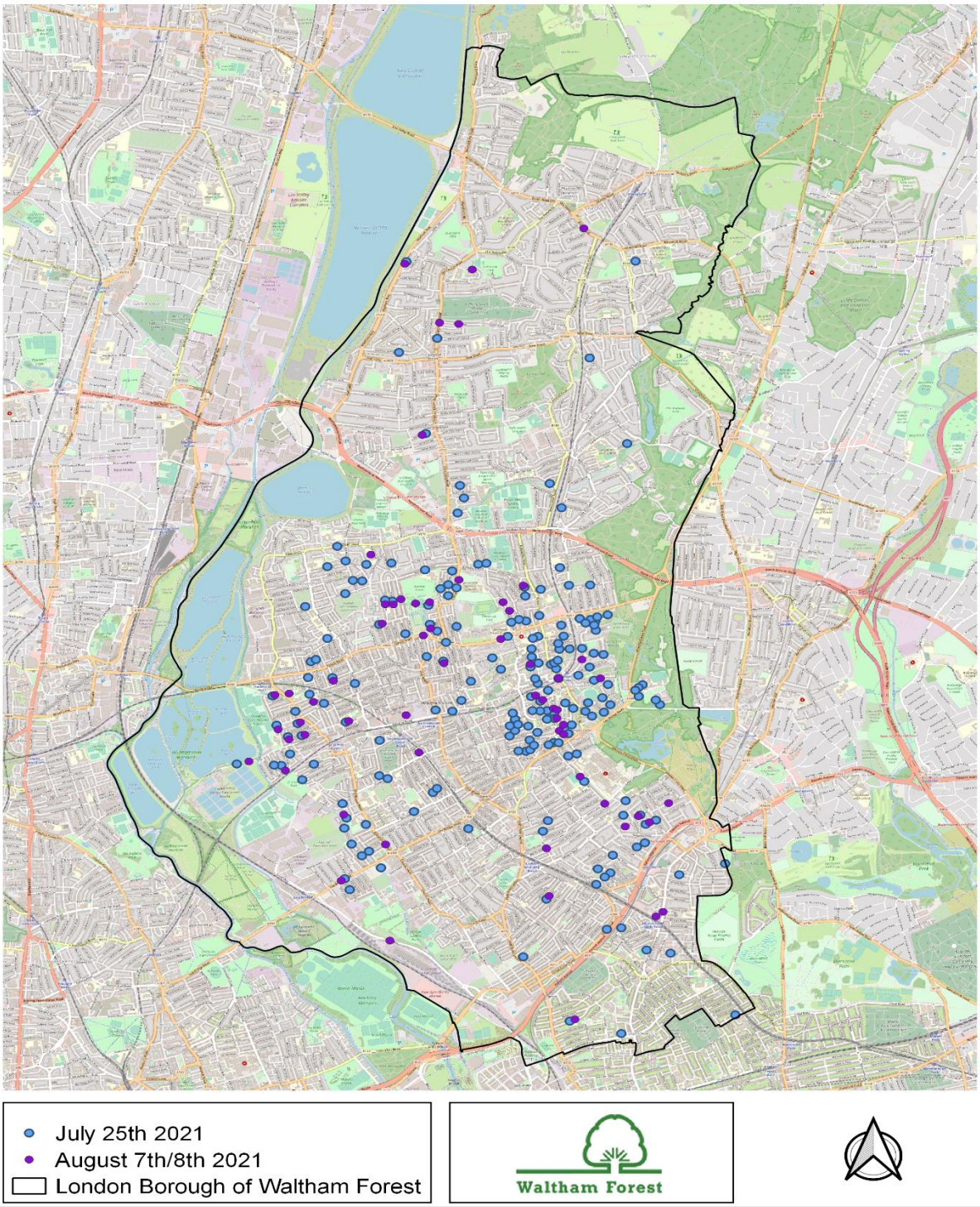


Figure 6: Flooding reports on July 25th and 7th 8th August 2021

3.3 Likely Causes of Flooding

The evidence within this report clearly shows that the amount of rainfall received during these flood events was extreme and fell within a very short space of time.

LBWF is an urban environment and there are limited areas for rainfall to naturally infiltrate the ground. The impact this would have had during both events, is that the vast majority of rainfall would have been attempting to drain through the existing surface water drainage systems.

Under normal rainfall conditions, highway gullies within the borough would collect surface water runoff and convey these flows into the Thames Water sewer system. Given the sheer volume of rainfall that was received in such a short space of time, it is evident that both the surface water sewer system and the highway drainage would have reached capacity extremely quickly. Subsequent rainfall received at this point would have been a major contributing factor to the flooding, as it was not able to follow its normal flow path.

It is also likely that there would have been increased overland flows in many places, where surface water could not access the drainage systems as it would normally. This would have added increased pressure to topographical low points within the borough, further increasing flooding in some locations.

80mm of rainfall fell in some locations on the 25th of July, which was approaching a 1 in 170-year storm return period. Surface water drainage systems are not designed to convey this amount of rainfall in a short space of time and ultimately this would have resulted in the surcharging of water into the nearby environment.

Thames Water have confirmed that their sewer system is only designed to withstand a maximum of a 1 in 30 years storm event. Therefore, the impact on the sewer system would have been so severe that in most places the highway drainage gullies would have been unable to drain to an overwhelmed sewer system.

It is important to note however, that the TW surface water sewer is only one part of the drainage system. Even if the sewer system was not at capacity, the sheer volume of rainfall falling so quickly, would have overwhelmed the highway gullies in many places resulting in some degree of flooding.

3.4 Impact on the Community

The flood events on 25th July and 7th and 8th August 2021 caused significant damage and extreme disruption across many locations with the borough. The worst affected areas were Walthamstow, Wood Street, Leyton and Leytonstone.

Widespread flooding, particularly on 25th July 2021, severely impacted a large number of homes, businesses and schools, as well as key health, utilities and highway infrastructure.

During and following the 25th July event, TW received 224 separate reports of internal flooding in the borough, predominantly affecting residential properties but also business premises, commercial properties and schools. On 7th August, TW received a further 25 reports of internal property flooding. A breakdown of the properties affected, based on TW records alone, is set out in table 2 below.

	25th July 2021	**7th August 2021**
Residential	208	19
Commercial	13	6
Schools	3	0
Total	224	25

Table 2 - TWU Sewer Flooding History Database records

While TWU records are understood to be broadly accurate in respect to the number of residential and commercial properties affected, the number of schools impacted is much higher than table 2 suggests, with the Schools Asset Management Team receiving reports of flooding across 28 different school sites, of which at least 10 require significant remedial works.

Additionally, on 25th July, Barts Trust declared a major incident due flooding at Whipps Cross Hospital. Flooding resulted in significant damage to buildings and the hospitals electrical system, which in turn resulted in power outages to a range of services and wards, with the immediate loss of 168 beds and 12 surgical theatres. With assistance from the LFB the Council moved 100 inpatients from the affected buildings to other areas of Whipps Cross or to other hospitals. However, the following day, all planned surgeries were cancelled due to operating theatres being unavailable. In total, 582 planned surgeries and over 100 outpatient appointments were cancelled as a result of the flooding.

Other major incidents of note include flooding and a subsequent electrical power failure in St David's Court, located near to the junction of Forest Road and Wood Street In this specific case, 46 households had to be relocated to alternative temporary accommodation while work took place to restore power to homes and make them habitable.

The impact of the flooding has been significant, both in terms of the number and nature of properties affected, but also the severity and extent of the flood and water damage and its associated longer-term impact.

Resident reports from the Brooke Road area have indicated that flood water reached depths of between 45 – 70cm inside properties, resulting in families being displaced for many months whilst properties are first dried out before substantive remedial works can take place. Photographic evidence of the severity and impact the flooding has had has been provided by a number of residents and some specific examples from the Wood Street South Flood Action Group have been included in Appendix H, highlighting the extent of the flooding on 25th July 2021.

Extensive flood damage was also reported to the Council by at least 10 residents in Forest Road and Clare Road, which are both situated on the alignment of the historic Fillebrooke river. Reports included cars being submerged and subsequently written off by insurers, alongside the severe internal property damage that was caused. Some residents have reported that they have still not been able to return to their property whilst repairs are being carried out as of February 2022.

Resident reports have largely been supported by the councils own operational teams, with areas such as Brooke Road, Oliver Road and West End Avenue in particular requiring significant cleansing and waste collection operations following the flooding. During the clean-up process, Council operatives confirmed that almost every household in these areas had items damaged by flooding that required removal.

Of the 28 schools affected many were forced to shut temporarily, resulting in children being unable to attend school, creating even more disruption in a period of uncertainty and challenge as a result of the Covid-19 pandemic. Of the 10 schools requiring more extensive remedial works as a result of the flooding, St Mary's Church of England Primary School has by far been the most affected. Internal flood depths reached 70cm within just 2 hours, creating significant structural damage, and the repair works are expected to take up to 12 months, with classes having to be taught in portacabins while ethe work is ongoing. Most pertinently, had the flooding occurred on a school day, there would have been significant risk to life, with evacuation procedures put under extreme pressure.

The flooding has had a profound impact on the personal lives, wellbeing and mental health of a large number of residents and businesses. Appendices I and L contain statements from a number of residents on the personal impacts as a result of the flooding. Loss of personal and sentimental belongings along with social, educational and economic disruption have been raised as key and common issues, and will impact many of those affected for some time.

In addition, the financial impact of the flooding on residents and businesses is expected to be significant, again both due to the number of properties affected and

the severity of the damage caused. Following storms Ciara and Dennis in 2020, the Association of British Insurers estimated the average cost of repairing a flooded home to be £32,000. and commercial properties £52,000. Based on this figure the estimated cost of repairing the 208 homes flooded on July 25th could be as high as £6.6m. Initial estimates of the remedial work required at the 10 schools suffering building damage as a result of flooding is estimated to be in the region of £8.2 Million. A breakdown by school is provided in Table 4 below. As detailed above, St Mary's Church of England Primary School is by far the largest contributor, with over £7.7m worth of structural damage. However, it should be noted that these figures do not included any costs associated with temporary classrooms, accommodation and arrangements needed while building repair works takes place. In many cases these costs are reasonably small in comparison to the capital works required, but for St Mary's it is estimated that this will result in a further £500,000 in temporary costs, at a minimum.

School	Estimated Cost of Repairs to Buildings (£)
Thorpe Hall Primary	£150,000
Gwyn Jones Primary	£20,000
Henry Maynard Primary	£134,314
Mission Grove Primary	£12,500
Newport Primary	£5,000
Woodside Primary	TBC
St Marys CE Primary	£7,700,000
Kelmscott Secondary	£70,663
Leytonstone Secondary	£78,000
Holy Family Secondary	£81,000
Total known to date	**£8,251,477**

Table 3 - Estimated repair costs of flood damage to local schools

Overall, the financial impact of the two storm events in July and August is currently expected to be in the region of at £16.4M, as set out in table 4 below. However, this figure is only an estimate and exact costings could be significantly more or less, depending on the size of the dwelling and level of damage. It also does not include the costs associated with remedial works to Whipps Cross hospital, or other temporary and transient costs, which were not available at the time of writing this report.

	Estimated Flood Damage July 25th	Estimated Flood Damage August 7th/8th
Residential	£6,600,000	£608,000
Commercial	£676,000	£312,000
Schools	£8,200,000	-
Total	**£15,500,000**	**£920,000**

Table 4 - Estimated repair costs to homes, businesses and commercial properties across both flood events

3.5 Flood Incident Response

This section outlines the responses received from each of the RMA's that LBWF contacted during the course of writing this report. The responses include what functions were exercised by each RMA in response to the flooding.

3.5.1 Civil Protection Service

The Civil Protection Service supports the Council's emergency arrangements in responding to Major Incidents in support of our residents and businesses, under the Civil Contingencies Act (2004), as well as supporting our multi-agency partners. During a significant flood event the Emergency Services may declare a major incident which would then activate the Multi-Agency Flood Plan (MAFP).

The Emergency Services, including the LFB and Police, attended a range of locations across the borough during the storm event. While emergency service support was required in a number of impacted areas, they did not report any specific risks at the time that required partnership assistance, or indicated that a coordinated multi-agency response was required. Both of which would have activated the Multi-Agency Flood Plan. However, the Council's Gold Command meetings were initiated and the Council's Local Authority Liaison Officer (LALO) was deployed to various locations in support of the Council's tactical response plan while also maintaining ongoing communication with the emergency services. The LALO was deployed to a range of sites to confirm local flood impacts, and identify council support requirements. In total, approximately 160 locations spread across 17 council wards were confirmed to be affected.

While many of the locations affected by flooding were residential, during the storm event the council became aware that Whipps Cross University Hospital was experiencing localised flooding. Whipps Cross Hospital declared a major incident and some of their patients were moved to alternative sites within Barts Health. The LFB deployed a number of appliances to provide support and assistance. As a result of the flooding, the hospital had to cancel all their planned surgery and outpatient appointments for the following day. The council's Town Hall also experienced some basement flooding, and business continuity arrangements were initiated to manage the flooding.

As a result of the heavy rain the council's Housing Service experienced a loss of utilities in St David's Court tower block and evacuated residents due to health and safety concerns. A rest centre was set-up to register approximately 46 displaced residents. All those displaced were either placed in hotel accommodation or chose to stay with friends and family. The LALO attended both St Davids's Court and the Town Hall to confirm the impact and provide support.

On 25th July, Thames Water contacted London Resilience to ask if they had been made aware of any significant issues arising from the storm. At this time London

Resilience had no specific reports relating to Thames Water Assets, however they were aware that it was likely that the surface water sewer network capacity would have been overwhelmed in many locations.

The British Red Cross, which supports all 33 London borough's emergency centres, did not receive any calls for support during or after the storm.

3.5.2 Environment Agency

Over 25th and 26th July 2021, the EA received over 100 calls to its Floodline service. Of these, over 23 were located within the borough of Waltham Forest. Several of these locations were areas known to have experienced surface water flooding in the past and included locations along the Fillebrooke catchment, such as Peterborough Road, Wadley Road, Kings Road and Drayton Road.

Around 16:44 on 25th July the EA's Flood Incident Duty Officer (FIDO) began to receive reports of localised flooding from the River Ching, in Highams Park. Residents' reported that water was surcharging from local drains, and flood water depths in the area were around 50mm (2 inches) deep. The reports detailed water approaching residential properties, and gardens becoming flooded, however, no internal property flooding was reported at these locations at the time.

Alongside Waltham Forest, neighbouring boroughs were also experiencing severe flash flooding. At 16:16 on the 25th of July the EA received a police report relating to severe flooding within LB of Redbridge, stating that flood water was entering gardens and motorists were trapped in vehicles that had become inundated with flood water. Later in the evening, EA incident reports continued to be received relating to Dagenham Brook and localised roads being flooded.

At 20:30 the EA FIDO received an update from operational teams in affected areas, confirming the extent and source of flooding. Reports suggested that flooding was predominantly being caused by surface water, which was exceeding the capacity of the existing surface drainage network.

At 23:36 the EA FIDO received an incident report declaring a major incident at Whipps Cross Hospital. Barts Trust request EA assistance to pump flood water from a basement location which housed one of the main power supplies within the hospital. The action was flagged as an urgent request, as the hospital would possibly have to evacuate up to 800 patients if the power supply was affected. Ultimately, 100 patients were evacuated from the hospital to alternative locations.

At 02:20 the EA FIDO received confirmation that their operations team had commenced pumping at the hospital site. Pumping continued throughout the night and the EA had left the site by 06:00, 26th July.

3.5.3 London Borough of Waltham Forest - Highway Authority Function

On 25th July the Council's Highways Service received its first call relating to the flooding at approximately 3.30pm. By 4pm The Highways Service had mobilised its Term Contractor, Rineys, supported by a team of LBWF officers.

In light of previous flooding history and known high risk areas, the Highway Service prioritised attendance at Turner Road, Brooke Road and Oliver Road in the Wood Street area, where a number of the initial reports had been received from. A large number of additional sites were subsequently attended across the Borough, however once the rain stopped and there was capacity within the sewer network, the water had mostly drained away. Sandbags were deployed to a number of locations, most notably the Town Hall on Forest Road.

On Monday 26th July, immediately following the first storm, the Highways Service suspended its regular gully cleaning programme and diverted resources to the areas most affected by the flooding. During the course of Monday 26th gulleys were cleaned at a number of locations including the Wood Street area. Regular maintenance activities were also suspended, while resources were prioritised attending areas reported to have been affected by flooding to identify any potential further remedial works or activities.

Following the storm events the Highways Service received a significant amount of correspondence, with over 400 reports received through the council's direct communications' channels and over 90 pieces of correspondence from local Councillors. As an immediate response to the flooding, alongside the prioritisation of maintenance and cleansing activities in affected areas, the highways Service provided additional visitor permits and free of charge traders permits for affected properties. To date, 213 additional free of charge visitor permits have been issued, including every house in Brooke Road and Oliver Road.

In addition to the immediate response detailed above, the Director of Highways and Traffic Management has prepared a substantive operational action plan to respond to the events in July and August. Some of the key actions completed include:

- Triaging, processing and responding to over 450 reports received by the service
- Completing a comprehensive street clean of roads in the three main Wards affected by the flooding along the Fillebrook. Parking, Neighbourhoods & contractors working together to deliver maximum impact to the road. Areas completed are;
    - Wood Street Ward (92 roads)
    - Forest Ward (69 roads)
    - Leytonstone Ward (80 roads)
- Temporarily removing parking restrictions to assist residents in the worst affected roads and provided free of charge traders permits
- Reviewing and updating flood risk information on the Council website
- Holding operational meetings with Thames Water and Department for Education
- Holding engagement meetings with local ward councillors and residents

The Highways Service undertook a review of current gully cleansing operations, which was completed in January 2022. This review will lead to changes in the current gully cleansing frequencies, in certain locations that have been affected by the flooding. Alongside this review, the Highways Service are also working to enhance the co-ordinated street cleansing operations. This involves working with parking, neighbourhoods and contractors, to deliver maximum benefit to areas most a risk of flooding. Locations include Wood Street Ward, Forest Ward and Leytonstone Ward.

3.5.4 Thames Water Utilities

The rainfall experienced across both events, particularly July 25th, placed extreme pressure on the TWU surface water sewer network. In many places, the volume of water received within the time period far exceeded design capacity. Thames Water have confirmed that there were no particular locations identified as having network issues or problems during the storms and their sites appeared to have operated to their design criteria; the fundamental problem being the amount of water entering the system substantially exceeded design levels.

There were 10 post flooding clean up visits made to properties that had signs of sewer flooding in Waltham Forest. TWU were not aware of any operational responses being required to Thames Water assets in Waltham Forest during these events.

