MAYOR OF LONDON

Surface Water Flooding in London

Roundtable progress report

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Foreword

In July 2021 London was hit by two serious flash floods, with some parts of the city receiving more than twice the average July rainfall in just two hours. The floods caused major disruption—homes and properties flooded by stormwater and sewage, more than 30 underground stations closed or partly closed, and some hospital wards evacuated. Some schools have still not seen students return to damaged classrooms as repairs continue.

Following these events, the Mayor convened a roundtable of those organisations with responsibilities for managing flooding in London to make sure everything possible is being done to improve the response to and reduce the impacts of extreme events in London.

Following the roundtable a range of actions are already in place to improve London's response to surface water flooding events. The London boroughs have established a multi-agency group to examine resilience improvements before and after flooding. Thames Water has commissioned an independent review of surface water flooding in London and an internal review of their operational and incident response. Thames Water and Transport for London are working together to apply flood mitigation measures in well-known flooding hotspots. The Environment Agency has established a new national team that is examining its strategic oversight role and has worked with the London Resilience Group on flood workshops. London Resilience is taking action to improve the communication across agencies about flooding.

The Mayor's London Plan has put in place strong development policies, meaning strategic developments are managing more surface water on-site and reducing pressure on stormwater infrastructure. The Mayor also published the London Sustainable Drainage Action Plan in 2016, providing a framework and a set of actions to help make the most effective use of London's current drainage infrastructure. Today, the Mayor has awarded £4 million through his Green and Resilient Spaces Fund to improve green spaces and help make them more resilient to floods. The Mayor, in partnership with Thames Water and the Department for Education, is also implementing the Climate Resilient Schools programme, targeting schools at the greatest risk of flooding to be better prepared and protected.

The work cannot stop there. The reality is that climate change means Londoners can expect to face extreme events like last summer's flooding more frequently. London does not have a strategic city-wide plan for surface water flooding and no organisation with legal responsibility at the city level for implementing one.

But Londoners deserve more. Partners are now working together to develop a strategic approach to managing surface water flooding now and into the future. Delivery of that plan will require clear and effective governance arrangements, greater coordination and action from all partners, and more flood protection funds from Government. Whilst we cannot entirely eliminate the risk of future severe rainfall on our city, this should ensure London and Londoners are better prepared and protected from the worst impacts of flooding on our city.

Shirley Rodrigues
Deputy Mayor Environment and Energy

Dr. Fiona Twycross
Deputy Mayor for Fire and Resilience

Executive Summary

London was hit by two extreme storms on the 12 and 25 July last year. Parts of London received close to 100mm of rainfall, the equivalent of more than twice the average July rainfall, in just two hours. The rain caused damage and disruption to homes and infrastructure across the city, and many Londoners required rehousing as their homes were flooded with stormwater and sewage. It rendered critical infrastructure unusable with the closure or partial closure of 30 London Underground stations and the evacuation of hospital wards and schools. Some of these schools have still not seen students return to damaged classrooms, as repairs continue.

London has been spared the scale of damage seen in Germany, Belgium, the Netherlands, New York, and Henan, China from rainfall in summer 2021. But some London basement properties were flooded up to near ceiling height. Under slightly different circumstances, for example if similar rainfall had occurred late at night, the story might be very different.

Mayor Sadiq Khan has said that London is at a crossroads and must act now to avoid the worst effects of climate change on our city. We are already seeing the impacts, and events of this magnitude are becoming more common. The probability of more extreme events, higher rainfall totals over larger areas and for longer periods, is increasing. Our city is not ready for the more extreme weather patterns that we expect to see over the coming decades.

There are policies in place and programmes underway to better manage surface water flood risk. The Mayor's Environment Strategy, London Plan, London City Resilience Strategy and his Green New Deal programmes are helping London respond to the climate emergency and increase resilience. So are the Environment Agency's and Lead Local Flood Authorities' flood risk management programmes. Even so, a step change in action and ambition is needed.

As there is no single authority responsible for surface water flood management, the Mayor called a roundtable meeting immediately after the July flooding to ensure that everything possible is being done to improve the response to, and reduce the impact of, these extreme events on our city. The roundtable included senior leaders from those organisations with responsibilities for responding to or managing surface water flood risk in London. The roundtable identified the need for more investment in surface water flood management, a more strategic approach to delivery, redoubling efforts in incident preparedness and response, improving communications and coordination, and improving

community resilience. While the incident response has been led by London's existing emergency management/resilience apparatus, the roundtable agreed to establish a task and finish group to examine the challenges of longer-term management of surface water flood risk in the context of climate change and recommend actions to address them.

This progress report highlights the actions taken to date and those under development by the roundtable and task and finish group.

Headline actions so far since last summer's flooding

Incident response:

- London boroughs have established a multi-agency flood group to examine resilience improvements before and after flooding.
- Thames Water has undertaken an internal review focusing on its operations, incident response, and customer communications and has commissioned an independent review of surface water flooding in London.
- The Environment Agency has established a new national team to examine its strategic oversight role and has worked with the London Resilience Group on flood workshops, and is developing flood awareness videos, working with the GLA and Hillingdon Council, including one on surface water flooding.
- The Thames Regional Flood and Coastal Committee has set up a task and finish group to make recommendations for improving the resilience of infrastructure to flood risk and set out resource requirements for implementing any projects or measures.
- TfL and Thames Water are working together to investigate and apply flood mitigation interventions in known flooding hotspots.
- The London Resilience Communications Group has taken action to improve the consistency of content and coordination of messages across agencies, for example signposting to the Floodline advice service.

Tackling the longer-term risks, key recommendations of the task and finish group:

- Commitment from lead partners, including the Environment Agency, Greater London Authority, London Councils, London Drainage Engineers Group, Thames Water, and Transport for London to establish a Strategic Group for surface water flood risk management to provide leadership, agree a vision, and develop a strategy and plan to achieve the vision:
    - Identify governance and resource for Surface Water Flooding Strategic Group by June 2022
    - Consider scope of strategic plan and initial evidence gathering by June 2022
    - Launch Strategic Group December 2022.
- Develop a supporting communications strategy that engages all stakeholders – London Resilience lead – by April 2022

- Implement a series of detailed actions identified to address the governance, funding, evidence and communications work areas outlined above – various leads beginning in April 2022
- Deliver a specific workstream to identify and reduce risk to occupiers of vulnerable basement properties – Launch April 2022.

The Roundtable will continue to meet into 2022 to ensure its findings and that of the task and finish group are being taken by the relevant agencies. It will also ensure they are shared and considered by all concerned parties to ensure an integrated improvement in London's resilience to current and future surface water flood risk. This includes a number of other reviews commissioned in response to the July 2021 flooding, for example by Thames Water and the National Infrastructure Commission and the London Assembly. Flood Risk Management Authorities (RMAs) are also carrying out post-incident reviews.

Pudding Mill Lane station: Rob Day

London Flooding Roundtable

Flooding in July 2021

The intense rainstorms of 12 and 25 July led to severe localised flooding across many parts of London. In response, Mayor Sadiq Khan convened a roundtable of key stakeholders to share information and learning about the incidents and how London responded, and to ensure that everything possible was being done to anticipate, prevent, and reduce the impact of surface water flooding in London. This report summarises the outcomes of the roundtable discussions so far, including an understanding of the incidents and the response, and the actions being taken by partners to improve London's flood resilience.

The roundtable, chaired by Deputy Mayors Shirley Rodrigues (Environment and Energy) and Fiona Twycross (Fire and Resilience), has focused on two main areas: the immediate emergency response to surface water flooding incidents and the adaptation of London to surface water flood risk in the longer term given the pressures of climate change and development. Topics covered have included:

- Gaps in governance and responsibility for the management of surface water flooding in London
- Public-facing communications about surface water flooding and points of contact for affected residents
- Forecast and warning products for emergency responders and the public
- The impacts of climate change on storms and surface water incidents
- Funding for surface water management interventions

To consider the longer-term strategic adaptation of London to surface water flooding, it was agreed that a task and finish group co-chaired by London Councils (representing London's boroughs) and the Environment Agency, who have statutory responsibilities for flooding, would be established. The group would set out the major challenges for managing the risk of surface water flooding and propose recommendations for addressing those challenges. That group presented its final recommendations to the London Councils Transport and Environment Committee (TEC) in February 2022. These are included in this report.

Incident response – findings and actions

Incident response
London was hit by two extreme storms on the 12 and 25 July last year. Parts of London received close to 100mm of rainfall, the equivalent of more than twice the average July rainfall, in just two hours. The rain caused damage and disruption to homes and infrastructure across the city, and many Londoners required rehousing as their homes were flooded with stormwater and sewage. It rendered critical infrastructure unusable with the closure or partial closure of 30 London underground stations and the evacuation of hospital wards and schools. Some of these schools have still not seen students return to damaged classrooms, as repairs continue.

London's emergency response organisations responded and deployed their capabilities largely as planned for an event of this nature. However, the sheer scale of flooding across London and the number of requests for assistance made to a range of agencies meant that there were capacity constraints (such as described under the section, Flooding impacts and emergency response), and areas for improvement as set out in this section.

As is always the case for incidents of this scale, the London Resilience Partnership undertook an extensive debrief of their collective response and produced recommendations for improvements. This review was expedited at the request of the roundtable given the urgency of the situation and the recommendations were published in September 2021. These recommendations cover weather and flood warnings and triggers, partnership coordination arrangements, real-time impact assessment, stakeholder and public communications, and community resilience.

A number of immediate actions were recommended and are in progress or complete. These include streamlining public flood communications, making sure that Londoners can reach a suitable single point of contact for advice or assistance if they experience flooding, and actions to improve the resilience partnership response, communications, and access to data.

The London Resilience Forum (LRF) flood working group is revising its flood response plan, to report to the LRF in June. This will include a revision of triggers and actions to be taken at the regional and local (borough) partnership levels and by individual response organisations.

Thames Water has undertaken an internal review focusing on its operations, incident response, and customer communications. This identified key lessons and actions, as a result of which Thames Water has:

- Reviewed its adverse weather processes, including triggers, how to collaborate with partners, how to support customers in recovering. Learning incorporated into a hydraulic flooding 'playbook,' a live operational plan for what to do in the event of expected heavy rain
- Improved call centre structures and increased their capacity to handle calls during incidents
- Improved website information and accessibility of information
- Published a sewer customer questionnaire online in order to gather information about properties at risk and the impacts of flooding

In addition, Thames Water are contributing to the LRP strategic flood response framework, working with Multi-Agency Coordination Group and on Multi-Agency flood plans in Haringey and Barking & Dagenham, and participating in borough flooding exercises. They are collaborating with Transport for London (TfL) to investigate known flooding hotspots and develop tailored solutions to manage the risk proactively.

Thames Water has also commissioned an independent review to investigate the causes of the flooding in London and how the city's resilience to surface water flood risk can be improved. The London Flood Review is being led by an independent group of external experts and overseen by a strategic stakeholder panel that includes representatives from the Greater London Authority, Transport for London, London Councils, the Environment Agency, London Drainage Engineers Group, the Consumer Council for Water, and the Thames Regional Flood and Coastal Committee. It is expected to issue its final report in Spring 2022, with interim reports at key stages before this. More information and the Review terms of reference are available on the London Flood Review web pages: https://londonfloodreview.co.uk/.

The Environment Agency has undertaken the following actions:

- Delivered two workshops with the London Resilience Group and Borough Resilience Forums to help improve understanding of flood risk management, focussing on the preparedness, response and recovery.
- Established a new national team to examine the EA's strategic oversight role and make recommendations.
- Established and chair the London LRF Working Group which oversees embedding the 30 recommendations identified through the incident debriefs to the July 2021 flooding

TfL undertook a network-wide assessment of the impacts of the July flood events to understand what the main impacts and TfL responses were, where actions could be

improved, and what data gaps exist. The findings will be integrated into TfL's Adaptation Strategy, which is currently being developed.

The Thames Regional Flood and Coastal Committee (Thames RFCC) has set up a task and finish group to consider infrastructure and resilience. This will make recommendations to the Thames RFCC in relation to a vision for infrastructure resilience for the Thames region. The Thames RFCC are in the process of recruiting to a new flooding engagement post to support Lead Local Flood Authorities with community engagement

London boroughs have established a multi-agency flood group to examine resilience improvements before and after flooding. Actions in progress include:

- Implementing a mapping system using Resilience Direct and incorporating the National Underground Asset Register, a digital map of underground pipes and cables to support more efficient utilities works.
- Producing a template to enable information sharing about flooding locations, impacts, and responses.
- Producing a data sharing agreement to enable use of CCTV footage as part of incident response.

The London Resilience Communications Group has taken action to improve the consistency of content and coordination of messages across agencies, particularly those that the public is more likely to contact. It has taken the following actions:

- Greater consistency in public facing advice (based on the content on the London Fire Brigade's (LFB) website) and promotion of a single helpline (Floodline) for the public.
- **London Councils** has shared updated links and contact details with all borough communications teams, and has held a briefing for Directors of Communications to share learning from boroughs directly impacted by last year's flooding
- **London Fire Brigade** has developed digital content as part of a warning and informing strategy to drive people to the online advice, focusing on mobilisation, sandbags, and grab bags.
- The LFB is also working on materials that will support an operational communications response in the event of an incident, to provide information about the response from an LFB spokesperson.