Following the flood events, TWU have commissioned an independent review to analyse their network performance during the events in more detail. This review will focus on five key objectives which are to: -

- Establish what happened during the storms of 12 and 25 July
- Determine how well Thames waters network performed during those storms
- Identify other factors, such as time of day, which potentially contributed to the flooding
- Recommend how Thames Water can achieve its responsibilities as a flood risk management authority and increase resilience to future extreme events
- Identify wider implications for London's drainage infrastructure and make recommendations to all authorities with surface water management responsibilities to increase resilience across the capital

TWU have indicated that they anticipate their review will be completed by the end of March 2022. Therefore, it has not been possible to include information resulting from their review within this report.

In the interim, TWU have completed an initial internal review following the flooding. The internal review has focused on the following areas:

- A review on the TWU call centre operations during the event
- A review of TWU overall incident response to summer flooding

TWU internal review has identified six key areas for improvement, supported by lessons learnt and 14 actions to address them:

1. Our response to adverse weather warnings
2. Our approach to customer service and ability to respond to contact from customers
3. Our ability to use data to gauge the impact of adverse weather
4. Our communications with stakeholders
5. Our incident response processes 6. Our onsite response.
6. Their onsite response

The full published internal review can be found on the Thames Water website at:

https://www.thameswater.co.uk/about-us/investing-in-our-region/london-flooding-response

Thames Water have also provided a breakdown of how the Brooke Road pumping station operated during both events in Appendix L.

4. Summary of impacts and findings

The sudden and intense rainfall that occurred on 25th July and 7th/8th August 2021 was extreme in nature. The storm events, estimated to be up to a 1 in 170-year occurrence, far exceeded the design capacity of current surface water drainage systems and it is clear that existing surface water flow paths will have quickly reached their capacity, including highway gullies and the surface water sewer system.

The most intense rainfall occurred during the afternoon of July 25th, which resulted in widespread disruption and flooding. At least 200 residential, 13 commercial and 28 schools reported some form of flooding. Estimated flood damage indicates the total cost of repairs across both events could reach as much as £16.4M This figure is however an estimate and could be substantially more or less depending on the individual properties. Statements of impact from local residents have been included in Appendices G, H, I, L and illustrate the profound and lasting impact the flood events have had on the community, well beyond just the financial repercussions.

While there was noticeably less rainfall on August 7th, reports were received of a further 19 residential properties and 6 commercial properties being flooded internally. There were also a high number of reports of roads flooding as outlined in Appendix C.

Of the RMAs that LBWF have engaged and consulted with in preparing this report, all have exercised their functions to some level in response to both flood events.

LBWF's Highways Service mobilised their term contractor on the 25th July, alongside a team of LBWF officers. On Monday 26th July LBWF Highways immediately suspended their regular gully cleaning programme as well as other reactive services, and immediately diverted resources to the areas affected by the flooding. In addition to this immediate response, a longer term action plan has been put in place, and is in the process of being delivered.

The EA received over 100 calls to its Floodline service on 25th July 2021. Reports were largely in areas known to have experienced surface water flooding in the past and included locations along the Fillebrooke catchment, such as Peterborough

Road, Wadley Road, Kings Road and Drayton Road. Whipps Cross Hospital also declared a major incident and the EA subsequently provided pumping assistance in collaboration with the LFB.

The Emergency Planning Team indicated that they had not received any report or specific risks that required any partnership assistance or indicate that a coordinated multi-agency response was required, which would have activated the Multi-Agency Flood Plan. The Council's Gold command meetings were however set up and the council's Local Authority Liaison Officer (LALO) was deployed during the incident to various locations in support of the council's tactical response plan, while still maintaining communication with the emergency services.

Thames Water indicated that they made 10 post flooding clean up visits to properties that had signs of sewer flooding in Waltham Forest. Additionally, they said that they were not aware of any operational responses to their assets being required in Waltham Forest during both events.

5. Recommended Actions

The following recommended actions have been produced to aid all risk management authorities to work collaboratively and to reduce the impacts of future flood events within the borough. LBWF as LLFA will continue to monitor these actions with our partner RMA's and complete its own actions wherever possible and resources allow.

The recommendations made below are the view of the LLFA and do not give the council additional powers to require any RMA to undertake work or enforce recommendations to be completed.

RMA/Stakeholder	Recommendation	Review Date
Civil Protection Service	The existing multi-agency flood plan is currently being revised. Civil Protection Service should ensure that this is published as soon as it has been completed. They should also consider that the updated flood plan takes account of the flooding in July and August 2021, where required.	April 2022
Civil Protection Service	Undertake a review of the Tri-Borough agreement and its future operation during major flooding events within the borough. Ensure all RMAs know the process for triggering major incidents and what	April 2022

	constitutes as a major incident in respect of local flooding.	
Civil Protection Service	When the updated flood plan is published, Civil Protection Service should consider the requirement for a multi-agency incident response exercise, to test the plan and include all key RMA's and stakeholders.	June 2022
LBWF Highways	Undertake a review of gully cleansing operations and frequencies.	Completed January 2022
LBWF LLFA	As the Lead Local Flood Authority, LBWF should consider the need to obtain enhanced flood forecasting analysis from Hydromaster.com. This would enable the LLFA to be able review past flood events, better understand flood risk within the borough and provide more confidence in locations which may be impacted by future rainfall events.	July 2022
LBWF LLFA	The LLFA should continue to explore and develop new flood mitigation schemes in partnership with other RMA's and affected communities wherever possible. This includes SuDS retrofitting and attenuation schemes, where those are a viable option.	Ongoing
LBWF LLFA	As the Lead Local Flood Authority, LBWF should wherever possible, promote the use of SuDS options on a catchment-wide basis to include locations upstream of known communities at risk of flooding.	Ongoing
TWU/LBWF LLFA	Engage with the National Flood Forum and offer support to local flood action groups. The NFF can offer advice to residents and businesses on how to recover following being flooded. This includes property flood resilience, insurance advice and working with communities alongside RMA's.	Ongoing
EA/LBWF LLFA	When supporting local communities at risk within Waltham Borough, residents should be reminded of the Environment Agency flood warning service and to sign up for these via the EA website if not already registered.	Ongoing
EA/LBWF LLFA	Where evidence of flood extents exists from either event, a desktop analysis of the existing surface water flood mapping should take place to identify any required updates.	December 2022

TWU	Undertake reviews of their response during the summer flood events. This should consider overall network performance, incident response and customer contact provision during the events.	Completed November 2021 https://www.thameswater.co.uk/media-library/home/about-us/investing-in-our-region/flooding-review/july-flooding-internal-review.pdf
TWU	Review findings of the TWU independent review and discuss the findings with the LLFA to work with them to formulate an appropriate response to the Oliver Road, Raglan Road, Shernhall Street, Lea Bridge Road and Brooke Road area by identifying catchment-scale solutions.	December 2022 TBC with Thames Water
TWU	Carry out a camera survey of the Fillebrooke to determine any locations requiring sewer cleaning operations and add required works to current programme. The findings of the camera survey should be communicated with affected communities and flood action groups.	April 2022
TWU	Continue with the published planned sewer cleaning programmes across the borough and communicate progress to residents as required.	December 2022 TBC with Thames Water
All RMAs	Should review current procedures for obtaining accurate property numbers affected by flooding, following an event to enable accurate flood data and impact recording.	June 2022
All RMAs	Must continue to support and seek maximum flood risk benefit from proposed pipeline flood mitigation schemes. Including, Brooke Road SuDS, Whipps Cross Hospital and Leyton Sixth Form College	October 2022
Residents and Businesses	All residential and commercial properties must review and install appropriate measures to increase overall network capacity and build	Subject to individual circumstances

	more resilient communities. There are a number of ways in which to attenuate rainfall in homes and properties and a collective approach across catchments will provide a far greater benefit to mitigating some of the flood risk. Replacing concreted areas with more permeable solutions is one example of this. Thames Water have developed rainwater attenuation planters as shown in Appendix O.	
Residents and Businesses	LBWF are currently offering residents and businesses a selection of Property Flood Resilience (PFR) measures that they can purchase, including flood gates, barriers and doors. The Servicestore flood prevention offer should be utilised by all affected residents and businesses where possible and appropriate. Further details of this offer are shown in Appendix P. It should be noted that not all PFR measures will be suitable for certain types of flooding. Basement and groundwater flooding may require specialist waterproofing which meets BS8102:2009 standards. It is advised that where properties experience this source of flooding that they seek an independent property survey to be conducted, to find the most appropriate flood protection.	Subject to individual circumstances
Residents and Businesses	Residents and businesses should create their own personal flood plans to better protect themselves against future flood events. Further information can be found on the Environment Agency website: Personal flood plan - GOV.UK (www.gov.uk)	Ongoing

6. Next Steps

The recommendations outlined in section 5 will be monitored by LBWF as the LLFA. We will continue to work in partnership with our partner RMAs and local communities to raise the recommendations and encourage them to be implemented.

LBWF will work closely with TWU and the EA to pursue options for capital drainage schemes within the borough and our CDA's, subject to scheme viability and budgets being made available.

In 2018 the LBWF Surface Water Investigations project assessed the predicted flood risk from surface water flooding within three CDA's - South Chingford, Fillebrook and Chestnuts Showground. An options appraisal of potential flood mitigation schemes was carried out. A number of these schemes are subsequently being developed and are outlined in Appendix N.

Any new flood mitigation options suggested will need to be prioritised against existing projects and provision of benefit cost assessments.

Any major works requiring capital investment will be considered through the Department for Environment Food and Rural Affairs (Defra) funding programme alongside local levy funding administered by the Regional Flood and Coastal Committee (RFCC) and other local funding schemes. The RMAs will continue to work together to engage with the communities affected and to identify all potential options for each location reduce flood risk across Waltham Forest.

Communities should be prepared for more similar extreme weather events in the future, such as heavy and intense downpours, often at short notice. Climate change could make these types of events more common, and residents should consider creating personal flood plans to help manage future impacts on their homes and businesses. Residents and communities have the ability to provide extra capacity to the surface water sewer network, by methods such as SuDS retrofitting and replacing concreted areas with more permeable solutions. There are also rainwater attenuation options such as those shown in Appendix O. Property Flood Resilience should also be considered by home and business owners, however it is noted that in some instances this may not be suitable.

LBWF will continue to work with RMAs and communities to highlight flood mitigation options available to the community and ultimately build community resilience overall.

7. Conclusion

The rainfall that fell across Waltham Forest Borough during both events was sudden, intense and extreme in nature and in some locations, such as Brooke Street and Oliver Road, this equated to over a 1 in 170-year rainfall event. As a result, the surface water across the borough overwhelmed Thames Water's sewer network. This resulted in numerous properties, businesses, schools and roads being flooded.

The impact on the community was felt across a very wide area, with major financial, social, economic and welfare impacts as result. Flood damage estimates equate to over £16.4M. Some residents have still not been able to return to their properties whilst repairs are undertaken. St Marys CE school is temporarily teaching children from portacabins until structural repairs are completed. Whipps Cross Hospital declared a major incident and experienced severe disruption to its service.

Recommendations in Section 5 are given for all RMAs and will be closely monitored by LBWF in collaboration with its partners. These include known capacity constraints, considering SUDS and ways to build community resilience against future flooding. The recommendations made are the view of the LLFA and do not give the council additional powers to require any RMA to undertake work.

It is recognised that there is unlikely to be one single action that will mitigate all flood risk within LBWF in the future, certainly to the degree of that witnessed on July 25th 2021, and climate change is clearly one of the most prominent contributory factors. However, there are a number of steps that can be taken in the short, medium and long term to reduce flood risk across the borough. These will undoubtedly require significant investment to build community resilience and improve, increase and enhance surface water network capacity, and all RMAs will need to actively consider a combination of flood mitigation options, including community SUDS schemes, alongside any future surface water sewer upgrades.

Residents will need to play a key role in addressing their own flood risk, alongside any support that RMA's can offer. Building borough-wide community resilience is imperative to combat the future threat of climate change and severe weather events. Residents and businesses should have robust flood plans in place and (where suitable) property flood resilience measures installed. A recent survey of one street identified that all 140 properties had their front gardens concreted over, as a prime example of the how each household can contribute, posively and negatively, to flood risk and mitigation.

Furthermore, it is key that local residents and businesses continue to report any incidents of flooding of property, open spaces and roads. This helps build and contribute to local knowledge around flooding patterns which can then help with future risk management and investment.

8. Disclaimer

This report has been prepared as part of London Borough of Waltham Forest's Responsibilities under the flood and water management Act 2010. It is intended to provide context and information with regard to contributing factors and probable cause of the flooding, which flood risk management authorities have relevant flood risk management functions and whether they have exercised or proposed to exercise those functions in response to the flood. The recommendations made are the view of the LLFA and do not give the council additional powers to require any RMA to undertake work or enforce recommendations to be taken forward.

The findings of the report are based on a subjective assessment of the information available by those undertaking the investigation and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event.

The council expressly disclaims responsibility for any error in, or omission from, this report and any supporting technical assessment arising from or in connection with any of the assumptions being incorrect. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the time of preparation and the Council expressly disclaims responsibility for any error in, or omission from, this report arising from or in connection with those opinions, conclusions and any recommendations. The London Borough of Waltham Forest does not accept any liability for the use of this report or its contents by any third party.

9. Appendices

Appendix A - Storm Return Periods

Surface water sewer systems have a limited capacity during storm events. They are not designed to cope with extreme rainfall events and when these occur the capacity of the drainage network can become overwhelmed, leading to localised highway or property flooding. Thames Water sewer systems in Waltham Forest are generally designed to withstand a maximum of a 1 in 30-year storm event.

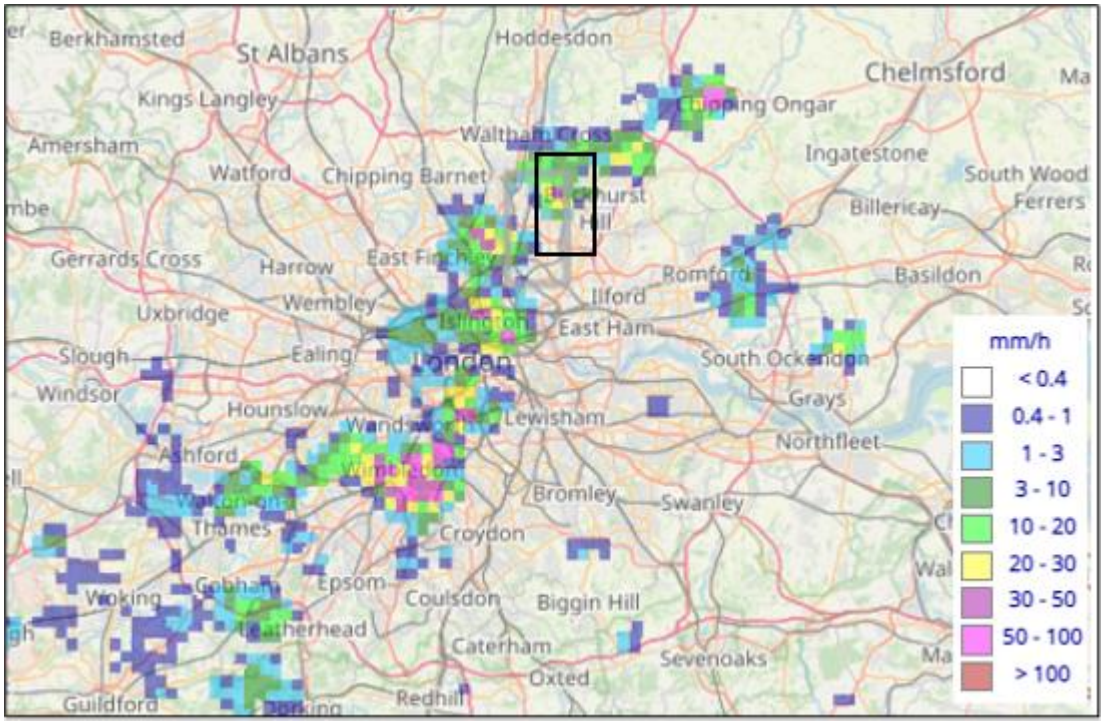
Storm return periods of 1 in 30 years have a 3.3% Annual Exceedance Probability (AEP). The AEP is the chance or probability of a natural event (such as rainfall or flooding) occurring annually and is expressed as a percentage.

Example: A 3.3% exceedance probability rainfall event has a 3.3% chance of occurring in any 1 year, which is equal to once in every 30 years. The following table illustrates the different exceedance probabilities and potential frequency of rainfall events.