In addition, three videos on different types of flooding are in development by the Environment Agency, Greater London Authority, and the London Borough of Hillingdon. These will be available to use at key moments, including bad weather, London Rivers Week, and London Flood Awareness Week.

Roundtable partners widely agreed that current funding for urban surface water flooding protection schemes, and the process for accessing funding, as well as funding for borough highways maintenance, is inadequate. Flood risk schemes in urban areas are typically too small in size to attract national flood risk funding, but we know they offer significant benefits for a modest investment. Flood and highways authorities also need sufficient resource to implement measures and maintain drainage infrastructure effectively. The Mayor has written to Government urging them to acknowledge the limitations of its flood risk funding mechanisms and address this funding gap.

Table 1: Emergency response actions

Action	Owner	Timeframe
Enhancements to resilience partnership coordination arrangements with a more forward learning stance on convening Resilience Partnership teleconferences to aid multi-agency information sharing and coordination in response to flood warnings.	London Resilience Group, Met Office, Environment Agency	Complete
Improve fast-time communications between local authorities and Thames Water during the response to surface water / sewerage flooding events.	Local authorities, Thames Water	Complete
Review of London Strategic Flood Response Framework and London Severe Weather & Natural Hazards Framework, including warnings and trigger levels, and actions to be taken by response organisations.	Environment Agency, UK Health Security Agency, London Resilience Group	June 2022
Review of Borough level Multi-Agency Flood Plans (MAFPs) to take account of learning from July 2021 flooding and feedback from the autumn/winter 2021 review of MAFPs by Defra.	Borough Resilience Forums (BRF), Thames Water	2022 (actual review dates are scheduled by BRFs)
Scope and if feasible commission a project to develop a partnership-wide approach to the fast-time collation of information about the location and extent of flooding impacts.	TBC in conjunction with wider stakeholders	Scope April 2022
Confirm roles, responsibilities and arrangements in place for the clearance of trash screens and gullies ahead of heavy rainfall events. Includes	Local authorities, LoDEG, Thames Water, Transport for London,	Ongoing, starting by March 2022

Action	Owner	Timeframe
identification of relevant assets and coordination of maintenance schedules.	Environment Agency	
Develop a coordinated public communications response for surface water flooding based on the London Resilience Communication Group (emergency response) Framework	London Resilience Communication Group	Complete
Increase capacity to handle calls from Londoners affected by flooding	Thames Water	Immediate/ complete
Thames Water independent expert review	Thames Water	Spring 2022
A request to Government for adequate funding for flood and highways authorities to allow them to implement flood risk management measures and maintain drainage infrastructure.	GLA	Immediate/ Complete

Longer-term management of surface water flood risk – findings and actions

Even when fully implemented, the improvements in emergency response arrangements will only go so far in improving the experience of Londoners during future flooding events. In most cases, emergency responders cannot prevent surface water from entering homes, business, and infrastructure. Prevention and reducing exposure where possible will be needed, considering the longer-term impacts of climate change.

Roundtable meetings are split into two discrete sections to cover current emergency and operational response issues as above and longer-term climate change adaptation issues. Early actions to come out of the longer-term impacts section of the roundtable included the Mayor calling on government for more funding—for surface water management particularly for flood and highways authorities to allow them to implement flood risk management measures and maintain drainage infrastructure through the comprehensive spending review.

Another key action was the establishment of a task and finish group led by London Councils and the Environment Agency as the bodies with the main responsibility for dealing with the emergency and longer-term response to surface water flooding. The group's role was to consider the major challenges to surface water flood risk management and provide recommendations to London Councils' Transport and Environment Committee (TEC), which represents London's boroughs on issues related to the implementation of city-wide, national, and international transport and environment policies. These challenges were grouped under four main themes:

- *Governance:* responsibility and accountability for managing the risk is distributed among a variety of bodies, with no strategic coordination or oversight, and no articulation of a strategic plan for London. There is work underway by boroughs and other organisations to manage the risk, but there is no consistency of approach, no overarching vision or common understanding of what the target levels of resilience are, or of what cumulative effect current action is having compared to what is needed. There are also gaps in capacity to improve resilience which need addressing.
- *Funding:* Government mechanisms for funding flood risk management currently disadvantage localised schemes in cities, which are often too small to justify the expensive and labour-intensive process of applying for the funding. Funding is also needed for other physical improvements including adequate maintenance or upgrade of drainage infrastructure, as well as for evidence, including modelling and

monitoring, for example to identify the optimal locations for interventions, and data on assets.

- *Evidence* itself is needed, as mentioned above to identify the optimal locations for interventions, but also for improving understanding of our current and target levels of resilience. For example, what are the limitations of interventions like SuDS? How can we effectively measure the performance of SuDS interventions? What would a plausible worst-case climate scenario mean for planning? How can we get a better picture – and more consistent across London - of our existing surface water assets as a means to improve maintenance and plan for new assets if and where required?
- *Promoting household/community resilience* means improving awareness of the risk and increasing take up of resilience measures like insurance, property-level flood protection, and flood planning where appropriate. This includes the potential for early warning, targeted communications and critically, must also reach those at greatest risk, for example in basement properties.

In some areas, notably around household/community resilience, the work streams proposed by the task and finish group address areas covered by the recommendations of the London Resilience Partnership (LRP) incident debrief; this is expected and LRP representatives attend the task and finish group to help ensure that the work streams are collaborating to avoid duplication.

The final recommendations of the task and finish group are outlined in the table below.

Table 2: Task and finish group recommendations

Recommendations
Governance/Strategic Planning The Task and Finish group recommends the establishment of a Surface Water Flooding Strategic Group to provide leadership on strategic-level surface water management in London; agree a vision for how to manage the increasing risk of surface water flooding in London; develop a surface water flooding strategy and plan to achieve this vision, develop a supporting communications strategy, and determine the delivery mechanisms and resources required to implement and monitor the plan. In designing the Strategic Group, strategy, and plan, consideration will be given to how broader climate change risks, such as heat, drought, and wind can be considered in the future. A Transition Group comprising representatives of the Task and Finish Group will work through September 2022 to support the establishment of the Strategic Group and its work by developing the scope for the strategy and plan; proposing the Strategic Group's governance structure and processes; identifying the resources required to develop the strategy and plan and the funding opportunities to realise them; and