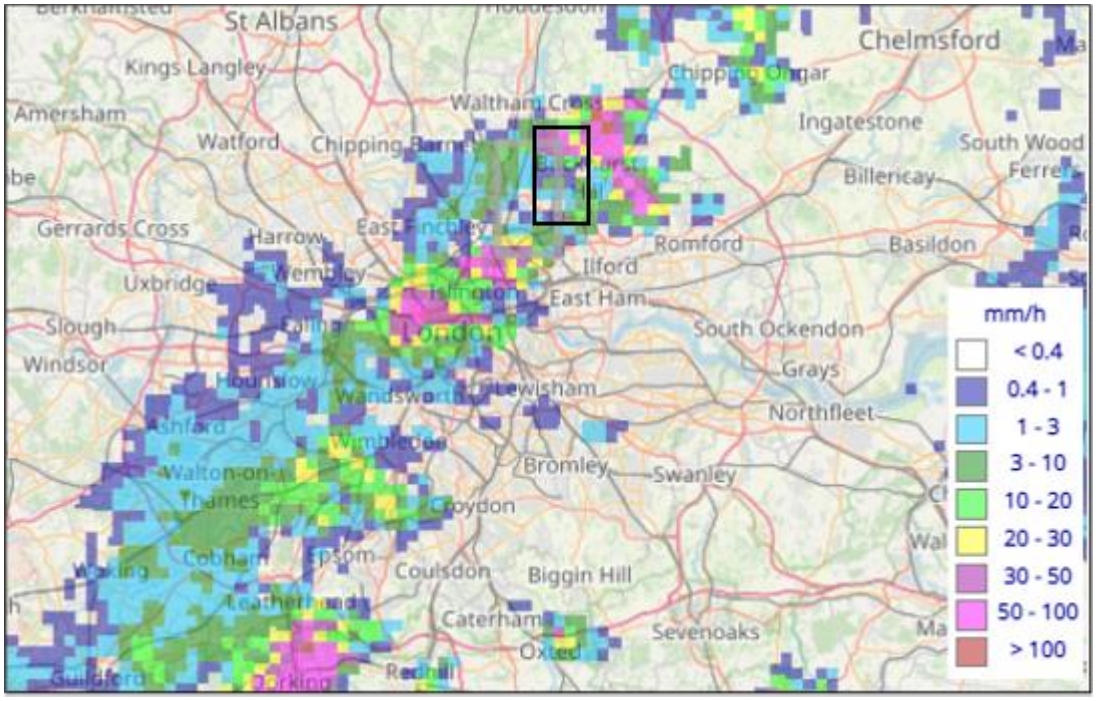
Annual Exceedance Probability (AEP)	Potential Frequency	Rainfall Event Size
1% AEP	1 in 100 years	Larger rainfall event  Smaller rainfall event
2% AEP	1 in 50 years	
3.3% AEP	1 in 30 years **(Surface water sewer maximum capacity)**	
5% AEP	1 in 20 years	
10% AEP	1 in 10 years	
20% AEP	1 in 5 years	
50% AEP	1 in 2 years	
100% AEP	Every year	

Table 5 - Storm return periods

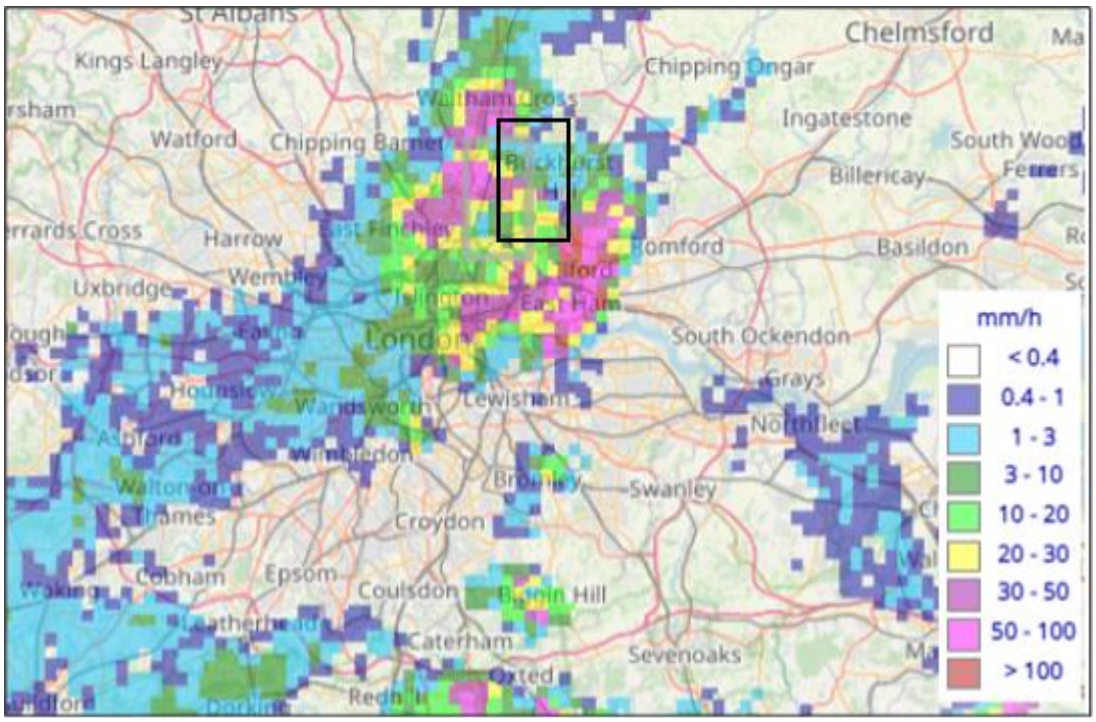
Appendix B – Storm Event Radar Images



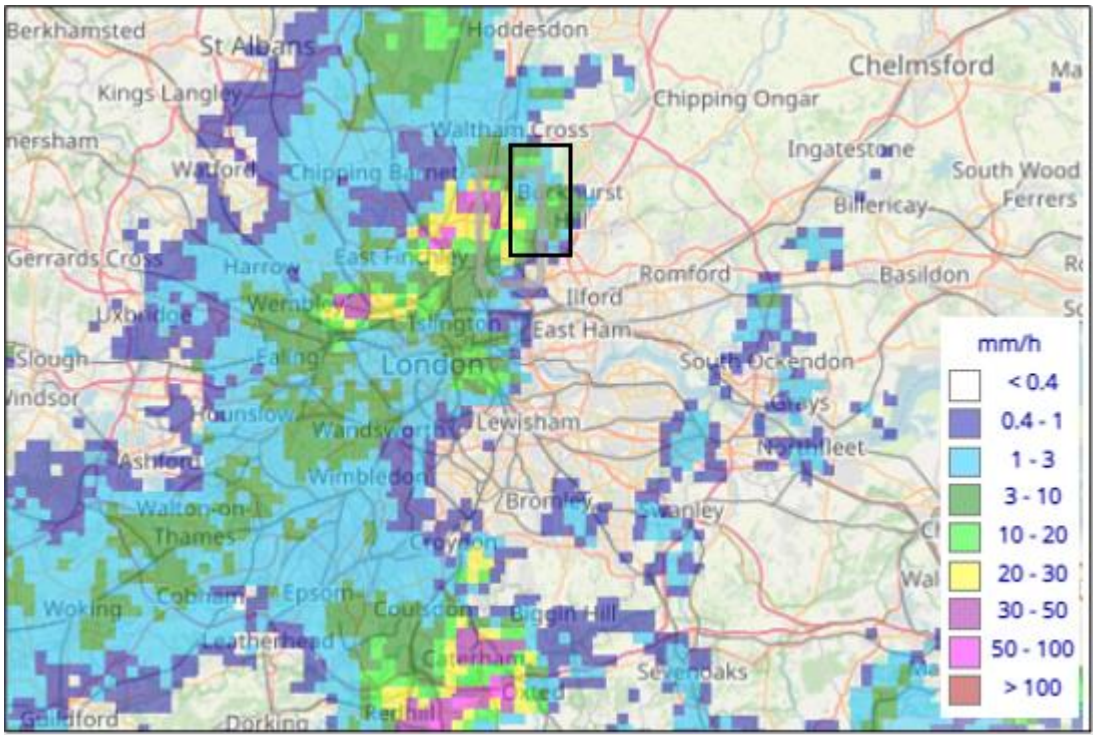
July 25th 14:00 rainfall mm/h



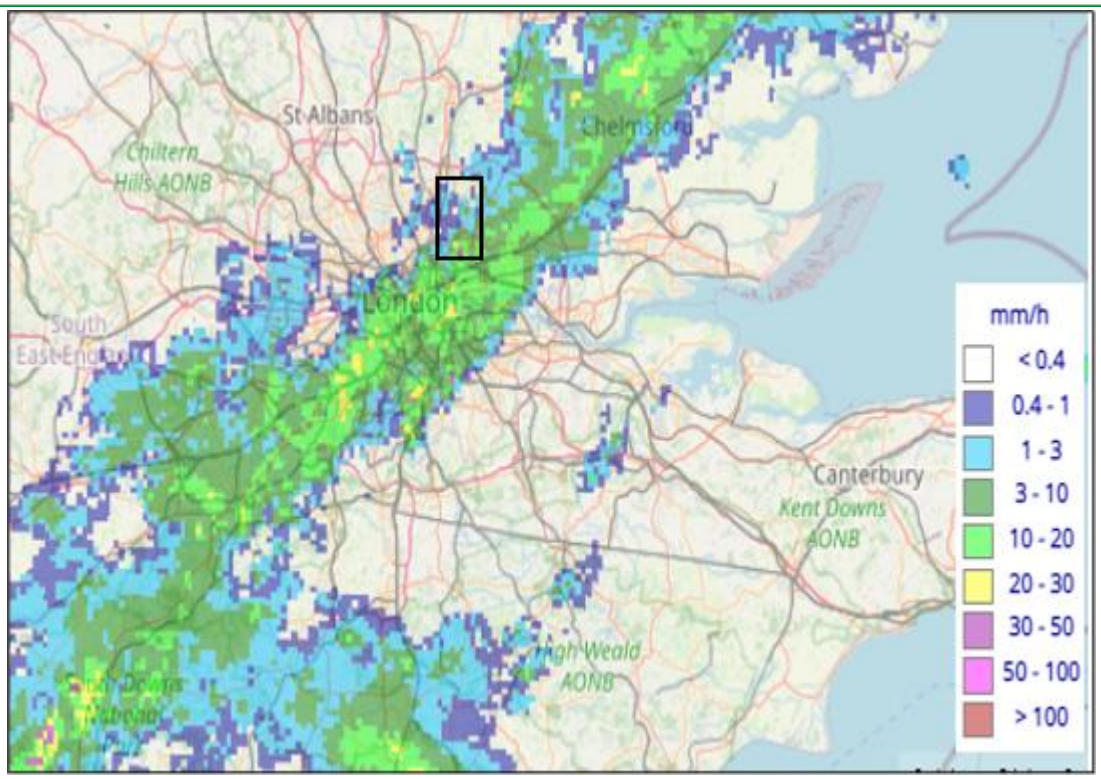
July 25th 15:00 rainfall mm/h



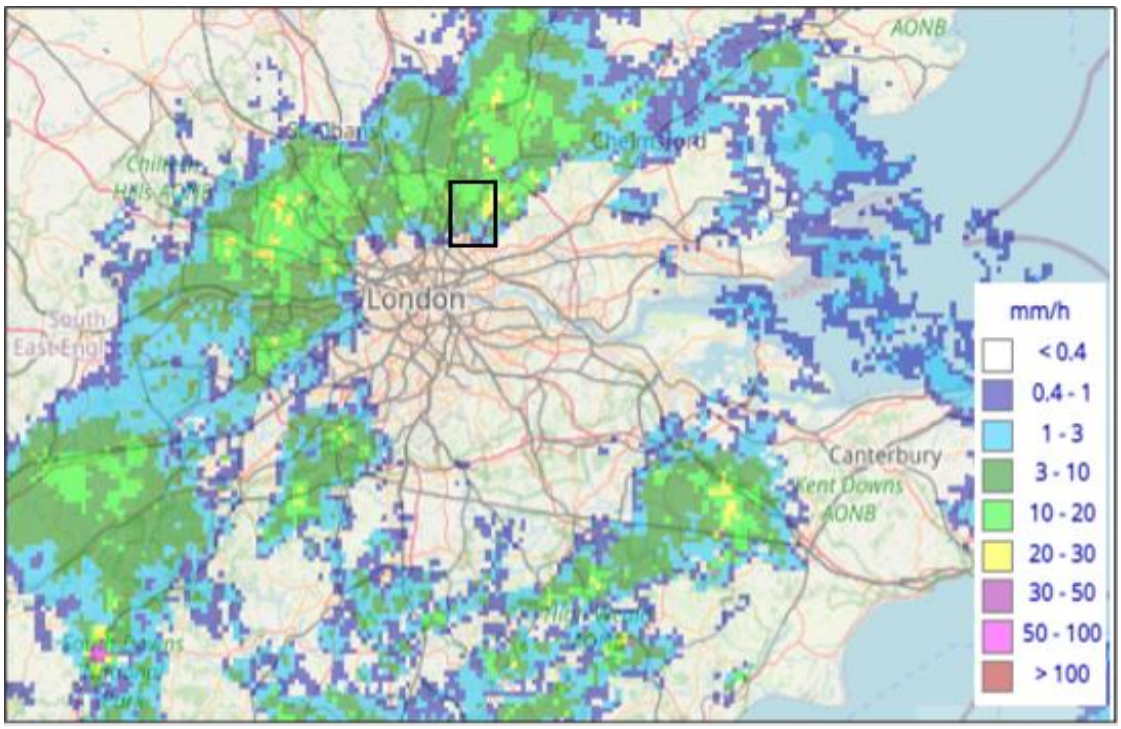
July 25th 16:00 rainfall mm/h



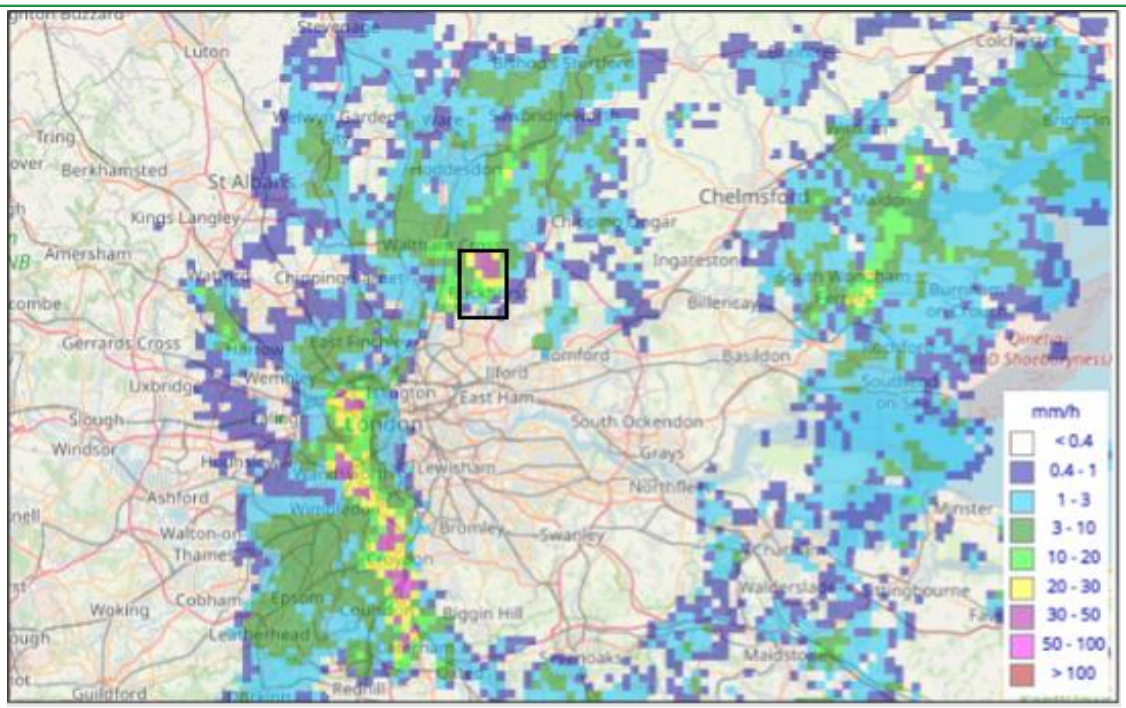
July 25th 17:00 rainfall mm/h



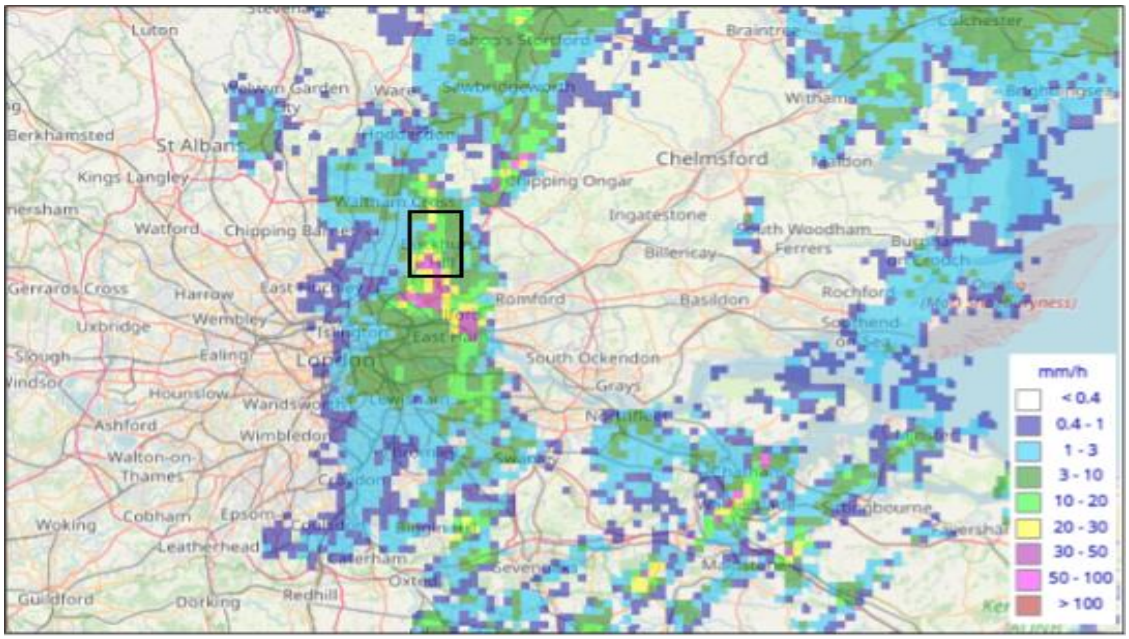
August 7th 07:00 rainfall mm/h



August 7th 09:00 rainfall mm/h



August 7th 11:00 rainfall mm/h



August 7th 11:30 rainfall mm/h

Source: [Dtn.com](Dtn.com) and Hydromaster.com

Appendix C - Total List of Known Roads Flooded During Both Events

The following list of roads affected by flooding has been sourced from all data provided by each RMA, during the course of the investigation. Individual RMA records are listed in Appendix D.

Ward	July 25th	7th / 8th August
Forest	Forest Road, Clare Road, Peterborough Road, West End Avenue, James Lane, Colchester Road, Leigh Road, Abbotts Park Road, Chesterfield Road, Stacey Close.	James Lane, Leigh Road, Peterborough Road.
Chapel End	Aveling Park Road, Beresford Road, Cazenove Road, Chingford Road, Clifford Road, Fulbourne Road, Evesham Road, Kitchener Road, Macdonald Road, Victoria Road, St Johns Road, Empress Avenue, Spruce Hills Road, Marten Road, Ardleigh Terrace, Brettenham Road, Farnan Avenue, Woodend Road.	Sturge Avenue, Woodend Road, Lloyd Park, Spruce Hills Road.
Higham Hill	Heron Close, Millfield Avenue, Warwick Road, Williams Avenue, Priors Croft, Billet Road, Chamberlain Place, Faulkner Mews.	
High Street	Coppermill Lane, Hawarden Road, Mission Grove, Pretoria Avenue, Tenby Road, Wellington Road, Edward Road, York Road, Orchard Street, Haroldstone	Coppermill Lane, Mission Grove, Stoneydown Road, Salop Road, York Road, Hawarden Road, Mission Road, Pretoria Avenue, Tenby Road,

	Road, Salop Road, Cassiobury Road, Newport Road, Chester Road, Blackhorse Road, Hazelwood Road.	Wellington Road, Edward Road, Hazelwood Road, Haroldstone Road.
Hoe Street	Forest Road (Bell Corner), Forest Road (Waltham Forest College), Hoe Street (by Yard Sale), Hoe Street (by McDonalds), Rectory Road, St Mary's Road, Folkestone Road, Byron Road, Prospect Hill, High Street, Grosvenor Park Road, Vestry Road, The Drive.	
Lea Bridge	Bridge Road, Dagenham Road, Hibbert Road, Lea Bridge Road (by Morrison's), Boundary Road, Markmanor Avenue, Blyth Road, Orient Way, Kettlebaston Road, Sunnyside Road, Shortland's Road.	Orient Way
Markhouse	Boundary Road, Wellesley Road, Queens Road, Connaught Road, Tennyson Road, Essex Road, Acacia Road, Devonshire Road, Lynmouth Road, Samantha Close, Tudor Court.	Connaught Road, Queens Road, Albert Road.
William Morris	Bedford Road, Omnibus Way, Winns Avenue, Badlis Road, Fleeming Road, Bromley Road, King Edward Road, Century Road, Walpole Road, Palmerstone Road.	Bedford Road, Carr Road, Fleeming Road, Omnibus Way, Winns Avenue.
Wood Street	Chestnut Avenue South, Chestnut Avenue North,	Brooke Road, Elphinstone Road,

	Greville Road, Bistern Avenue, Elm Road, Brooke Road, Oliver Road, Brunswick Street, Evelyn Road, Fyfield Road, Greenacre Gardens, Greenway Avenue, Radbourne Crescent, Salisbury Road, Shernhall Street, Turner Road, Vallentin Road, Wood St, Barrett Road, Addison Road, Albion Road, Avon Road, Barclay Path and Barclay Road, Beulah Path, Bisterne Avenue, Brandon Road, Brookfield Avenue, Buck Walk, Butterfields, Buxton Drive, College Place, Comely Bank Road, Corbett Road, Cromwell Road, Dean Gardens, Dukes Passage, Eastern Road, Ferndale Avenue, Fernhill Court, Forest Rise, Foresters Drive, Havant Road, Hempstead Road, Hillside Gardens, Hylands Road, Linford Road, Lucerne Grove, Marlowe Road, Maynard Path, Maynard Road, Morgan Avenue, Nagle Close, Oakhurst Close, Oakhurst Gardens, Parkstone Road, Raglan Road, Ravenswood Road, Roland Road, Rosslyn Road, Salters Road, Stocksfield Road, The Forest, The Risings, Tristram Close, Upper Walthamstow Road, Waverley Avenue, Waverley Road, Western Road, Wigram Square, Wilson Street, Winsbeach, Woodlands Road, Woodside	Fyfield Road, Chestnut Avenue South, Greenway Avenue, Raglan Road, Turner Road, Brookfield Avenue, Barrett Road, Elm Road, Maynard Road, Elm Road.