Recommendations
initiating the standardisation and collation of the evidence to support the strategy and plan. The timeline for delivery of these recommendations is as follows: • Recommendations agreed by Task and Finish Group February 2022 • Identify governance and resource for a Surface Water Flooding Strategic Group by June 2022 • Consider scope of strategic plan and initial evidence gathering by June 2022 • Launch Strategic Group December 2022.
Funding • Undertake work to identify the level of resource required to support the Strategic Group and develop and implement the strategic plan. • Support for smaller flood risk management schemes and ability to access funding to be requested from Government by London Councils TEC • RMAs and London Councils TEC to consider what future resource might be offered to support this work
Evidence • Map vulnerable infrastructure and places (people, basements and key infrastructure) with a particular emphasis on understanding the situation concerning basements and the level of vulnerability of residents there. • Develop an agreed template and standards for collecting relevant evidence and for modelling. • Develop a memorandum of understanding for sharing data amongst partners. • Review what models are required to support the development of the London surface water strategy and plan, and how these should be achieved. • Put together a bid for Thames RFCC and Thames Water to fund modelling to inform Drainage and Wastewater Management Plans and Local Flood Risk Management Strategies. • The ARCADIS strategic SuDS identification work carried out for the London Strategic SuDS pilot should continue, focusing on priority hotspots. Secure government/Thames RFCC funding to extend the approach to the rest of London • Collect evidence on financial and other, more intangible savings achieved through the avoidance of surface water incidents. • Create and populate a centralised datastore that can collate and manage the gathered data. Identify which organisation is most suitable custodian • Work with the Met Office and other providers to agree the data that should be provided to RMAs and other relevant agencies (such as the estimated return

Recommendations
periods of rainfall events) to help understand the impacts of flooding and improve response planning. • London Councils TEC to support boroughs in responding to this review of existing resource, governance, and evidence.

Communication
• Development of public communications that places flood risk as part of an ongoing development of community resilience with regard to incidents which may increase in frequency and intensity due to climate change and focuses on improving public understanding of:
  • current and future risk levels,
  • roles and responsibilities of the different organisations
  • actions that can be undertaken by the public to prepare for and lower the risk of surface water flooding to them (including financial risk through e.g., adequate insurance).
• Develop a supporting communications strategy that engages all stakeholders, from communities at risk of flooding to RMAs, regulators, regional and national government – by April 2022

Basement properties • Establish a specific workstream to determine how best to prevent harm to people living in basements – considering identifying areas or properties at high risk of basement flooding and determining how best to use this information to improve their flood resilience, both before flooding occurs and in improving response during a flood incident. By April 2022

Thames Water has also commissioned an independent expert review of the July flooding to assess the performance of drainage assets and make recommendations about how changes to the drainage system, operations, and policies could improve resilience to future storms. The findings of this review will inform efforts to plan strategically for surface water flood risk management in London.

Other ongoing reviews into the recent surface water flooding include a Chartered Institute of Water and Environmental Management review of surface water flood risk and the National infrastructure Commission's (NIC) review of surface water flooding, both of which are underway. In December 2021 the GLA responded to the NIC's Call for Evidence to in December 2021 which will inform their investigation and report on surface water flooding, due in the autumn this year. The London Assembly's Fire, Resilience, and Emergency Planning (FREP) Committee and its Environment Committee are also both investigating London's preparedness and response (see Appendix D).

London's surface water flooding: the risk and current management

Surface water flooding in context

The types of flood risk that affect London are tidal flooding, fluvial (river) flooding, surface water (pluvial) flooding, sewer and groundwater flooding. The London Risk Register determines surface water flooding to be a Very High Risk. This means it is a critical risk requiring immediate attention. Further information about the London Risk Register and arrangements for incident response can be found in Appendix D.

Surface water flooding is perhaps the most challenging flood risk to manage as it is difficult to predict both in terms of timing and location. It occurs when the drainage system becomes overwhelmed and rain cannot get into local drains, sewers or watercourses. It can be caused either by the sheer intensity of rainfall or by infrastructure failure, such as blockages within the drainage network. London's surface water flooding is exacerbated by increasing areas of impermeable surfacing, such as roads, roofs, and pavements, and a Victorian drainage system never designed for the current levels of population. In London, there are more than 200,000 residential and commercial properties at risk of flooding from heavy rainfall events, and 43 percent of hospitals and 44 percent of utility sites are in high flood risk areas.[1]

The sporadic, localised, and intense nature of summer convective storms makes it hard to predict accurately when and where surface water flooding will occur. This means it is difficult to provide a reliable warning or alerts system. While mapping and modelling have given risk management authorities (RMAs) some understanding of where surface water flooding is likely to occur, residents may not know the risk they face, how to reduce it, or how to respond during a flood. It is expected that heavy intense storms will occur more frequently due to climate change. Recent events have shown that the current level of risk and vulnerability of homes and infrastructure may already be unacceptable and without action we expect this to increase further (see below).

Climate change and the risk of surface water flooding in London

The intense rainstorms that cause flooding are expected to become more frequent with global warming, because warmer air can hold more moisture. Research by the Met Office

[1] Greater London Authority. London Regional Flood Risk Appraisal 2018. Online at https://www.london.gov.uk/sites/default/files/regional_flood_risk_appraisal_sept_2018.pdf

shows that extremely heavy rainstorms (>30mm in an hour) will be twice as likely by the 2030s.

Currently, almost-stationary intense rainstorms are uncommon in Europe, but in the future are expected to occur across the continent, including in the north. This slower storm movement increases rainfall amounts accumulated locally, and in turn the risk of surface water flooding beyond what was previously expected.

While there has been no study into the role that climate change played in London's July flooding, the intense rainfall in London in July is illustrative of the type of event we expect to become more frequent in the future. A recent climate attribution study of the storms in Western Europe in summer 2021 has shown that climate change made the one-day rainfall in July in Germany, Belgium, and The Netherlands more intense - increasing the intensity of the rainfall by between 3 and 19 percent.[2]

The numbers of statutory flood investigations undertaken by Local Authorities in London show that the frequency of these events is increasing, with multiple events occurring each year.

Current urban drainage systems are based on historically lower rainfall intensities and will not be able to cope with the significant increases in the intensity of heavy rainfall that are expected with global warming. Work under the UK Climate Resilience FUTURE DRAINAGE project is translating the UK Climate Projections (UKCP Local) into tailored climate change uplifts to inform future urban drainage design.[3] The new uplifts are greater than current climate change allowances used in design standards, suggesting that these allowances will need to be revised.

Responsibility for managing surface water flood risk

The management of surface water flood risk in London is dispersed among a range of organisations with different responsibilities and accountabilities, as set out below. The Flood and Water Management Act specifies that surface water flooding is the responsibility of local authorities, designated as Lead Local Flood Authorities (LLFAs). In London this means there are 33 responsible authorities, one for each London borough and the City. There is no single responsible authority or agency bringing together the work of the individual LLFAs into a holistic picture for London.