	Park Avenue, Wyatts Lane, Wood Street.	
Leytonstone	Wadley Road, Esther Road, Hainault Road, Kings Road, Kings Passage, Drayton Road, Colworth Road, Fairlop Road, Southwest Road, Bulwer Road, Scarborough Road, Bushwood, Harvey Road.	Alleyway between Shernhall Street and Raglan Road, Esther Road, Kings Road, Orient Way, Wadley Road, Percy Road, Preston Road.
Hale End and Highams Park	Bell Vue Road, Haldan Road, Thorpe Hall Road, Beech Hall Road, The Hale, Woodstock Road, Hale End Road, Manor Way.	Haldan Road
Cathall	Leslie Road, Oakland Road, Lynn Mews, Norman Road,	
Endlebury	Eatons Mead, Church Road, Old Church Road.	Eatons Mead, Peel Close, Alpha Road, Old Church Road.
Larkswood	Parade Gardens, Loxham Road.	
Hatch Lane	Gordon Avenue, Wyemead Crescent	
Valley	Bateman Road, Marmion Road, Marmion Avenue.	Bateman Road
Grove Green	Sidmouth Road, Grove Green Road, Claude Road.	Claude Road
Cann Hall	Vansittart Road.	
Total	**198**	**53**

Appendix D - Individual RMA Flooding Records Provided to LBWF

Thames Water - Sewer Flooding History Database, internal property flooding records:

Ward	**July 25th**	**7th / 8th August**
Forest	22 residential	
Chapel End	2 residential	
Grove Green	1 residential	
Higham Hill	4 residential	
High Street	1 residential	
Hoe Street	1 commercial 1 residential	1 residential 1 commercial
Lea Bridge	4 residential	1 residential
Markhouse		1 residential
William Morris	2 residential	1 residential
Wood Street	10 commercial 3 school 141 residential	10 residential 5 commercial
Leytonstone	26 residential 2 commercial	1 residential
Hale End and Highams Park	2 Residential	1 residential
Cathall	1 residential	
Larkswood	1 residential	1 residential
Valley	1 residential	1 residential
Endlebury		1 residential
Total	**224**	**25**

LBWF - Highway flooding reports and roads requiring waste removal following flooding:

Ward	July 25th	7th / 8th August
Forest	Forest Road, West End Avenue, Peterborough Road	James Lane, Peterborough Road.
Cathall		Leslie Road.
Chapel End	Aveling Park Road, Bedford Road, Beresford Road, Cazenove Road, Chingford Road, Clifford Road, Fulbourne Road (nr Fredrick Bremer), Evesham Road, Kitchener Road, Macdonald Road, Omnibus Way, Victoria Road.	Sturge Avenue, Woodend Road, Chingford Road, Spruce Hills.
Endlebury		Eatons Mead, Peel Close.
Grove Green	Heron Close, Millfield Avenue, Warwick Road, Williams Avenue.	Claude Road.
Higham Hill		
High Street	Coppermill Lane, Hawarden Road, Mission Grove, Pretoria Avenue, Tenby Road, Wellington Road, Edward Road.	Coppermill Lane, Haroldstone Road, Hazelwood Road, Mission Grove, Stoneydown Road, Salop Road, York Road.
Hoe Street	Forest Road (Bell Corner), Forest Road (Waltham Forest College), Hoe Street (by Yard Sale), Hoe Street (by McDonalds), Rectory Road, St Mary's Road, Folkestone Road.	Byron Road, Forest Road by college, Forest Road by William Morris Gallery.
Lea Bridge	Bridge Road, Dagenham Road, Hibbert Road, Lea	

	Bridge Road (by Morrison's).	
Markhouse	Boundary Road, Bridge Road, York Road, Wellesley Road.	Tudor Court, Connaught Road.
William Morris	Badlis Road, Billet Road, Fleeming Road, Winns Avenue.	Bedford Road, Carr Road, Fleeming Road, Omnibus Way, Winns Avenue.
Wood Street	Wood Street, Addison Road, Albion Road, Avon Road, Barclay Path, Barclay Road, Barrett Road, Beulah Path, Bisterne Avenue, Brandon Road, Brooke Road, Brookfield Avenue, Brunswick Street, Buck Walk, Butterfields, Buxton Drive, Chestnut Avenue North, Chestnut Avenue South, College Place, Comely Bank Road, Corbett Road, Cromwell Road, Cuthbert Road, Dean Gardens, Dukes Passage, Eastern Road, Elm Road, Evelyn Road, Ferndale Avenue, Fernhill Court, Forest Rise, Foresters Drive, Fyfield Road, Greenacres Gardens, Greenway Avenue, Greville Road, Havant Road, Hempstead Road, Hillside Gardens, Hylands Road, Linford Road, Lucerne Grove, Marlowe Road, Maynard Path, Maynard Road, Morgan Avenue, Nagle Close, Oakhurst Close, Oakhurst Gardens, Oliver Road, Orchard Street,	Alleyway between Shernhall Street and Raglan Road, Brooke Road, Elphinstone Road, Fyfield Road, Chestnut Avenue South, Greenway Avenue, Raglan Road, Turner Road, Wood Street.

	Parkstone Road, Radbourne Crescent, Raglan Road, Ravenswood Road, Roland Road, Rosslyn Road, Salisbury Road, Salters Road, Shernhall Street, Stocksfield Road, The Forest, The Risings, Tristram Close, Turner Road, Upper Walthamstow Road, Vallentin Road, Waverley Avenue, Western Road, Wigram Square, Wilson Street, Winsbeach, Wood Street, Woodlands Road, Woodside Park Road, Wyatts Lane.	
Leytonstone	Kings Road, Queens Road, Colworth Road, Esther Road, Wadley Road, Fairlop Road, Drayton Road, Southwest Road, Bulwer Road.	High Road, Esther Road, Kings Road, Orient Way, Wadley Road,
Valley		Bateman Road.
Total	**130**	**60**

Environment Agency – Floodline calls received:

Ward	**July 25th**	**7th / 8th August**
Forest	West End Avenue, Colchester Road.	Not provided to date
Cathall	Peterborough Road.	-
Chapel End	Saint Johns Road, Empress Avenue.	-
Hale End and Highams Park	Thorpe Hall Road, Haldan Road.	-
Hatch Lane	Gordon Avenue.	-
High Street	Edward Road.	-
Lea Bridge	Markmanor Avenue, Blyth Road.	-
Larkswood	Parade Gardens.	-
Markhouse	Tudor Court.	-
William Morris	King Edward Road,	-
Wood Street	Vallentin Road, Turner Road, Barrett Road.	-
Leytonstone	Kings Road (near Kings Passage), Drayton Road, Wadley Road, Vallentin Road.	-
Total	**21**	-

Appendix E - Photographs of Known Flooding Locations

Figure F 1 - Turner Road, 7th August

Figure F 2 - Brooke Road, 25th July

Figure F 3 - Peterborough Road, 25th July

Figure F 4 - Peterborough Road, 25th July

Figure F 5 - Brooke Road and Oliver Road 25th July

Figure F 6 - Brooke Road and Oliver Road 25th July

Figure F 7 - Oliver Road 26th July 2021, debris left from flooding

Figure F 8 - Clare Road Forest Road Junction

Figure F 9 - Clare Road Forest Road Junction

Figure F 10 - Forest Road Flooding

Figure F 11 - Forest Road Flooding

Appendix F - Flood Damage Wood Street South Flood Action Group

Figure F 12 - Flood damage to home

Figure F 13 - Flood damage to home

Figure F 14 - Flood damage to home

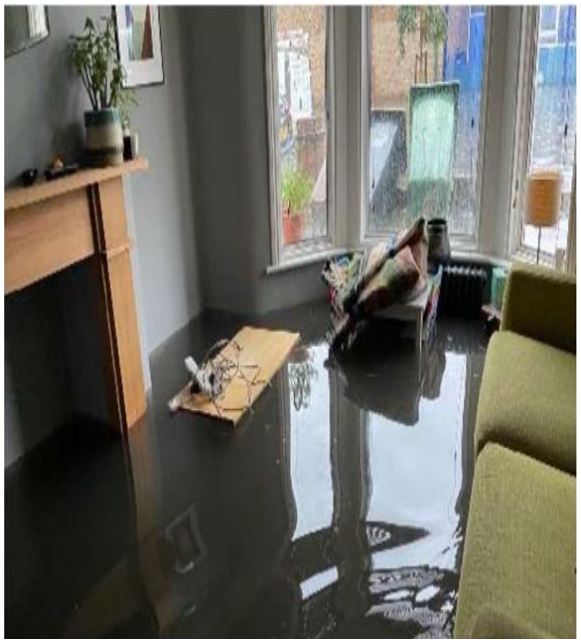


Figure F 15 - Flood damage to home

Figure F 16 - Brooke Road 25th July

Figure F 17 - St Marys CE School temporary portacabins

Appendix G - Residents and Councillors - Flooding Insight Data

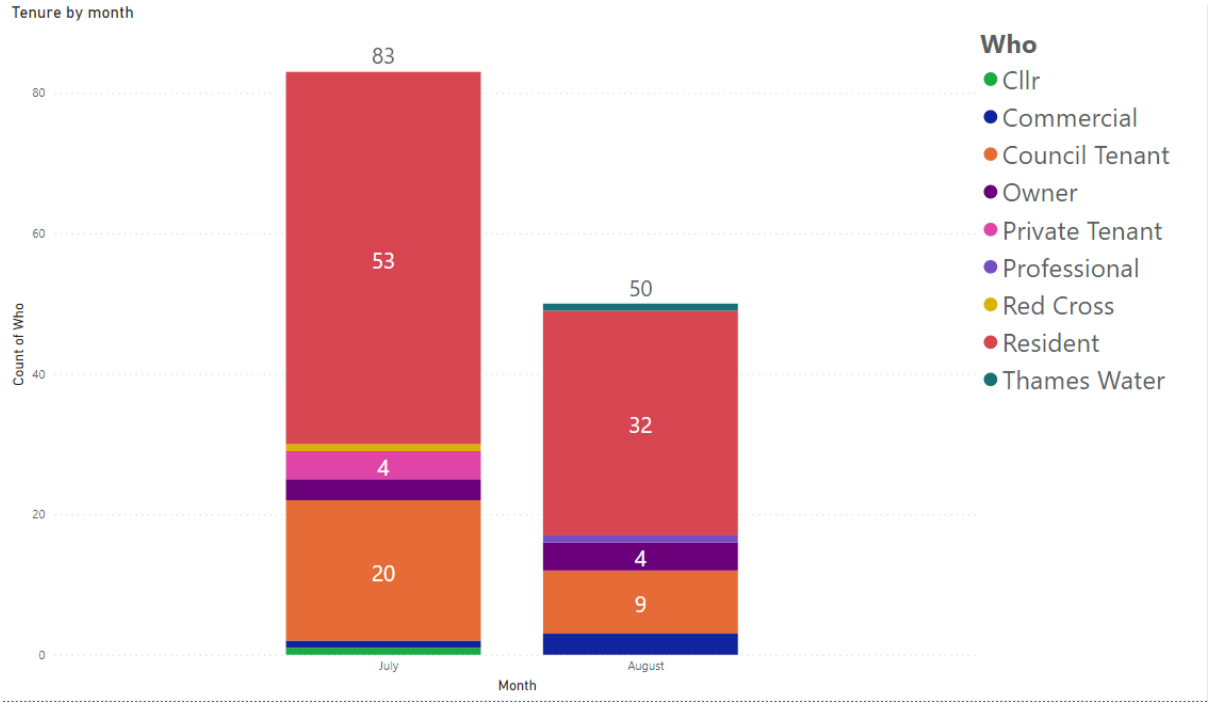
This following information sets out a snapshot of some core data and insight that was gathered by LB Waltham Forest during the flood events in July and August. This data encompasses reports made by residents and local ward councillors.

Flood calls – Who was in touch?

Over 83 calls were received regarding flooding on the 25th July. Calls were received between 15:04 at the last call at 23:54.

Over 50 calls received on the 7th August regarding flooding. 1st call was at 10:51 and the last call 14:47

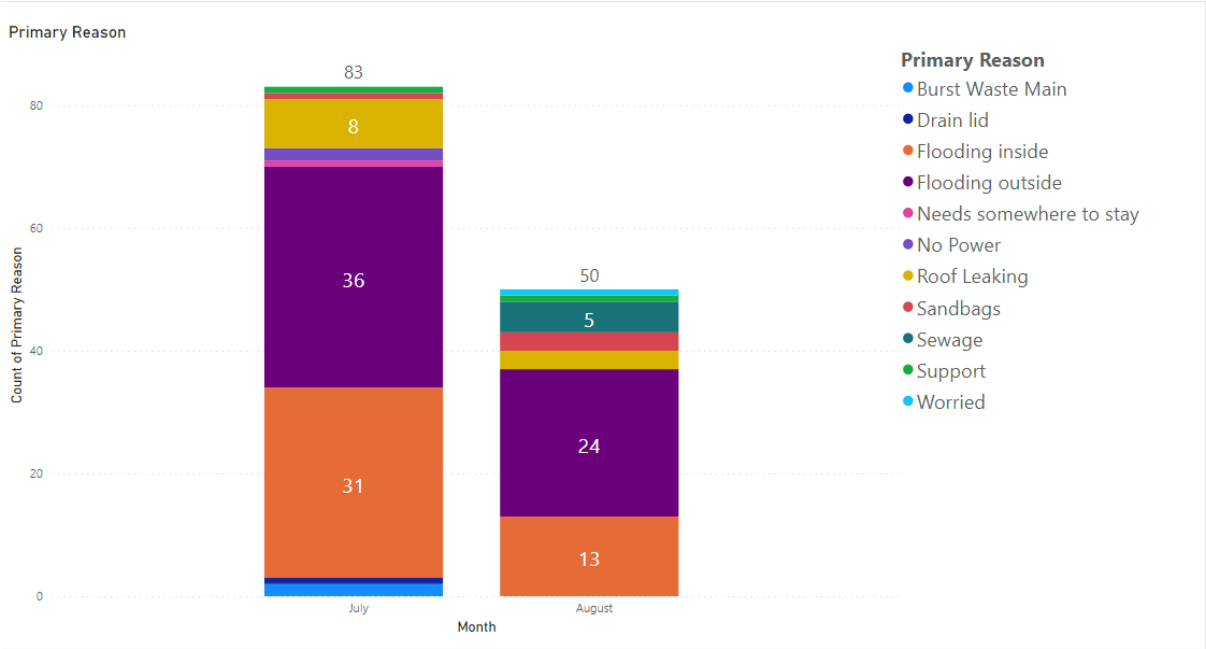
The highest number of calls were logged as 'Resident' which indicates this was a call which sits in multiple categories, or their tenure could not be identified



Flood calls received - primary reasons

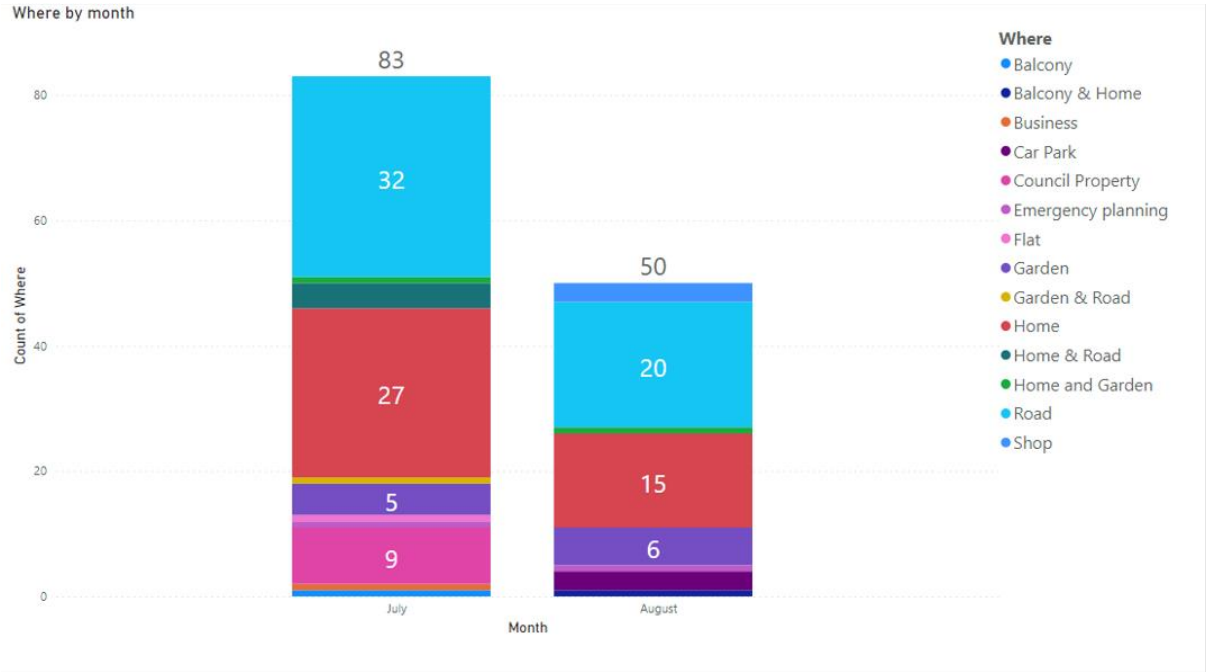
The highest amount of calls for both floods was due to flooding outside. When adding all the external categories above 68 calls (51%) were for calls affecting areas other than personal property.