[2] Kreienkamp, F., et al. (2021). Rapid attribution of heavy rainfall events leading to the severe flooding in Western Europe during July 2021. *World Weather Attribution*. Online at https://www.worldweatherattribution.org/wp-content/uploads/Scientific-report-Western-Europe-floods-2021-attribution.pdf

[3] FUTURE DRAINAGE Guidance for Water and Sewerage Companies and Flood Risk Management Authorities: Recommended uplifts for applying to design storms. JBA Consulting, July 2021. Online at https://artefacts.ceda.ac.uk/badc_datadocs/future-drainage/FUTURE_DRAINAGE_Guidance_for_applying_rainfall_uplifts.pdf

Outside of London's emergency response framework for flooding, which sets out the coordination and strategic level planning for and response to a flooding incident, there is currently no strategic plan for managing the risk in the longer term. Whilst action aimed at addressing it is happening in pockets across the city, this is piecemeal, with no coordination or measurement of how it contributes to overall levels of flood resilience.

Given this the Mayor of London through his London Plan, the London Environment Strategy, and the Mayor's Transport Strategy set a framework of policies to support adaptation to climate change, including managing surface water flood risk through sustainable drainage interventions. For example, the London Plan includes a drainage hierarchy requiring new development to achieve significant reductions in run off rates and to store water within the development close to where it falls. Where possible this should be achieved through green infrastructure designed to manage water. London's urban greening factor policy also encourages the design of green space to manage water. At the local scale, the London Plan discourages development proposals that include impermeable surfaces, and the Mayor has produced guidance on depaving, which sets out how to go about it and the benefits of doing it.

The Mayor's Green New Deal programmes, including Greener City, Grow Back Greener, and Green and Resilient Spaces funds, have contributed over £20m since 2016 to help London adapt to climate change, including through retrofitting of sustainable drainage. £1.8 million has funded more than 40 projects specifically addressing surface water flood risk. Examples include rainwater capturing at Camley Street Natural Park, sustainable drainage features along Acklam Road in North Kensington's Swinbrook Estate and creating swales and ponds on Streatham Common.

Appendix B provides detail about a range of strategies, policies, and plans relevant to managing surface water flood risk in London.

Strategic policy and responsibilities

The Department for Environment, Food and Rural Affairs (Defra) is the policy lead for flood and coastal erosion risk management in England. New or revised policies are prepared with other parts of government such as the Treasury, the Cabinet Office (for emergency response planning) and the Department for Levelling Up, Housing and Communities (for land use and planning policy). These national policies are then delivered by Risk Management Authorities (RMAs). Those relevant to London are:

- Environment Agency
- Lead Local Flood Authorities
- Water and sewerage companies
- Highways authorities

Flooding is a complex hazard where multiple sources often interact, for example surface water, sewer and river flooding. It requires coordination between different Risk Management Authorities.

Defra has a Surface Water Management Action Plan for England. In July 2021 it published a policy update on surface water management that reported against the 22 actions in the Plan. While some actions will be useful, including improvements to risk mapping others need to go further or better reflect the specific issues urban areas face. Defra has made welcome improvements to the mechanisms for funding flood risk management interventions, but these don't yet go far enough to enable funding for small urban schemes.

In addition to national flood policies set by Defra and other government departments, and the national flood risk and coastal erosion risk management strategy prepared by the Environment Agency, there are local flood risk management policies in place at the London wide and borough level (see Appendix B).

The Environment Agency officially has the strategic overview responsibility for all types of flood risk works closely with Lead Local Flood Authorities, who are responsible for surface water and other RMAs in order to manage the risk. The Environment Agency has no formal operational role, nor funding from Defra, for the operational management of surface water flooding. In the event of surface water flooding the Environment Agency will support partners in responding to this if resources are not needed for fluvial or tidal flood response. The table below shows which organisations manage flood risk day to day, which may be different from those leading during the response and recovery phases, the processes for which are below.

Water companies are responsible for managing public sewers. In London, Thames Water provides the drainage services and manages London's sewer network and wastewater treatment facilities. Thames Water is working with stakeholders on a Drainage and Wastewater Management Plan, which will support their future wastewater management planning process. A consultation on this plan will be published in summer 2022.

Regional Flood and Coastal Committees (RFCC) are responsible for coherent plans for identifying, communicating and managing flood and coastal erosion risks across catchments and shorelines; for promoting efficient, targeted investment in flood and coastal erosion risk management; and for linking between flood risk management authorities and other relevant bodies to develop mutual understanding of flood and coastal erosion risks in their areas. RFCCs are responsible to the Department for Environment, Food, and Rural Affairs (Defra). The Thames RFCC is looking at how it can support improvements in how surface water is managed and flood risk management interventions funded. This includes increasing current funding for surface water schemes.

Table 3: flood risk responsibilities

Organisation	Flood type risk								
	Main rivers (large rivers) and Coastal	Ordinary watercourses (small rivers)	Surface water	Ground water	Sewer flooding	Road drainage	Offsite reservoir	Onsite reservoir	Canals and artificial waterways
Environment Agency	X								
London Boroughs (Lead Local Flood and Highways Authorities)		X	X	X		X Non Motorway or TLRN (Transport for London Route Network) roads	X		
National Highways						X Motorway Roads			
Transport for London (TfL)						X Red route roads TLRN			
Utility Companies					X				
Canal and Rivers Trust									X
Reservoir Owner								X	

Source: London Strategic Flood Response Framework (adapted)

Cycleway raingardens: Enfield Council

Drainage infrastructure, surface water management programmes and interventions
In addition to the formal policies and plans above there are a range of other activities underway that affect or are working to reduce surface water flood risk in London. These include:

- The London Sustainable Drainage Action Plan, published by the Mayor in 2016, sets out actions to increase the uptake of sustainable drainage (SuDS). It focusses on how SuDS can be delivered as part of other redevelopment, maintenance or street works schemes. The plan has also produced SuDS guidance and training for practitioners across sectors including retail, education, and healthcare.

- The Mayor's grant programmes have to date provided £20 million of funding for green infrastructure and climate resilience measures in parks and in the public realm, new local green infrastructure, and de-paving of hard surfaces to improve surface water management. These areas now form a key part of the Green New Deal for London recovery mission, jointly led by the Mayor and London Councils.

- Integrated Water Management Strategies/Plans (IWMS) are partnership projects between organisations with responsibilities for managing water, including boroughs, Thames Water, and the Environment Agency. They set out a more integrated approach for planning water supplies and flooding infrastructure. Focusing on the Mayor's growth areas, IWMSs move away from plot-by-plot solutions to identify broader strategic measures for managing surface water. These may include using green space for surface water storage or storing water for re-use. Such measures reduce flood risk and pressure on the drainage network.

- The London Strategic SuDS Pilot is a recent and ground-breaking partnership project, the first phase of which completed in 2021. Through detailed modelling, it demonstrates how aggregation of small SuDS schemes could deliver a collective flood risk benefit comparable to larger schemes. This allows boroughs to estimate potential costs of installing SuDS in optimised locations where they deliver the greatest benefit. By demonstrating these benefits, the aims to reinforce the case for national flood funding. The project has helped unlock £1 million from the Thames RFCC to deliver SuDS in London over the next six years. While this is only a fraction of the investment in surface water management required, it demonstrates successful proof of concept and the need to roll out the approach more widely.

- The Government's Flood and Coastal Resilience Innovation programme is funding two London boroughs, Barnet and Richmond-Upon-Thames, to deliver projects that will demonstrate how natural flood management can address flooding in urban areas and deliver property-level resilience and community preparedness. Other Innovation programme funded schemes across the country are looking at warning and informing and improvements for surface water schemes. The learning from those will also help inform future surface water work in London.

Delivery of SuDS by Lead Local Flood Authorities, borough and TfL Highways teams, and Thames Water is becoming more commonplace as a means of managing surface water by slowing the flow of water into London's drainage network. The Thames RFCC has established the Thames (catchment) Flood Advisor team to support Lead Local Flood Authorities in developing flood schemes and bidding for funding to the RFCC. But these programmes of retrofit and the scale of funding are unlikely to be enough at the current scale to keep pace with the growing risk London faces from surface water flooding.

Bridget Joyce Square raingardens (LB Hammersmith & Fulham)

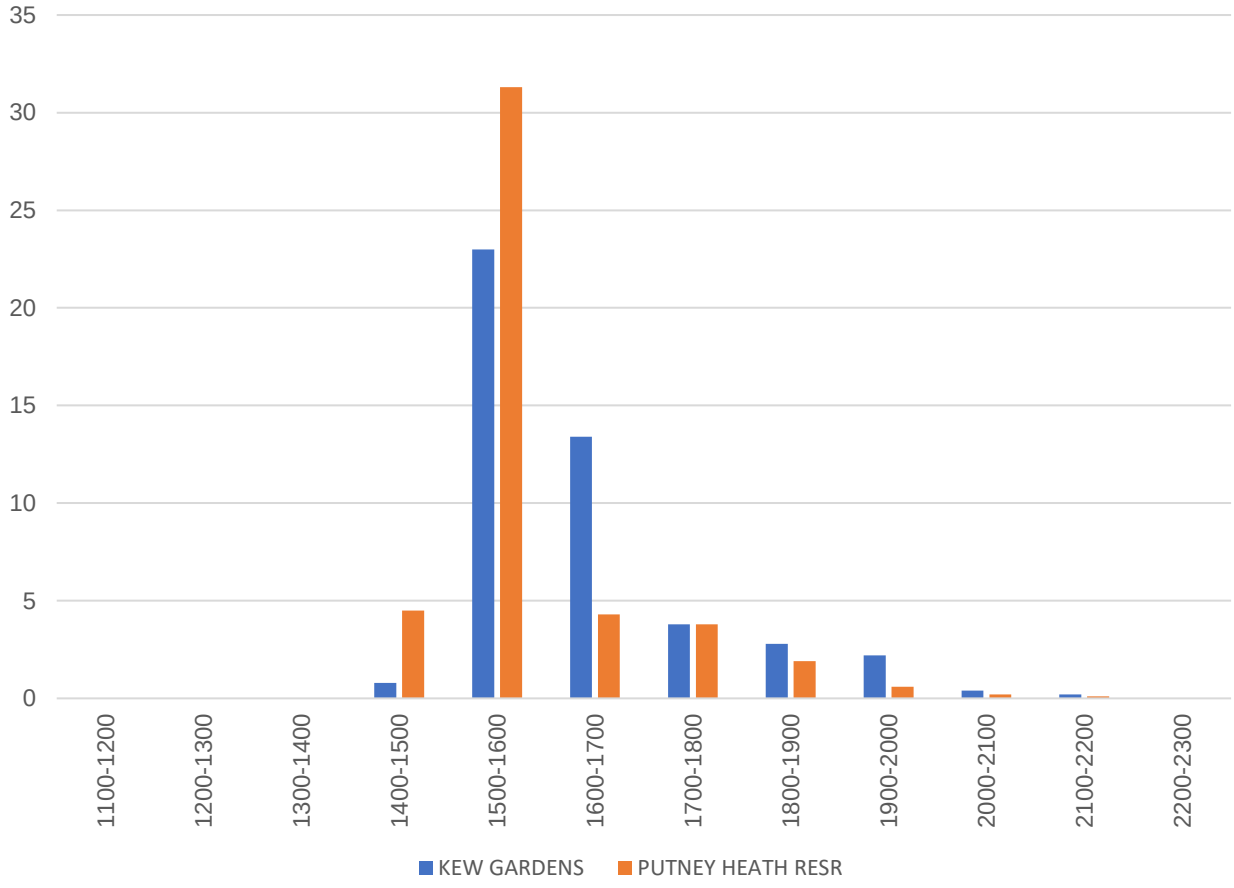
Overview of summer 2021 flooding incidents in London

Rainfall

The official network of rain gauges in London is sparse, making it difficult to have a fully accurate picture of how much rain actually fell on the 12th and 25th July. Because intense rainstorms are very localised, it is highly likely that the most intense rainfall missed the official Met Office gauges or the semi-official network of Environment Agency gauges.

The Met Office has conducted an analysis of the data from official, semi-official, and unofficial rain gauges for the 12 July rainfall.