When calling about their property many calls were because people were unclear what to do, through to – mainly in the first incident – people actively needing support.



Flood calls – where?

The data provided shows the location within a home and or street as to where the flooding occurred.

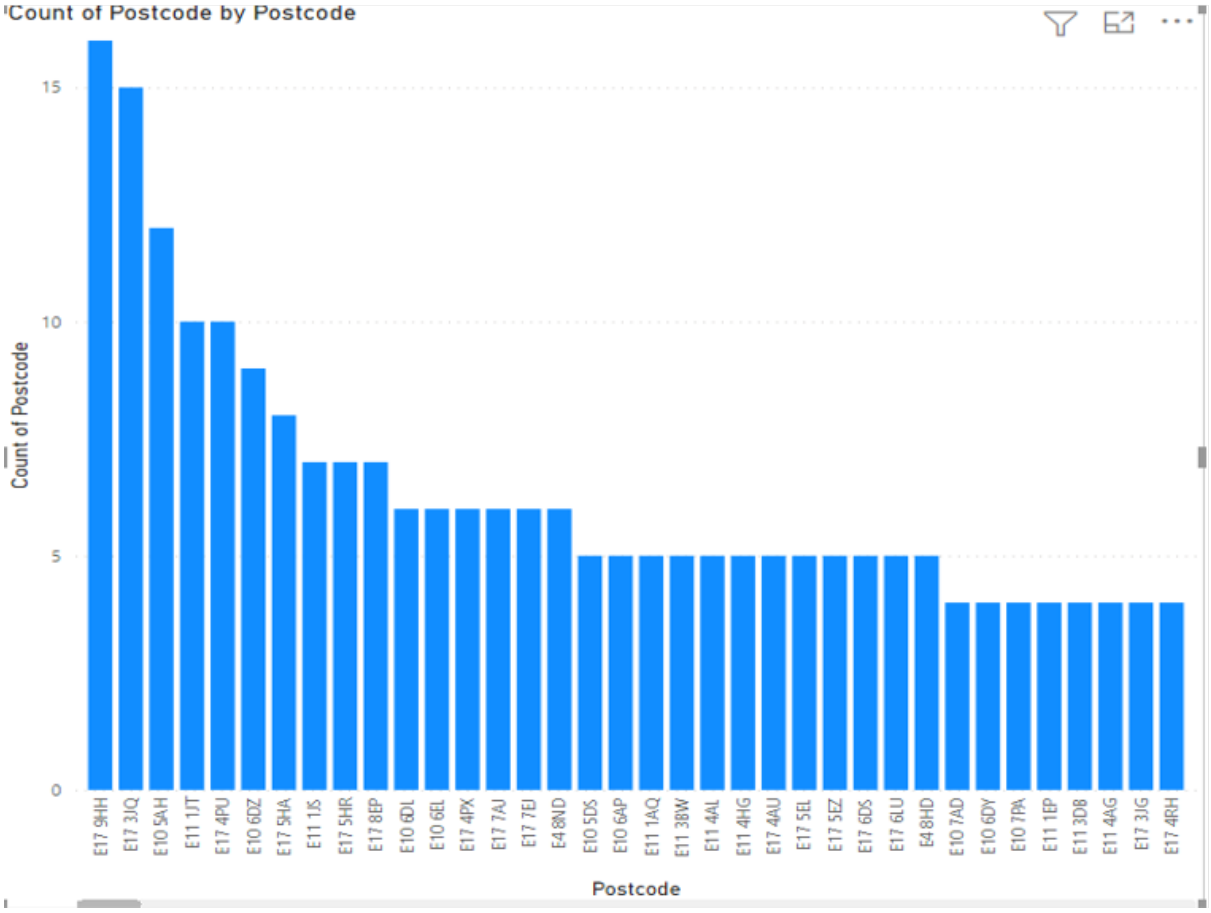


Flood Drainage - Reports Received

During the January-August 2021 there were a total of 1045 reports of Drainage issues with significant spikes in July and August

These have been broken down into reports logged by resident directly and reports logged via our CRC. 76.5% were logged by customers themselves on our website.

Data shows the top 14 roads affected within the borough, with Brook Road in Wood Street Road Ward having the highest number of reports.

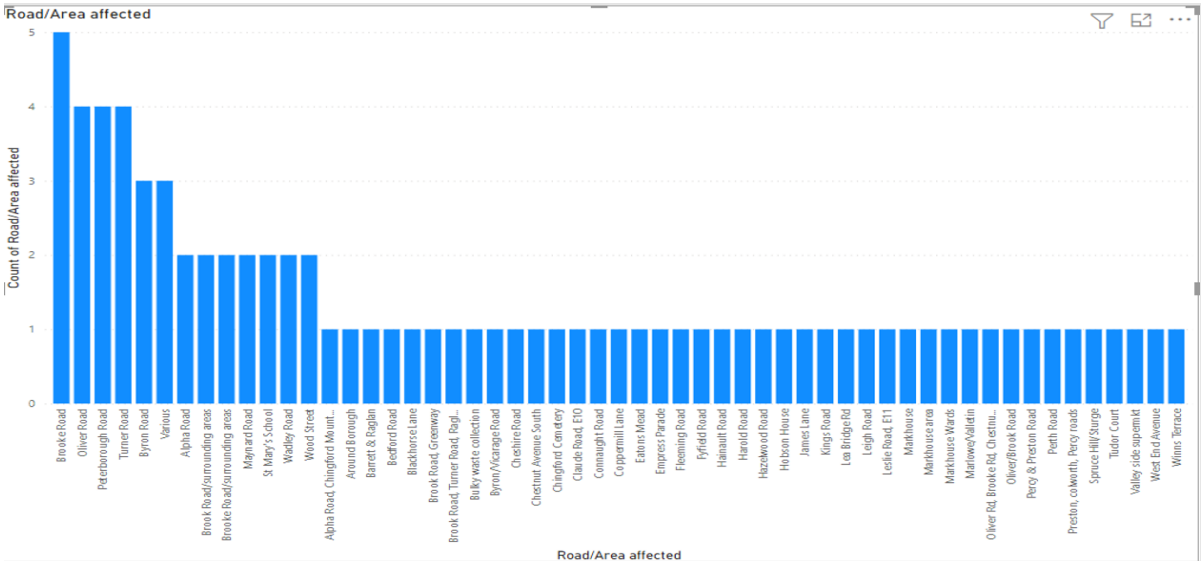


Year	Self	Service	Total
2021	800	245	1045
January	42	14	56
February	50	12	62
March	34	5	39
April	21	7	28
May	45	15	60
June	36	21	57
July	355	111	466
August	217	60	277
Total	800	245	1045

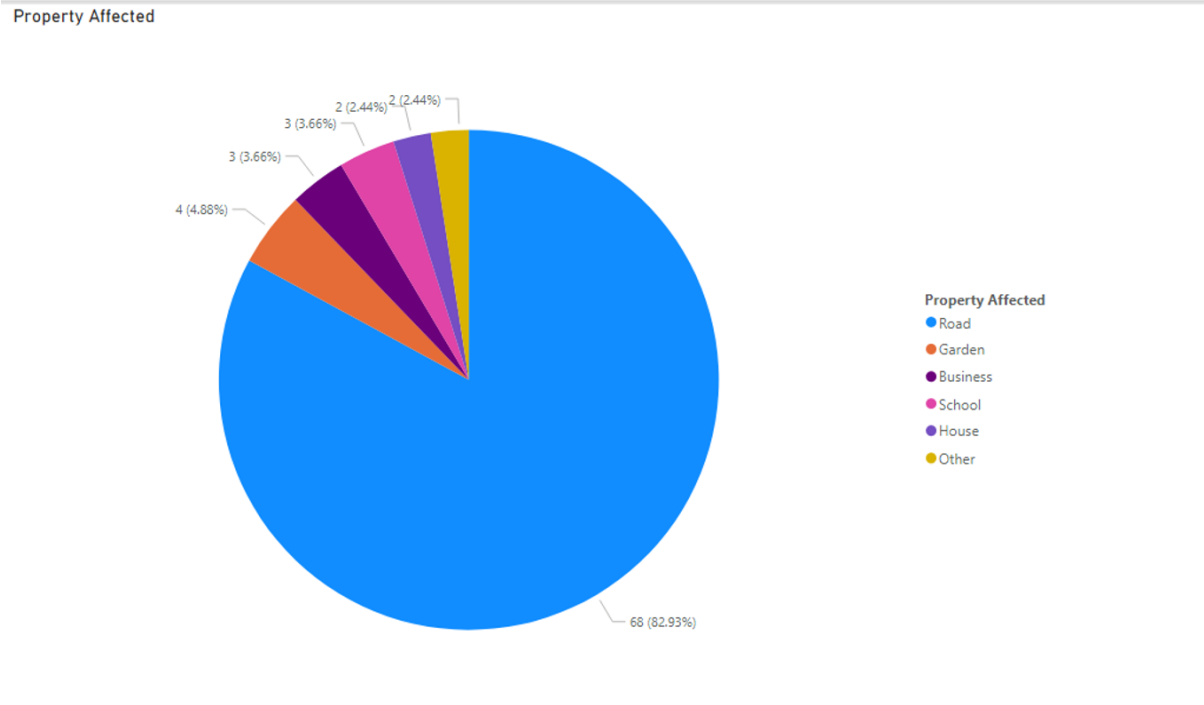
Flood drainage reports - contact by ward councillors

The data provided shows an insight into the roads affected by the flooding as reported by various ward Cllrs, the first line shows data where we have gone back and requested further information to capture this correctly.

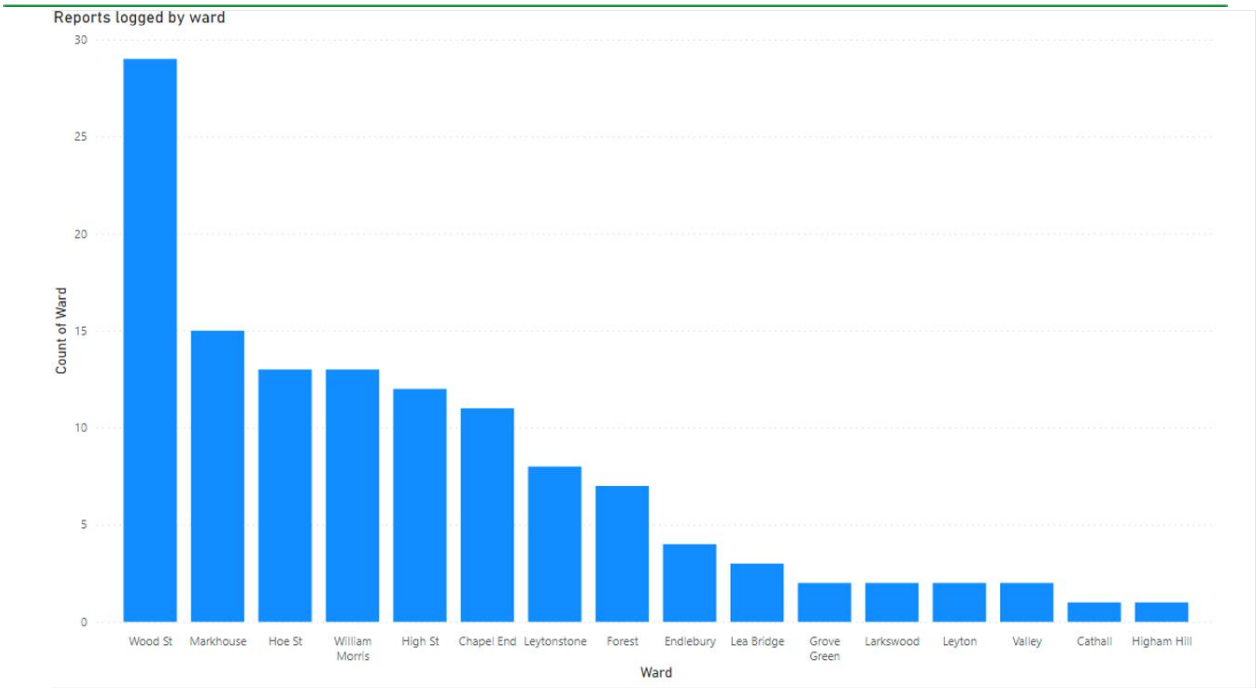
The emerging pattern based on this data shows Brook road as the most affected followed by three other roads within the Wood Street Ward. In addition, there were 9 contacts for more general updates.



The data provided by the Cllrs drilled down further shows the types of properties affected. The main category was 'Road' which is external to residents' properties which coincides with the data on slide 5 where the CRC logged the most calls received were in relation to 'Roads'.



The data provided here is broken down by Ward. As the previous data sets show the most affected ward was Wood Street. This is apparent across all reporting channels.

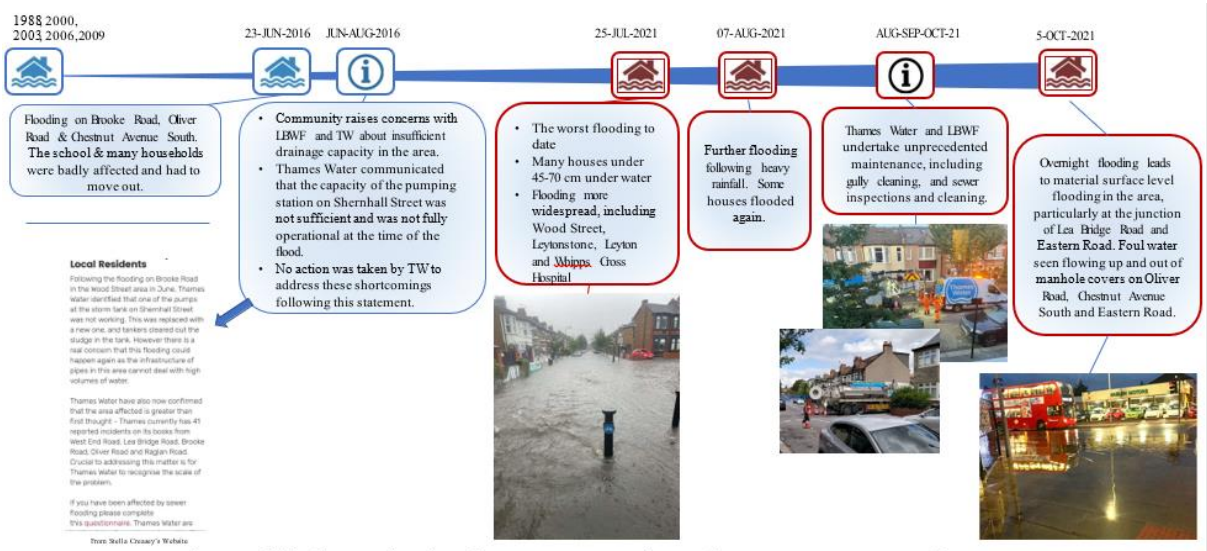


Appendix H - Wood Street South Flood Action Group

The Wood Street South Flood Action Group represents the residents of Brooke Road, Oliver Road, Chestnut Avenue South, Raglan Road, Granville Road and Shernhall Street. Following the flood events a public meeting was held with RMAs and the residents to address their concerns around local flood risks. Further detail on the specific impacts the flooding had on their homes can be found in Section 3.3 and photographic records within Appendix E.

The group's objective is to ensure that a lasting solution is put in place to prevent such flooding from happening again.

The group have recently provided a presentation which outlines the impacts on their homes, concerns and objectives of the group for the future. The following information is an extract of the information provided to LB Waltham Forest by the group.



What the group would like to happen next

To ensure that a lasting solution is put in place to prevent our community from flooding again.

TWU to address the underlying infrastructure issues

- Implement infrastructure improvements previously identified, to ensure fit for the future in terms of both climate change and additional load from housing and commercial development.

TWU and LBWF to implement short term measures to mitigate risk to the community

- TW to unblock and repair damaged sewers and pipes to improve flow along the network. Ensure sluice gates etc are in correct position.
- LBWF to ensure street level drainage and gullies are well located as in some cases recent changes to road layout (speed tables, modal filters, Copenhagen's etc.) appear to have hampered effective drainage

TWU & LBWF to increase frequency and efficacy of cleaning and maintenance to their respective facilities and networks, including:

- At least annual maintenance of sewers due to low gradient of pipes as recommended in 2007 Flood Study Report. Currently only one documented planned maintenance event between April 2016 and August 2021.

Requested Actions:

- LBWF and TWU to confirm how they will coordinate together to implement and monitor short term measures to mitigate risk to the community.
- LBWF and TWU to confirm they will respond in a timely fashion as requested above.
- Clarify how our voices and evidence can be incorporated into the London-wide independent review.
- Confirm if and how TWU will be able to incorporate the above improvements into their Drainage and Wastewater Management Plan, which we understand to already be at an advanced stage.
- To collectively agree how the community will be engaged and kept informed of progress on the above and ask you to commit to a progress update meeting before Christmas 2021.

Appendix I - West End Avenue & Peterborough Road Residents

The residents of West End Avenue and Peterborough Road have provided their observations and experiences following the flood events. Their objective is to see lasting flood mitigation solutions implemented in their community and work with RMAs to be better prepared in the future.

The following information is an extract from the presentation provided to LBWF by the group.

Locations of flooding

25/07/21: Flash flooding

Peterborough Road

3.30pm

West End Avenue

25/07/21: Water subsides

around 7pm
Peterborough Road
Residents open main drains, flood water drains quickly

around 8pm
West End Avenue
Residents open main drains but flood water doesn't drain

Post flood cleanup and maintenance

29 July
Street Clean-up

06 Aug
Peterborough Road
Emergency gully cleaning

Aug/Sep
Enhanced gully cleaning across the entire area, including street closures

21 Sep
West End Avenue
Thames Water inspection

15 Nov
West End Avenue
Thames Water cleaning

Observations: Peterborough Road

- Rainfall on the day was substantial.
- Gullies were blocked and prevented the water draining after the rain ceased. This must also have resulted in higher water levels.
- At the time the main drains were opened, there was sufficient capacity to drain the floodwater rapidly.

Observations: West End Avenue

- Gullies did not appear to be substantially blocked.
- Once the main drained were opened, water drained away very slowly, indicating these drains were blocked.
- Subsequent inspections appear to confirm this.
- The blocked drains must have resulted in higher water levels.

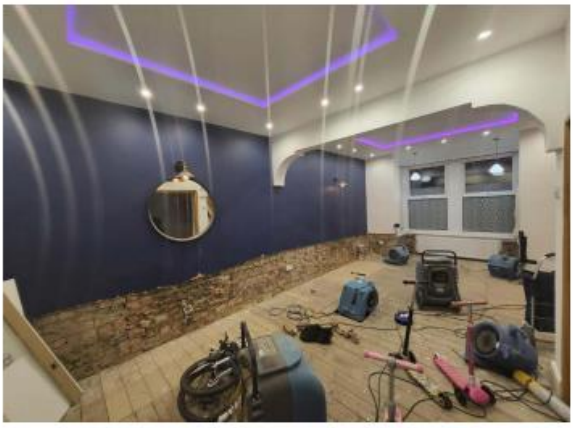
Conclusions

- Gullies were blocked and ineffective, indicating they have not been maintained sufficiently by **Waltham Forest Council.**
- Main drains were operating at very limited capacity in West End Avenue likely due to a substantial blockage, indicating they have not been maintained sufficiently by **Thames Water.**

Lack of support

- There was no on site response on the day from any officials. It took proactive local residents to deal with the problems.
- There was significant smelly sludge left on the road, which posed a health hazard and was not cleaned up until days after the flooding.
- Accessing support from the council, particularly around parking permits for tradespeople, has met with difficulty and cold attitudes.

> **"The flood has had a massive impact on our lives, especially with a baby due soon and a toddler in tow. The financial and emotional implications have been huge and we still have no idea when we will be able to return to our home."**



> **"Our children have lost their play area, their living room and their dining space. Most of our day is spent in one bedroom. The effects of the flood have put immense strain on us all."**

Requested Actions:

- An easily understandable publication, jointly from the Council, Thames Water and any other organisation covering:
    - What went wrong that caused such very bad flooding
    - What has been done so far to address the problems
    - What will be done in future to address these problems
- Waltham Forest Council and Thames Water to commit to an enhanced maintenance schedule for all streets at risk of Fillebrook flooding
- Schedules for inspections and maintenance to be published and accessible to residents, and a method for residents to hold you to account to this commitment
- For the independent report commissioned by Thames Water to hear our story of what happened
- An explanation of what water infrastructure is under our streets and who is responsible for them
- A single point of contact for flooding emergencies
- Provide guidance and support to enable us to protect our properties against future flooding

Our questions:

- Why did no one show up to help us – did something not happen that should have been done?
- Is there a plan to evacuate vulnerable people from their homes if needed? Whose responsibility is this?
- The 2018 Fillebrook Critical Drainage Area report prepared for the council included three proposed schemes: a pipe upgrade on Lea Bridge Rd between Raglan Rd and Halford Rd, and flood attenuation basins in Whipps Cross Hospital and Leyton Sixth Form College. What is the status of these schemes?

Appendix J - Greenway Avenue Residents Flood Impact Statements

Our sense of helplessness in the face of the weather was shocking. We had a huge number of people working together, and we only just managed to stave off flooding. If we had been in Brooke Road, we wouldn't even have managed to do that. There's definitely been a heightened sense of anxiety since those downpours among those who were worst affected, and for people with young children, it's been especially tough. A number of people are also having a tougher nursery/school run in the morning, and while parents have been incredibly grateful that there is somewhere for the little ones to go, and they're very positive about the nursery/school near St Saviour's, it's meant a lot of extended disruption because of the flooding of St Mary's School.

This has come on the back of the pandemic and lockdown, and people are still processing the consequences of that. One of the benefits of the lockdown has been community ties have sprung up or been strengthened, and we're using that as our basis for trying to go for a long-sighted, sustainable approach to the flooding and drainage problems.

While we hope to be a voice for our local community, and doing everything we can to organise and plan and make possible changes, we obviously need to be plugged in to something bigger, because as Greenway Avenue householders, we have no direct influence on Thames Water strategies, and the Council's flooding strategy, so we are asking to be included in that and plans to improve the management of water in this catchment.

What follows are first-hand accounts of some of the worst affected people:

Resident 1

July 25th, 2021 was absolutely terrifying.

Water like a raging river coming through the back of garden towards our home is something I still have nightmares about.

It was nearly 5 months ago and that day still brings back fearful memories, adrenaline and anxiety. We are still on tenterhooks every time it rains.

The rain that day was unbelievable and by around 3pm our garden started pooling with water by 3:30pm it was like a damn had burst its banks we had a torrent river running through. At 3:35pm I called 999 for a fire engine but realising that they may never come, at 3:39pm I called for help on our residence what's app group.

Incredibly, we had around 20-25 neighbours come and help bail our garden out, which in turn saved neighbour either side from flooding. This went on for an excruciating 3 hours.

My baby and toddler were home and terrified of what was happening. Luckily a neighbour also came to watch over them as the rest of used buckets and brooms to take the water from the garden through the side alley and eventually out to the road until we much later found someone with a pump to help. Please see the video for evidence.

We experienced the most awful nightmare, not knowing when it would end. The manholes and drains were at full capacity and not taking any water, in fact they were overflowing with water.

The flood water on July 25th was partly due to surface run- off but also massively to do with a Thames Water drain overflowing upwards as the drains were at capacity and there was so much pressure the water was exploding out of the manhole in the back lane behind Greenway Avenue. It was this water from the overflowing drain that was so impactful to our situation.

This happened on both the 25th July and 7th August. Please note for clarity, this is the only time our gardens have flooded, when the Thames Water drains are beyond capacity.

We had a subsequent much smaller issue on August 7th, 2021 where the garden flooded again, which increased the general level of fear and anxiety that every time it would rain, we would be flooded again.

I have been on rain watch and high alert ever since the 25th July and cannot tell how emotionally exhausted I am from that.

We have had to cancelled plans, as we are too scared to leave our home in heavy rain. Been up all-night checking for the rising water levels. It has been so disruptive to our life and I fear the impact will remain if we don't get that drain and the general drainage in the catchment sorted.

My children's nursery on Brooke Road has also been relocated nearly 2 miles away, because of the floods and so, we are still affected on a daily basis.

The residents on Greenway Avenue have created a community that are fighting for something to be done about:

- the Thames Water drain that overflows
- the general drainage in the area.

On the flood map it states the back lane of Greenway Avenue is a tributary to the Brooke Road underground river. Therefore, help with drainage around Greenway Avenue would obviously provide protection to these properties but I think it could also massively help the properties down to Brook Rd and the catchment area as a whole.

Resident 2

We moved into our house in 2013. At first the garage flooded occasionally, and the water table came up a couple of times creating a musty smell in the house. It was inconvenient but manageable. Over the last two or three years our garden has regularly flooded. It happens more often and on a larger scale with each passing year. It has become a question of when, not if, the house will flood.

On 25th July this year, 'the big one' finally arrived. We moved our most personal possessions upstairs and joined a group of neighbours bailing water out of back gardens in the hope of saving our house. We narrowly avoided a flooded house and the water filled our crawl space damaging floors and woodwork. We are still drying out and it's nearly December!

We almost flooded again on the 7th August but were saved by our next-door neighbour pumping water out of their garden as soon as the water pooled. Both incidents of severe flooding were driven by heavy rain and a Thames Water drain in our back lane being dramatically overwhelmed, effectively turning our land into a river capable of flooding us and many more houses downstream of us.

Since the summer floods we have bought a pump and added a sandbag wall to our back boundary. I still don't feel safe. I obsessively check the weather forecast and am filled with fear and anxiety every time it predicts heavy rain. We have cancelled social events and family visits multiple times since the summer because we need to be at home to set up our pump at the first sign of flooding. We have had to pump water on two occasions since the summer and have both spent additional days stuck at home and nights awake, monitoring the rainfall and being ready to leap into action. It's exhausting and extremely stressful. It takes days to recover from the emotional overload and the sleep deprivation. It was bad enough being disconnected from family, friends and normal life by Covid but even when it's 'safe' to do a bit of living we can't if it's raining.

We HAVE to stay at home and protect all we've worked for and our pets. We have no other choice, as the responsible authorities are doing nothing to stop the flooding. We are left in this hellish situation of being completely beholden to the weather and all the unpredictability of the different rain forecasts. We dare not take a holiday and even going home for Christmas won't be possible if the forecast is bad. News footage of other people flooded out at Christmas haunts my dreams! It's an awful situation to be in and I wouldn't wish it on my worst enemy.

Resident 3

I am writing on behalf of myself and my husband to share the impact that the July flooding had on our house and wellbeing.

We were away from the house preparing for our wedding (just a few days later) when the flood happened.

We were alerted by our neighbours that next door had been overwhelmed and the flooding was building up in our garden. We were incredibly worried and unable to take action because we were far away from the house and not able to travel home. We were dependent on WhatsApp updates and the kindness of our neighbours who ended up pumping out our garden. If that had not happened, we could have had considerable damage. My understanding was that the water was well above the level of the threshold into the house. Safe to say we did not sleep that night and the stress has a huge impact on what is supposed to be one of life's happy events.

We were in the middle of construction work which created additional stress about the cost of any flooding and the damage to any new fittings.

We have since moved back in but since then, our garden has become a mud bath. Every time it rains, we get water build up that threatens to encroach on the house. This means that every time there is heavy rain, we worry it might happen again. Sometimes if this happens at night we can't get to sleep because of this fear.

We have invested over £600 in flooding defence equipment including sandbags and a pump but we are aware this we wouldn't be sufficient to prevent a major event like in July.

We welcome the action Waltham Forest are taking to reduce the impact of flooding on residents and believe there is a significant opportunity to divert some of the flooding at the back of Greenway Avenue which is running down into Brook Rd.

Resident 4

On the day in question, I noticed water running down our garden path and water beginning to pool in front of our decking. It was clear the significant amount of water that was coming from the back access road and I went out there to investigate and saw the overflowing drain at the top (taking the video). Alarmed, I notified other neighbours that action was going to be needed to try and stem the small river that was now gushing down the back road and flowing through mine and neighbours' gardens above us. I quickly covered up the air bricks at the back of our house as best I could and got buckets and brushes to try and prevent it entering under the house. It quickly became apparent that this was going to be a losing battle as the sheer amount of water was overwhelming, particularly the water that was now flowing through gardens up the street from us and into mine. By this stage other neighbours were out and trying to stem the flow of water and we began a collective effort to protect our houses.

Since the flooding we have had rising damp at the back of the house, the result of some water that got in through the air bricks. Every time there is heavy rain a pang of anxiety comes on and fear that more flooding will occur. Many times, since I have set about covering up the air bricks in anticipation. I am also worried about the damage that could occur to the wooden home office we recently had built (which fortunately did not get damaged first time around).

Resident 5

While my home did not suffer significant damage in the July floods, my life has still been substantially affected by them. At the time of the flood, two of my children attended the nursery at St Mary's school on Brooke Road, and my third child was at St Mary's school (I now have two at the school and one at the nursery). I'd like to emphasise that the school and nursery have done a fantastic job continuing to support their children in trying circumstances. Nevertheless, the flooding of the school and nursery and subsequent repair works have had a huge impact on the wellbeing of myself, my husband and our three St Marys children.

Due to the extensive damage it sustained, St Mary's nursery has been closed since the flooding, with all children relocated to St Saviours nursery approximately two miles away. The nursery currently predict they will be able to bring children back to the St Marys site on 10 January 2022. This will be nearly 5 months from the flooding util July. My household does not own a car and the average cost per week to take my children to the St Saviours site by train and bus is about £40. By the time the nursery re-opens, we will have had to do this for 21 weeks, so the total additional cost incurred is over £800. This means my husband and I have had to find an additional £168 / month. We have been able to absorb this cost but not all families will be this fortunate. In addition to the cost, the logistics of transporting our children to the temporary site has been extremely stressful.

We have not yet had a date for the completion of the repairs to the school. St Marys school is not able to offer the full range of facilities the children need and deserve while repair works are ongoing. A large portion of St Mary's school children are learning in temporary units and all are eating in a marquee. This takes up over half of the playground space which, combined with the closure of the gym, gives children substantially less space.

Based on my experience and my conversations with other St Mary's parents, I would urge you to assess and quantify the full social impact of the flood, in particular the impact on children and their education. Some examples, from my experience, are below.

- I mentioned the nursery has been brilliant, but they have been stretched for space and resources in their temporary location. I have seen the impact of this in some new behavioural issues and developmental regressions in my 2 (now 3) year old during this time.
- St Mary's school opened late as a result of the flooding works and had an extended October half term break by one week. Parents have had to find additional childcare to cover this time.
- Due to the repair works and temporary facilities, a large generator is running in the St Marys playground all the time. This will impact on air quality which will be harmful to the children.

I am keen that the fact that this flooding is not an unprecedented, or one-off event, is fully recognised by all involved in trying to address the issue. This is the second time in five years St Mary's school has flooded so badly they've had to close and relocate the nursery. The work to repair St Marys has not included any additional adaptation measures as far as I am aware, so a future flood will have the same impact. I will have one or more children at St Marys for the next nine years and am extremely concerned that in this time the school may flood again. This time the flooding happened on a Sunday; the question that keeps me up at night is what if next time it happens on a school day when hundreds of young children, including mine, are there?

Appendix K - Barts Health Flooding Impact and Planned Mitigation

Impact of July flooding

NHS Barts Health NHS Trust

- The flooding was the worst case in at least 40 years.
- Water cascaded across the site towards the lowest area at the James Lane/Peterborough Road boundary.
- At the same time, external storm water drains became overwhelmed and flood water backed up from James Lane lifting manhole covers on site.

- The flooding led to a power cut resulting in the loss of 168 beds and 12 surgical theatres. Services were interrupted for two weeks whilst infrastructure was drained, dried out and damage repaired.
- The energy efficient Combined Heat & Power Plant was damaged and off line for 3 months.

3

Flood Mitigation - since July

NHS Barts Health NHS Trust

Works carried out to improve resilience against a repeat occurrence:

- Bunds installed to protect Surgical Block basement critical infrastructure
- Extra sumps created
- Sump pumps replaced with higher duty and bigger drain discharge pipes
- Theatre chiller plant raised onto plinths
- Extra drains installed to protect against James Lane flood water

4

Flood Mitigation – further planned investment

NHS Barts Health NHS Trust

£1 million of further Capital Works planned – to be carried out by the end of March 2022:

- Replace main electrical substation 1 and raise above maximum flood level
- Flood protect low lying generator serving substation 1
- Construct bunds around the Energy Centre
- Back up basement pump system with a new generator

5

Flood Mitigation
Background & Overview

The Hospital site sits within the Fillebrook Critical Drainage Area (CDA) and is susceptible to Surface Water Flooding. The sources of the surface water flooding have largely been attributed to the historic culverting of the Fillebrook river and urbanisation of the surrounding area.

Flood Mitigation

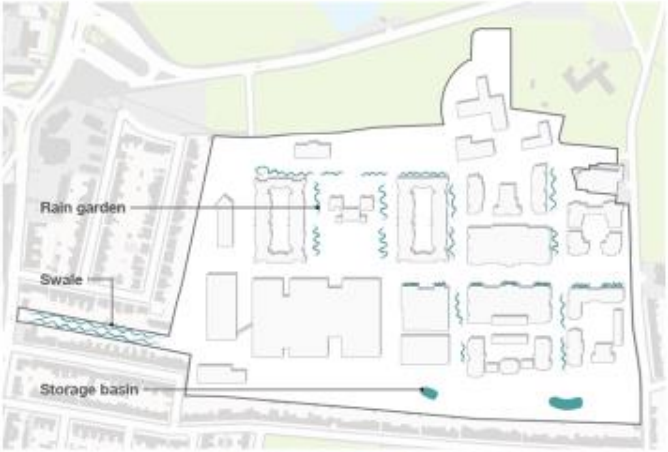
Hospital design incorporates **green roofs and attenuation tanks** to reduce the "run off" rate of surface water into the existing drainage system to reduce peaks - equivalent to a "**green field conditions**"

Residential Masterplan includes same flood mitigation measures

Critical Drainage Area set aside to provide flood attenuation tanks and natural ponds to further improve the impact of flooding

Drainage designed to promote increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation

However, these plans can only be delivered in full through the redevelopment of the hospital and the wider site



Swale

Rain Garden

7

Flood Mitigation
Existing Hospital Drainage Regime

- The Hospital sites existing drainage regime is believed to be one of the primary influences on the historic and current flooding issues experienced within the site
- No known on site attenuation / surface water management and circa 90% of the existing site area is considered impermeable
- The max discharge rate is currently 4% of the sites estimated surface water run off generated in the most extreme rainfall events (1 in 100yr event)
- Existing drainage network at risk of being overwhelmed, leading to increase in overland flows, surcharging of the network and flooding
- Rainfall data would be needed to established & classify the extremeness of recent storm events

Flood Mitigation
SuDs Strategy

- Promotion of green infrastructure to increase bio-diversity, permeability and surface water management to reduce the risk of on site and off site flooding
- Measures include tree pits / rain gardens, swales / basins, permeable paving, granular & cellular attenuation and blue / green roofs
- SuDs strategy will improve the mgmt and control of the SW discharge down to a new rate of 45 l/ s (circa 97%), equivalent to greenfield run off

Appendix L - Thames Water Brooke Road SPS (Sewage Pumping Station)
Thames Water provided the following description on the Brooke Road pumping station during the July and August events.

Brooke Road SPS (sewage pumping station) has a dry weather flow (DWF) wet well with one pump, a holding chamber and a discharge sewer. The storm sewer is set up as a mirror of this. From the operating logs below, it appears that Brooke Road SPS performed as designed during both rainfall events.

At Brooke Road SPS, the gravity sewer enters the wet well and it is pumped into the gravity sewer downstream. In storm conditions, the sewer level will rise and the pumps will be inhibited, preventing the downstream sewer from becoming overwhelmed. At this point the wet wells will fill up and once full will start filling the holding chambers. Once the sewer level subsides, the pumps inhibit will stop and the pumps will start and pump out the well and holding tanks into the sewer.

Events:

25/07/2021

13:56 – The discharge sewer level came up and the pumps stopped

14:03 – Storm Wet well changed to high

14:06 – DWF wet well changed to high

15:38 – Storm holding chamber change to high

26/07/2021

10:35 – The sewer level subsided and pumps started.

11:06 – Storm wet well high cleared

11:10 – Storm pump stopped.