Figure 1: Hourly Rainfall 12 July 2021

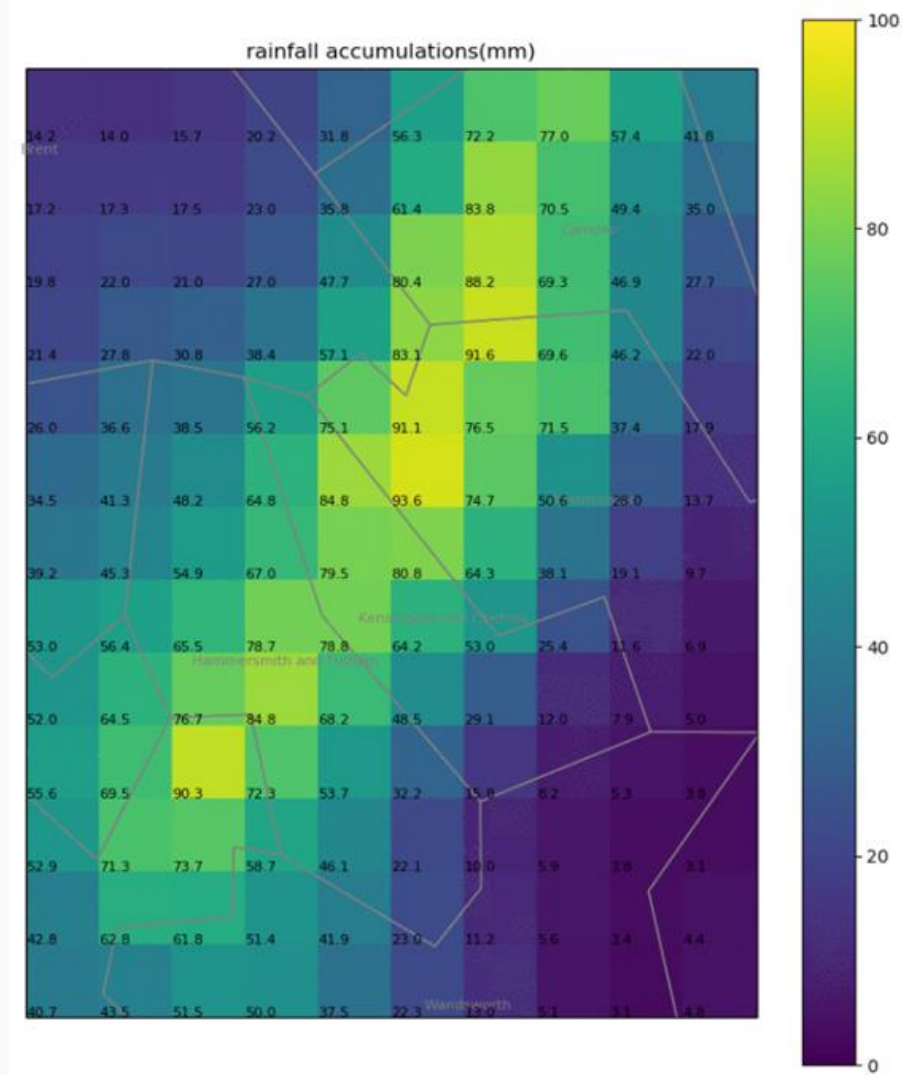


Source: Official (Met Office) / Semi-official (Environment Agency) rainfall figures

The Met Office has also completed some radar analysis of how much rain fell in 1 km grid square and this showed, on the 12th July, a narrow swathe of London saw rainfall totals exceeding 80 mm, falling in a relatively short space of time, with some over 90 mm. The image to the right shows the rainfall totals, using radar analysis, for the period of 1400-2100 on 12th July.

By taking the rainfall gauge data, both official and unofficial, and looking at the radar analysis it is possible to say that some locations in London saw close to 100 mm of rain in the space of just two hours—or more than twice the average July rainfall—on the 12th July.

This is an unusual event for London, but it is not unprecedented, with other past events showing similar rainfall totals or more. The most famous past event would be the Hampstead storm of the 14th August 1975 when 170.8 mm of rain fell leading to considerable damage to property and disrupted public services.



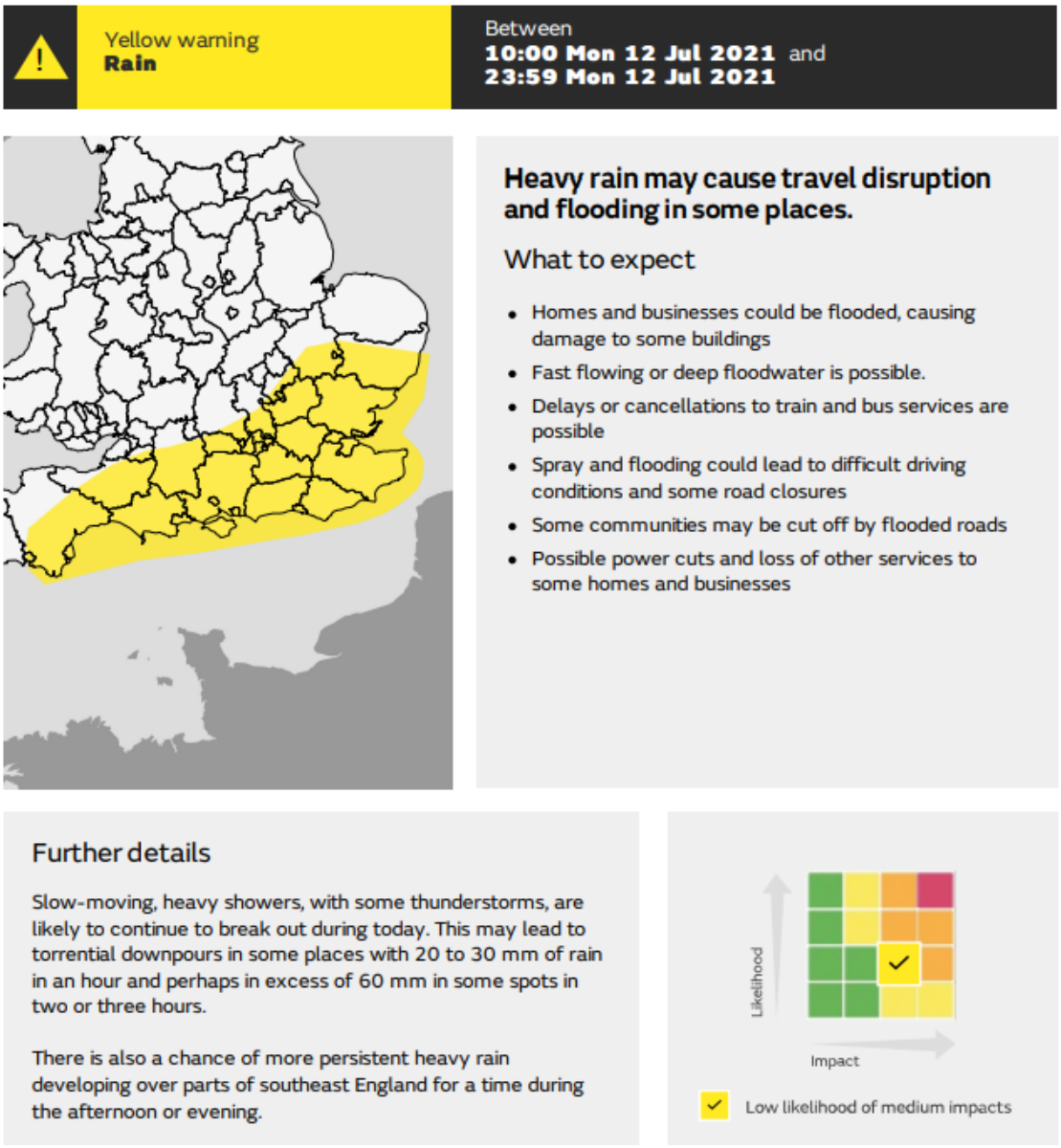
Flooding impacts and emergency response

July 12

- The Met Office issued a Yellow Rain Warning (Low Likelihood of Medium Impacts) valid from 10.00 to 23.59 on Monday 12th July. This was issued to the London Resilience Partnership via email at 09.40 along with further advice from the Met Office Advisor (Civil Contingencies) and the Environment Agency (EA). The Flood

Forecasting Centre issued a Yellow Flood Guidance Statement (Low Likelihood of Significant Impacts) at 10.27.