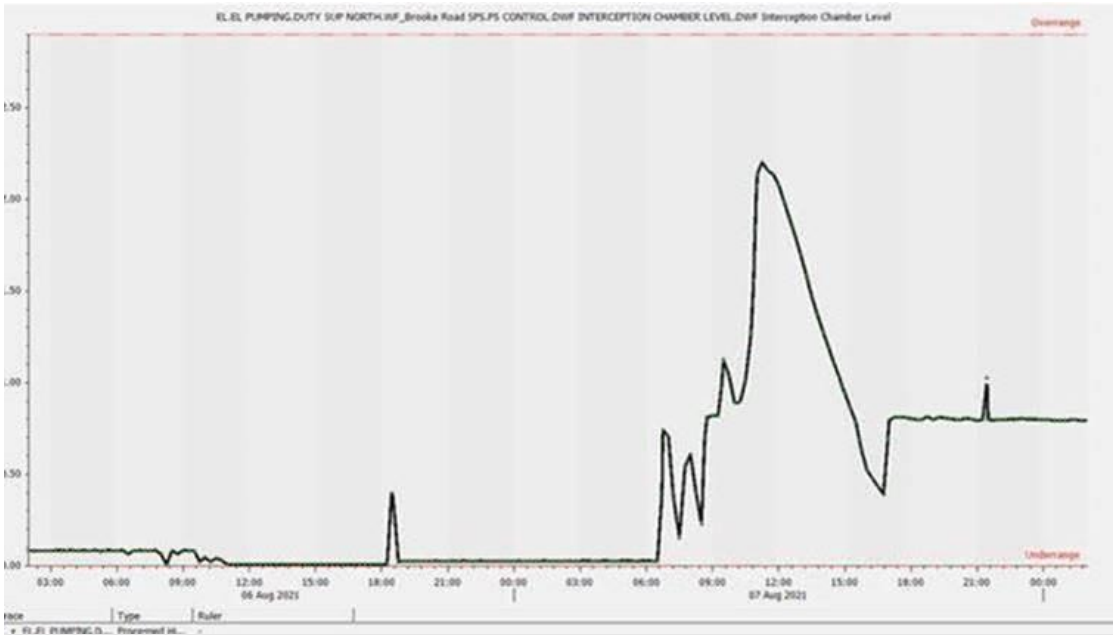
In summary, the site looks to be running as it should; the site is designed to store larger volumes of water in high flows and pump back when the sewer will not be overwhelmed.

07/08/2021

08:52 – Pumps changed from stopped to running,

08:53 – Pumps changed from running to stopped, pumps inhibited due to the sewer level increasing.

Trends below show discharge chamber level increasing after pumps have stopped indicating the sewer being surcharged due to extreme rain fall.



08:58 – Storm Wet well changed to high.

09:04 – DWF Wet Well changed to high.

11:00 – DWF Ultrasonic Fails, from the level trends it can be seen this is because it goes under water.

11:33 – Storm Holding tank goes high. Level trends show this to be at 4.5M

11:00 – Storm Holding tank ultrasonic Changed to failed. From the trends this shows the head going under water at 5M

12:19 – Storm Holding tank ultrasonic changed to normal. Trends show the tank still at 5M

12:42 – DWF Holding tank ultrasonic change to normal.

16:56 – Pumps changed to running. This ties up with the discharge chamber levels subsiding.

17:28 – Storm Wet Well High changed to normal. The storm Wet Well then resumes normal operation.

18:20 – Storm Holding Tank High change to normal.

23:59 – DWF Wet Well High changed to normal.

08/08/2021

03:04 – DWF Pump changed to stopped, Site is fully pumped out.

No other events on 8/8/21

In summary, the site operated as it was designed to during the flooding events.

Appendix M - Resident Stories and Impacts From the Flooding

The following are a selection of redacted emails received by LBWF to outline the huge disruption and chaos caused by the recent flooding from residents.

Due to flooding, people's cars been written off

Resident in Forest Ward

We had no power, the walls are damaged, our flooring has been displaced. We don't even know how safe it is to be in our own home. The water came up to the second step on the stairs inside our home, completely submerging all sockets and going up the walls. Our sofas were bobbing about in filthy water, Water damage to tumble dryer, freezer, clothes, both sofas, suitcases, storage units (the water has destroyed the bottom of them, so they collapsed). We have no content insurance.

Company car written off; 48 families were rehoused.

Resident in Wood Street Ward

The bottom of hazelwood where it meets Haroldstone has flooded again. Homes, gardens, kitchens and cellars flooded, causing stress and anxiety

Resident in High Street Ward

Our basement flooded and we have had to build a dam in our gateway so that our garden is not continually underwater.

Resident in Grove Green Ward

Due to constant rush of water and debris, flooding has occurred in 3 – 4 shops and our Showroom causing extensive damage

Resident in Highams Park and Hale End Ward

Floor water from Chingford Mount Cemetery lapping at the air brick just below our back door. Causing, stress and anxiety

Resident in Larkswood Road

Heavy rain flooded basement, had to get the fire brigade round to pump it out. After a week we managed to get it dry and now today in the heavy rain this morning it has flooded again. Lots of damage

Resident in Leytonstone Ward

Sewer runs through our back gardens in Bedford Road and our garden has been flooded with raw sewage twice now.

Resident in William Morris Ward

Continual major flooding at the bottom of Turner Road that has caused flooding into my front garden and property in heavy rainfall. Huge cost to replace everything

Resident in Forest Ward

Living on Esther road we have recently been affected by the floods, destroying personal possessions of many of my neighbours.

Resident in Leytonstone Ward

During the flooding my car and my son's car were very badly flooded and are both being currently assessed as to whether they are repairable or will be written off. The flood water also entered my property through the air bricks and then into the sub floor. Today flood contractors came to access the damage and have installed an industrial humidifier to remove the water from the sub floor and to help alleviate the terrible smell of damp in our property, this will be operationally onsite until 16th August.

Resident in Forest Ward

Had to close restaurant due to heavy flooding. Lost regular customers and huge loss in income

Resident and Business in Lea Bridge Road

Cellar flooding, causing huge distress to elderly parent

Resident in Markhouse Ward

1. The school need to use mobile classrooms which may require planning permission despite them being temporary as part of the refurbishment. Please confirm whether this is an essential requirement from the outset or what other options are available
2. It is estimated that two-year groups will need to be educated off site for the first few weeks of term. In an attempt to avoid online learning, we are exploring alternative options for a creative offsite curriculum.
3.As the car park will be repurposed during the works, staff will be unable to park on site.

School in Wood Street Ward

Kitchen floor, hallway floor and front room and all floorboards need replacing, I have tried to dry them out with dehumidifier running day and night, but a builder has advised they are no good and all need to be replaced that is going to cost a lot of money

Resident in Forest Ward

Have lost a lot of possessions to water damage and was still engaged in the process of clearing the basement when a second bout of flooding struck on Saturday, this time bringing raw sewage.

Resident in Wood Street Ward

I feel pretty crushed emotionally post flood damage, never mind all the man hours trying to sort my house out, which will be going on for months. All of my downstairs is trashed again. Huge stress dealing with flooring companies, tilers, decorators, electricians and a few others.

Resident in Leytonstone Ward

Subsided pavement causing structural damage every time it rains as there is a crater there. Unable to use pavement and water getting into the ground is causing the underground structure to further weaken. We are now worried that this crater will spread to the front wall structure causing huge costs.

Resident in Leyton Ward

Flooding caused damage to properties on Spruce hills road twice in the last 2 months. On the first occasion, WF council told us to claim for damage through our home insurance. However, my insurance company will not pay out again for flood damage so soon after the first. I cannot afford to keep paying for damage to my property and belongings

Resident in Chapel End Ward

Flood water gusting from behind park. Current trees on Wadham Road cause new extension to crack.

Resident in Hale End and Highams Park Ward

Appendix N - LBWF Planned Flood Mitigation Schemes

Local Flood Risk Management Strategy Update

Under the Flood and Water Management Act 2010 the Council is required to produce a local flood risk management strategy. The strategy has been developed with the input and guidance of the Environment Agency and has been subject to public consultation. The current strategy was published in 2015 and in 2022 the Council will be updating the existing strategy to align with the National Flood Risk Management Strategy published in 2020, by the Environment Agency. The existing strategy can be viewed on our website here.

Sustainable Urban Drainage Schemes (SuDS)

Sustainable Urban Drainage Schemes SuDS are designed to both manage the flood and pollution risks resulting from urban runoff and to contribute wherever possible to environmental enhancement and place making. With this in mind, the multi-functionality and multiple benefits of SuDS should always be considered.

Sustainable drainage systems (SuDS) mimic natural drainage processes to reduce the effect on the quality and quantity of run-off from developments and provide amenity and biodiversity benefits. When specifying SuDS, early consideration of potential benefits and opportunities will help deliver the best results.

The schemes detailed below have been identified as priorities for the introduction of SuDS, alongside other flood reduction and prevention measures. The Council has also published its capital Infrastructure Delivery Plan which is available on their website. This details the current proposed infrastructure development within the borough and includes the capital allocation for new flood mitigation schemes.

Location	Scheme overview
South Chingford Flood Mitigation	Potential rainwater pipe disconnection schemes at Mandeville Court, Maple Avenue and Rolls Court. Potential flood storage schemes at Memorial Park, Larkswood Playing Fields and Rolls Sports ground.
Chestnuts Showground	A flood mitigation scheme has been designed and there is an opportunity for this to be coordinated and integrated into the Campus Redevelopment SuDS Drainage and Attenuation proposals, providing enhanced amenity, environmental and biodiversity benefits for the site.
Brooke Road, Walthamstow	Brooke Road has a history of flooding, however gully capacity and volume issues were particularly highlighted during the recent flooding events. To achieve the most benefit at this location a combination of upgrades including SuDS schemes and building community resilience in the local area and surrounding areas. All of which would increase overall network capacity.
Wadley Road and Esther Road, Leytonstone	The proposed scheme here includes constructing SuDS features in natural depressions in the road.
Whipps Cross Hospital	The proposed scheme here includes the introduction of a temporary flood alleviation basin (as it is only wet during rainfall events) within Whipps Cross Hospital.
Leyton Sixth Form College	The proposed scheme here includes flood storage within the eastern field of Leyton Sixth Form College.

These schemes are mapped in Figure 7 below.

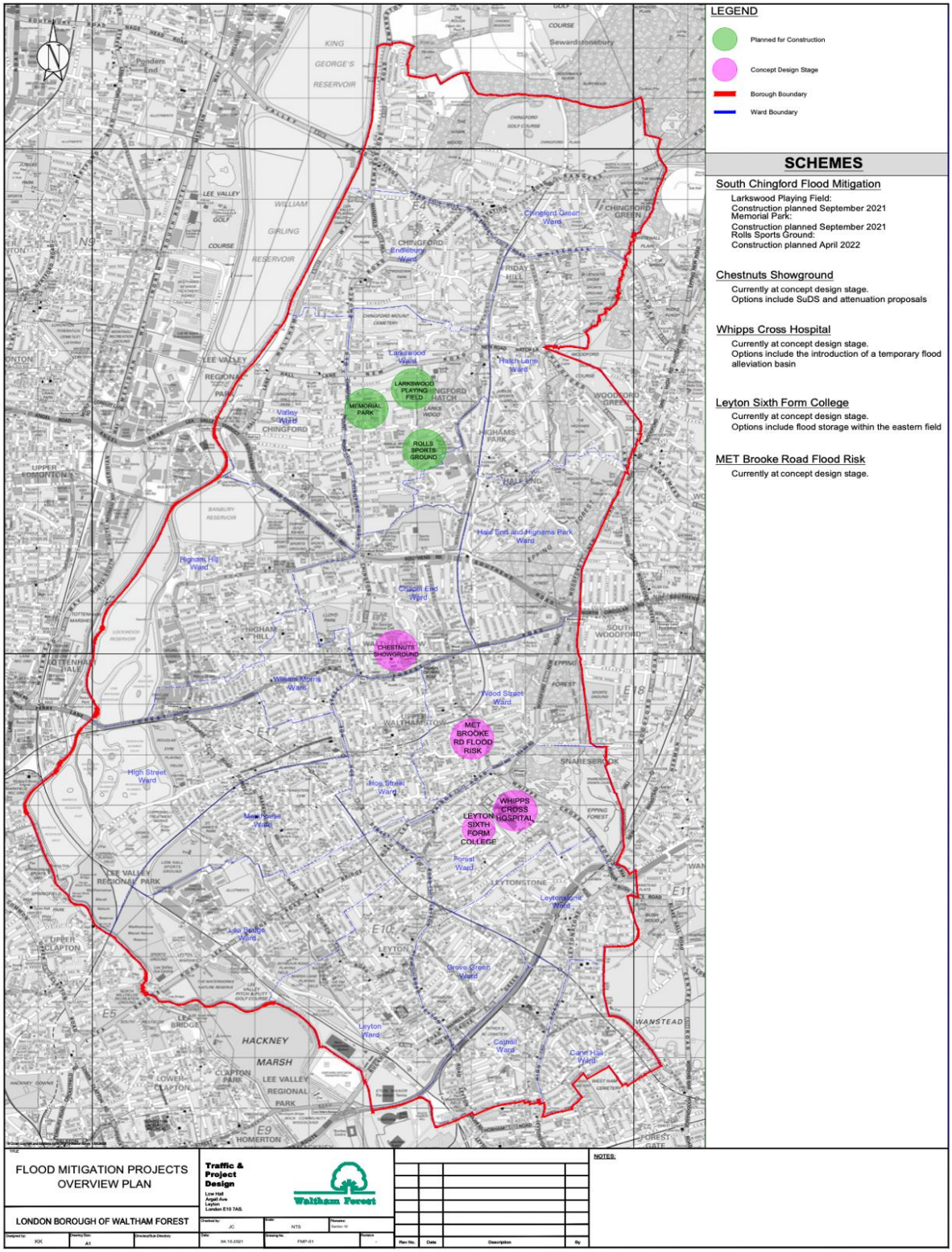


Figure 7: Planned Flood Mitigation Schemes in Waltham Forest Borough

Appendix O - Thames Water Flow Attenuation Planters

The Innovation team at Thames Water have tested and developed a variety of flow attenuation planter tanks over recent years. A kit of moulded parts comprising tanks, trays and a lid were commissioned in 2019 and have since been installed and tested at several Thames Water sites. The design enables the components to be assembled in a variety of configurations depending on the layout of the site, the available space and customer requirements.

The basic tank is 600 x 400 x 950mm, with a nominal volume of 216 litres. A lid can be used to cover the tank or planter trays can be used, which reduces the nominal volume to 192 litres. A smaller inner tank is housed within the main tank to act as a permanent water reservoir, with a nominal volume of 18 litres. A tap links to the inner tank to enable a watering can to be filled to water the plants. Options for a larger inner tank are currently being considered. Coir liners are used within the planter trays with drainage hole drilled to prevent saturation.

The basic components are shown in the pictures below, with examples of the rainwater pipe connectors, the installation configurations and outlet arrangements. The outline dimensions are included with a sketch of the operating principles and planting suggestions.

For further information contact: Dejan Vernon dejan.vernon@thamsewater.co.uk or David Walters david.walters@thameswater.co.uk

Tank with planter trays

Tank with lid (normally colour matched)

Inner Tank

Planter Trays

Inner tanks at higher level if lid used

Inner tank at lower level if planter trays used

Planter tanks can be joined along short side (400 x 1200mm)

Planters joined along long side (800 x 600mm) or more if needed

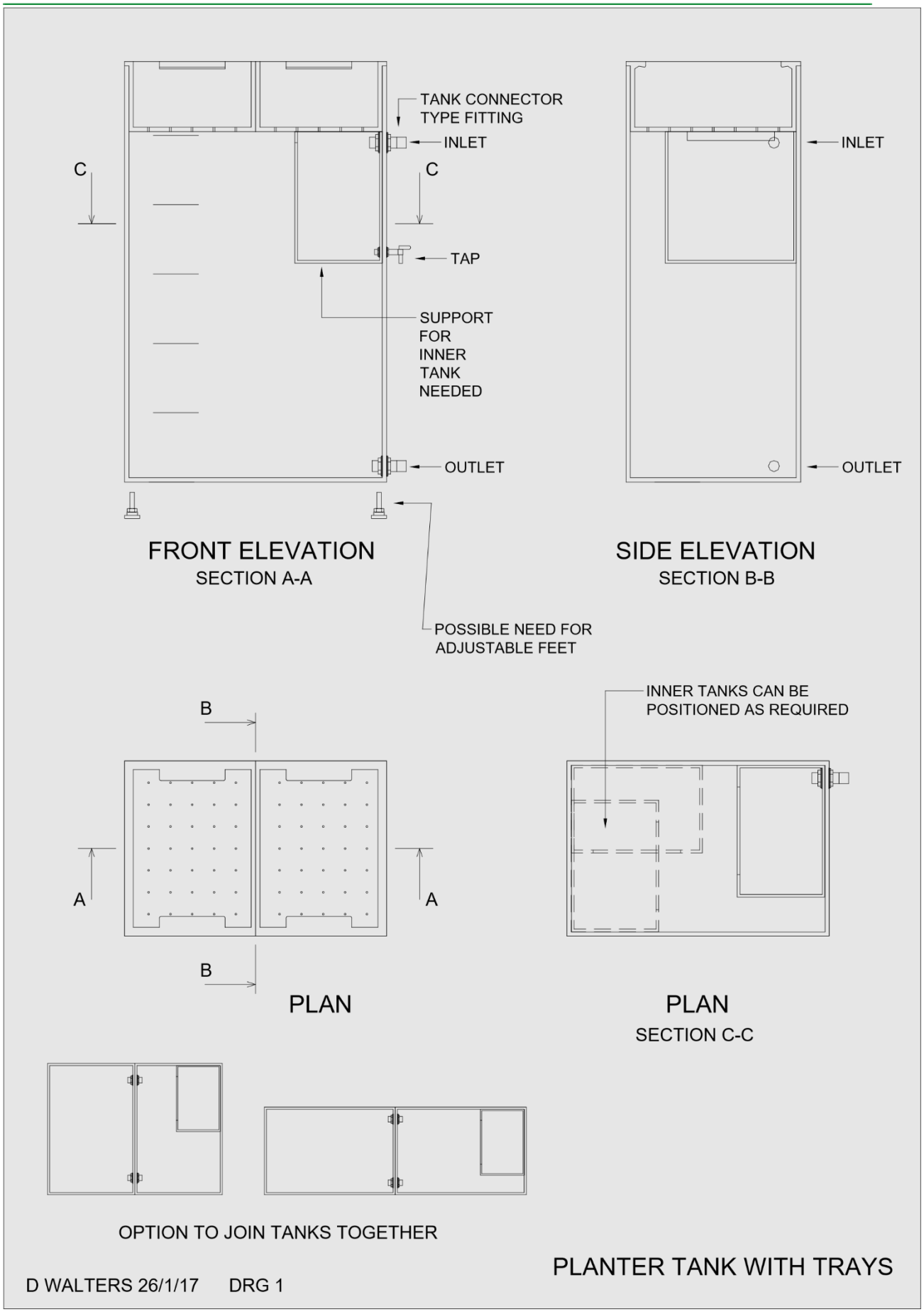
Example installations at Thames Water sites:

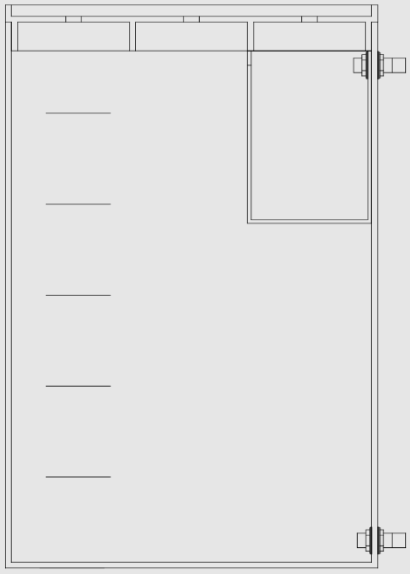
Double planter installation at Longreach STW

Planter installation at Reading STW

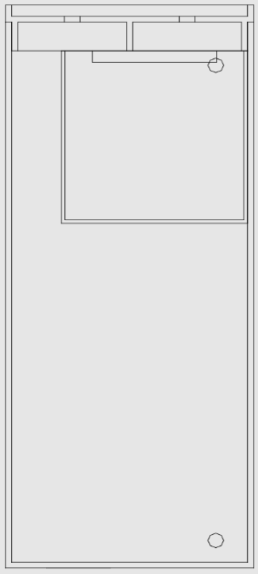
Planter installation at Hogsmill STW

Planter installation at CWC Reading

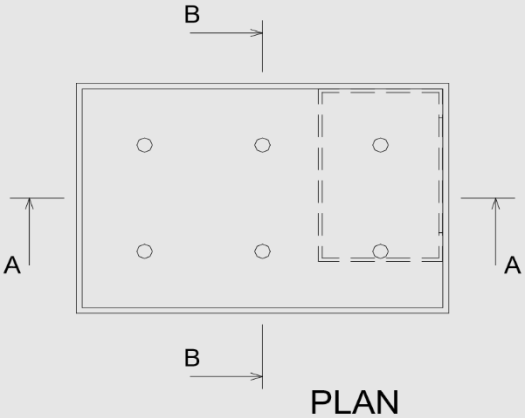

TANK CONNECTOR TYPE FITTING
INLET
C
C
TAP
SUPPORT FOR INNER TANK NEEDED
OUTLET
FRONT ELEVATION
SECTION A-A
INLET
OUTLET
SIDE ELEVATION
SECTION B-B
POSSIBLE NEED FOR ADJUSTABLE FEET
B
A
A
B
PLAN
INNER TANKS CAN BE POSITIONED AS REQUIRED
PLAN
SECTION C-C
OPTION TO JOIN TANKS TOGETHER
D WALTERS 26/1/17
DRG 1
PLANTER TANK WITH TRAYS



FRONT ELEVATION
SECTION A-A



SIDE ELEVATION
SECTION B-B



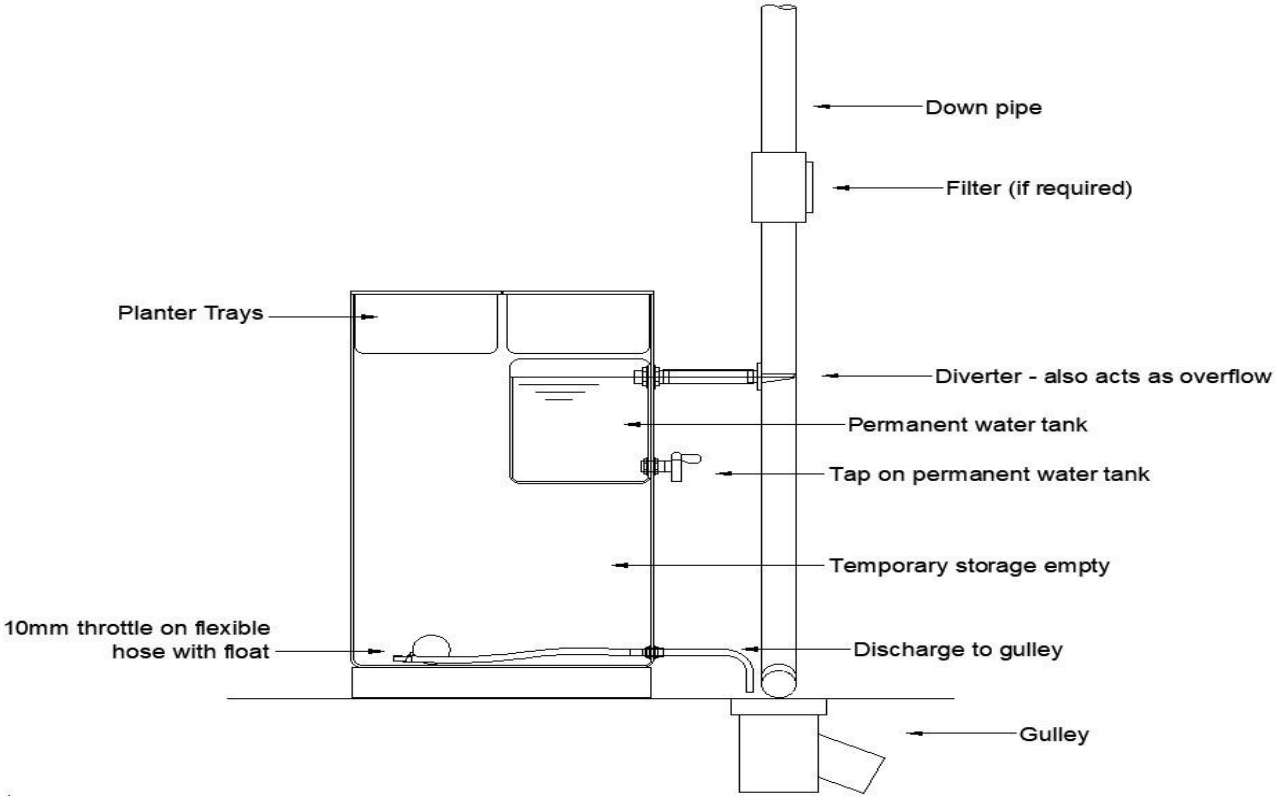
PLAN

OPTION TO JOIN TANKS TOGETHER

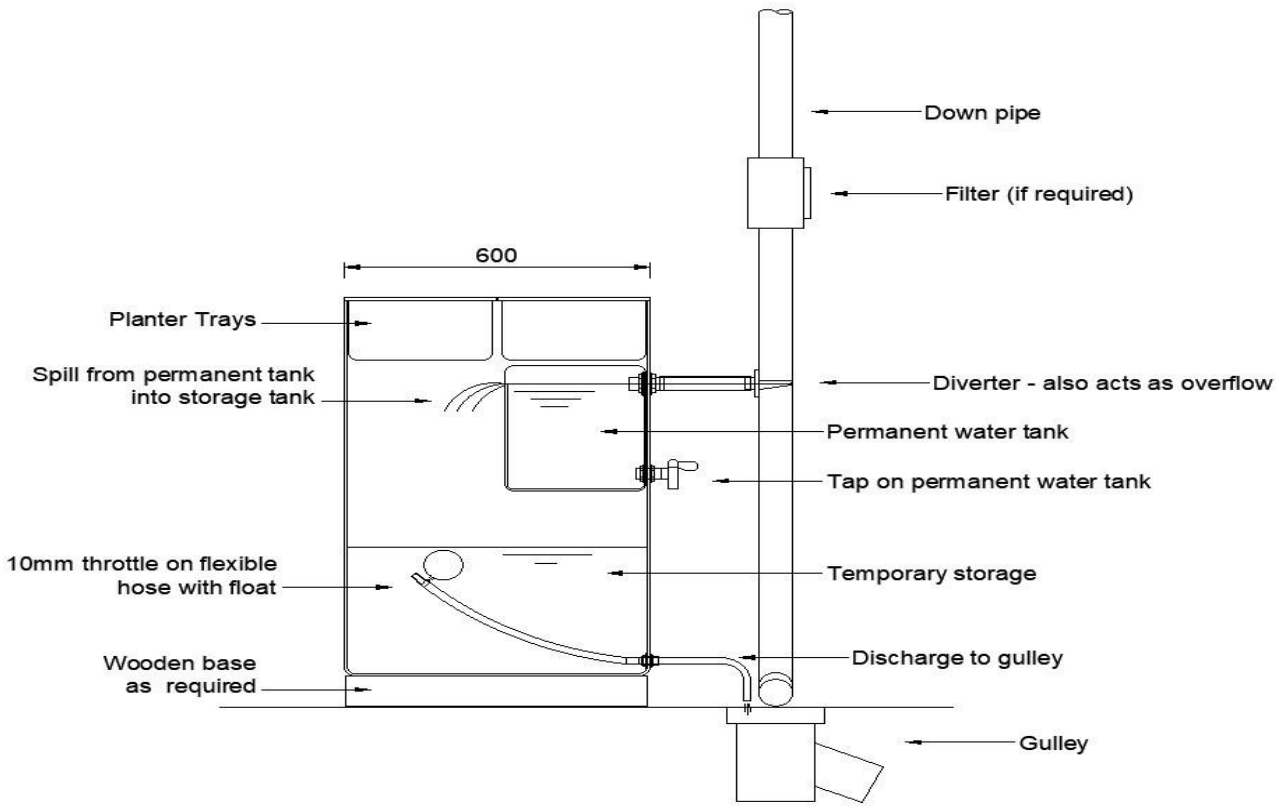
PLANTER TANK WITH LID

D WALTERS 26/1/17 DRG 2

Planter operation



Planter filling/attenuating during rainfall



Waste to Wealth Summit
Planter Exhibit Planting Information

The planting in this display is a mixture of winter, drought tolerant, evergreen plants.

- **Euphorbia 'Blackbird'** – an evergreen perennial with a compact, bushy growth habit. Its outstanding feature is the exceptionally dark purple velvety foliage which contrasts strikingly with the large clusters of yellow-green flowers that bloom in late winter/early spring.
- **Helleborus x hybrids Single White** - provide a great source of colour in the winter months. They grow in most conditions, but thrive in well-drained, humus-rich soil, out of direct sunlight.
- **Thymus citriodorus 'Variegata'** - commonly called lemon thyme is primarily grown as a culinary herb for its rich, lemon-scented leaves. It is easily grown in average, dry to medium, well-drained soils in full sun. Tolerates drought and poor soils of somewhat low fertility. Loose, sandy or rocky soils with excellent drainage are best. Dislikes moist to wet soils where it tends to rot. It is evergreen in mild winter climates. Harvest leaves for cooking throughout the growing season.
- **Thymus serpyllum** - a vigorous evergreen mat-forming plant with dark green leaves and clusters of bright rose-purple flowers. One of the best for large groundcover plantings. Also nice in the rock garden, or used in mixed containers and tubs. May be mown in early spring. Easily divided in spring or early fall. Once established it is drought tolerant and attractive to butterflies.
- **Skimmia 'Kew Green'** - a hardy, dome-shaped evergreen shrub with clusters of greenish-white flowers. Those flowers are furled into tightly-packed buds, but come spring they burst open and into bloom.

The planting was designed by The Garden Club London who were responsible for the creation of Thames Water sponsored Urban Flow garden at the 2018 RHS Chelsea Flower Show which won a highly prized gold medal as well as best in category. The garden had key messaging around drought, climate change, water efficiency, air quality, biodiversity and SuDS.

The garden proved hugely popular, winning both gold and best in category. As a result the garden and its messaging on received a great deal of public and media attention.

Appendix P - LBWF Servicestore Flood Prevention Offer

Flood Barriers and Gates

- Flood Barriers are suitable to all types of openings, from single doors to larger openings such as roller shutters or driveways. There are no width or height limitations due to modular designs.
- Flood Gates represent a robust and efficient form of flood protection. Easy to maintain and operated manually by one person, flood gates represent a quick and optimal deployment option for all door openings.

Permanent bolted option

Polypropylene temporary option

Pack of 20 inflatable flood protection cubes

Anti-flood Air Bricks

- An automatic, permanent flood protection solution. Anti-flood Air Bricks use rising water to automatically shut off, inhibiting water ingress through the airbricks and therefore flooding underneath the property.
- Anti-flood air bricks are engineered to act like a standard air brick in normal weather conditions, ensuring unrestricted airflow underneath the property.

Vent Covers

- A rapid-deployment option for preventing water ingress to existing air vents. Vent covers offer flood protection to low lying vents. All fixings are pre-installed to ensure the covers can be easily affixed to the wall when required.

Anti-flood air bricks

Vent covers

Back Water Valves

- A simple device used to prevent backflow through smaller wastewater pipes such as kitchen sinks, downstairs showers, washing machines and dishwashers.
- The valves are installed directly to the pipe and represent a passive measure, the valves automatically close with rising water.

Non-Return Valves

- A simple and cost-effective solution to prevent backflow of sewage into a property.
- The valves are installed directly to the manhole and represent a passive measure; the valves automatically close to prevent the backflow of sewage through a downstairs toilet in a flood event.

Replacing hard surfaces with permeable options

- Most driveways rely heavily on hard landscaping, which often creates problems during heavy rainfall, with water having nowhere to go.
- Solutions can be as simple as replacing hard landscaping with gravel, it's the cheapest permeable option and it allows water to drain quickly

Back water valve

Non-return valve

Permeable garden solutions

Collect Rainwater

- A water butt can collect rainwater from drains. Collecting the rainwater in key places will stop excess water from pouring onto the ground. Water from water butts can then be used to water plants or even wash cars.

Permeable Paving Options

- Other options to gravel are permeable paving products such as brick pavers, which have small holes to allow the water to drain through them, and cellular pavers which are made from recycled plastic and hold aggregates together. You could also consider a grass guard, which means you are still able to drive vehicles without the grass turning into mud.'

20l water butt including tap and stand connected to a downpipe

Permeable paving options

For prices and further information please contact London Borough of Waltham Forest.

wfdirect@walthamforest.gov.uk

0208 496 3000

Appendix Q - Briefing Note, Planned Borough-wide Section 19 Report

Briefing Note: Planned Borough-wide Section 19 Report, August 2021

Background:

London Borough of Waltham Forest is the Lead Local Flood Authority (LLFA) for London Borough of Waltham. As the LLFA we have a duty to investigate certain instances of flooding, to the extent that we consider it necessary. These duties are outlined within the Flood and Water Management Act 2010, Section 19. The Act states:

Flood and Water Management Act 2010: Section 19 – Local Authorities: Investigations

3) 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 -

   c) which risk management authorities have relevant flood risk management functions, and

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

4) Where an authority carries out an investigation under subsection (1) it must -

   e) publish the results of its investigation, and

   f) notify any relevant risk management authorities.

On the morning of Sunday the 25th of July at around 9am, Waltham Forest experienced widespread surface water and property flooding at multiple locations, following an extreme storm event. Local rainfall totals in some locations reached in excess of 26mm in 15 minutes and over 66mm across a 24-hour period.

Following the 25th of July event, further storms passed over Waltham Borough on the weekend of the 7th and 8th of August. This resulted in further widespread surface water and property flooding across the borough.

Both rainfall events resulted in severe disruption to the highway network and saw multiple incidents of internal and external property flooding. Some of the areas affected included locations such as Turner Road, Brooke Road, Peterborough Road in Whipps Cross and Eatons Mead.

To ensure that LBWF are fulfilling our duties as the Lead Local Flood Authority, we will now be conducting a Section 19 flood investigation report across the borough. The extent of this report and timeline for completion are detailed below.

Section 19 brief:

The forthcoming Section 19 flood investigation report will achieve a number of things. The report will: -

- Understand which risk management authorities were involved and have flood risk management functions during the events.
- Identify if each of the risk management authorities exercised, or is proposing to exercise, those functions in response to the flooding.
- Provide recommendations arising from the investigation, to limit the impact of future severe rainfall events and better protect our communities and infrastructure.

The report will consider all available data from our partner Risk Management Authorities (RMA's). This will include, Environment Agency rainfall data, Thames Water sewer data, and our own highway data, such as gully maintenance regimes.

The report will not focus on individual properties, as this is not the intended purpose of this Section 19 report. Instead, we will investigate the areas most affected to help inform on future flood mitigation options across the borough.

The flood investigation report will generally contain the following information and format:

- Background information on the areas affected, the current flood risk, and historic flood events which may have taken place.
- A high-level overview of the extent and impact of the flood event which took place, dates, times and length of event, types of flooding (such as internal/external property or commercial dwellings or highway flooding).
- Investigation detail such as photographic evidence, partner data on rainfall totals, sewer networks and maintenance regimes of drainage assets.
- Resident and community flooding reports, feedback, photos and enquiries relevant to the report. This will include reports made by the public directly to the council and those received by partner RMA's such as Thames Water.
- Feedback and information from our partner RMAs on any response they provided to the flood event. This may include assets they may have operated during the event, such as pumping stations or information on surface water sewer network capacities.
- Any Information and response to the flood event from our highway maintenance contractors and Emergency Planning Team.
- Any information pertinent to this report received from neighbouring LLFA's.
- Probable cause of the flood event based on the evidence reviewed during the investigation.
- Recommendations on future mitigation methods to reduce flood risk within the borough. These could take the form of a number of options such as, quick win schemes/actions, further investigation such as catchment modelling, development of future FRM schemes and possibly riparian landowner actions.

- Publishing the Section 19 report in accordance with the Flood and Water Management Act 2010.

- Next steps and actions following completion of the Section 19 report. This may include developing/investigating future schemes, increased gully maintenance, or sewer network maintenance requirements.

Appendix R - Table of Acronyms

LBWF	London Borough of Waltham Forest
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management
TWU	Thames Water Utilities
LFB	London Fire Brigade
LAS	London Ambulance Service
FWMA	Flood and Water Management Act
SuDS	Sustainable Urban Drainage Systems
LLFA	Lead Local Flood Authority
TfL	Transport for London
RMA	Risk Management Authority
CDA	Critical Drainage Area
FIDO	Flood Incident Duty Officer
SPS	Sewage Pumping Station
PFR	Property Flood Resilience
STW	Sewage Treatment Works
CWC	Clear Water Court
Cllrs	Councillors

Appendix S - Useful Contacts and Links

Flood and Water Management Act 2010 - Section 19:

https://www.legislation.gov.uk/ukpga/2010/29/section/19

Civil Contingencies Act 2004:

https://www.legislation.gov.uk/ukpga/2004/36/contents

Flood Risk Regulations 2009:

https://www.legislation.gov.uk/uksi/2009/3042/contents/made

Highways Act 1980:

www.legislation.gov.uk/ukpga/1980/66/contents

Water Resources Act 1991:

www.legislation.gov.uk/ukpga/1991/57/contents

Land Drainage Act 1991:

www.legislation.gov.uk/ukpga/1991/59/contents

EA – 'Owning a watercourse' Riparian ownership rights and responsibilities:

www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx

EA - Prepare your Property for Flooding:

How to reduce flood damage

Flood protection products and services.

https://www.gov.uk/prepare-for-flooding

LBWF – Local Flood Risk Management Strategy

https://www.walthamforest.gov.uk/content/flooding-and-drainage

National Flood Forum (including The Blue Pages Directory and information, help and advice on insurance)

www.nationalfloodforum.org.uk/