- The Environment Agency issued four fluvial flood alerts in London.



- The London Fire Brigade declared a Major Incident due to heavy rainfall creating serious flooding, predominately across the south-west and north-west of London.[4] The Boroughs affected included Kensington & Chelsea, Hammersmith & Fulham,

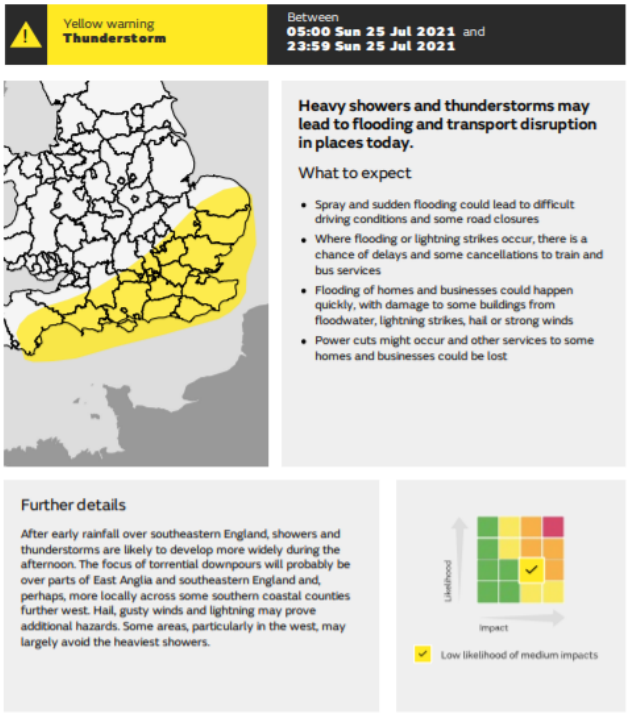
4 A Major Incident is an event or situation with a range of serious consequences which requires special arrangements to be implemented by one or more of the emergency responder agencies (e.g. the emergency services or local authorities). For a full explanation, see the London Emergency Services Liaison Panel Major Incident Principles, December 2021

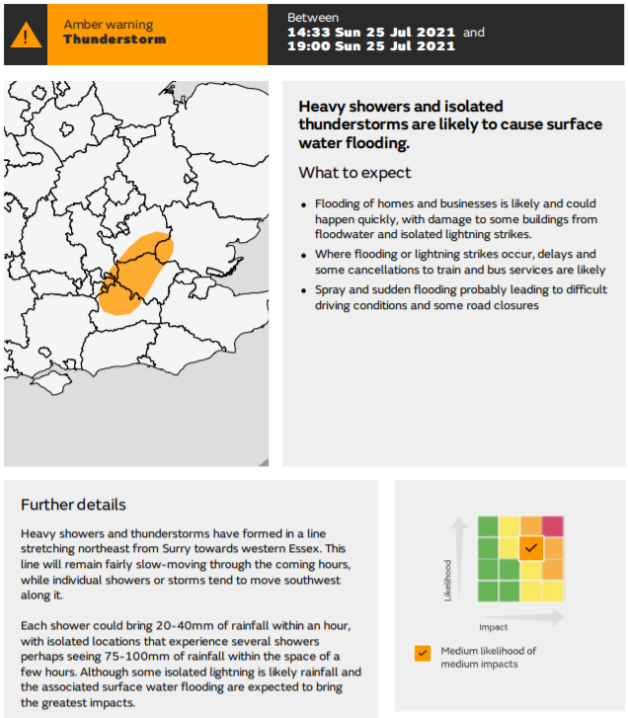
Wandsworth, Hounslow, Hillingdon, and Westminster. However, many other boroughs saw a significant increase in flood-related calls.

- Following the declaration of a Major Incident, the London Resilience Group convened a London Resilience Partnership teleconference held at 20.30 to share information about the situation and the emergency response, and to discuss key issues and decisions required. This resulted in actions to make further contact between partnership organisations and convene a further teleconference if required, to share details of vulnerable persons in areas affected by flooding, and for the London Resilience Communication Group (a group of public communications representatives of resilience partnership organisations) to agree and share public communications messages.
- By midnight 12 July 2021 LFB recorded 1,755 incidents. It is estimated that LFB Control dealt with 3,000 calls between 12 July and 13 July. The data makes this the busiest period for the Brigade ever recorded. Due to the volume of 999 calls LFB Control triggered a request for additional control officers to recall to duty to assist. Existing arrangements were implemented that diverted the overflow of calls from LFB to the North-West Fire Control, Staffordshire, and West Midlands Fire Control. The call volume was such that all fire control rooms in the UK were asked to receive calls.
- The sheer number of incidents led to mutual aid from bordering Fire and Rescue Services (FRS). This is LFB's arrangement for accessing cross border support from other FRSs.
- The type of calls received included those that were considered both life threatening and non-life-threatening calls, examples include:
    - vehicles stuck in high water with people trapped inside
    - flooding in residential premises including properties where people needed assistance evacuating or rescue
    - flooding where there was a danger of fire and partial collapse of structures due to water.
- The Royal Free Hospital's main site in Hampstead was impacted by surface water run-off from the heavy rain with some rain entering the Children's Emergency Department and Heart Attack Centre. Consideration was given to requesting London Ambulance Service (LAS) implement an overnight redirection of emergency ambulances, however the impacts were resolved locally, and the redirection was not required.
- Most of the services on the Transport for London network were severely disrupted. On the London Underground network, 16 stations had to close fully or partially. On the London Overground the flooding severely damaged and overwhelmed all assets (points, signalling, AC/DC power etc.) in the affected areas. On the surface road network, several locations were adversely impacted.

July 25

- The Met Office issued a Yellow Thunderstorm Warning for heavy showers and thunderstorms valid from 05.00 to 23.59 on Sunday 25th July 2021. This was originally issued at 11.29 on Friday 23rd July and updated at 09.50 on 25th July. The Flood Forecasting Centre issued a Yellow Flood Guidance Statement (Low Likelihood of Significant Impacts) at 07.04 on Sunday 25th July 2021.
- The Met Office warning was later upgraded for the area most likely to see significant impacts. At 14.33 on the 25th July an Amber Thunderstorm Warning for heavy showers and isolated thunderstorms was issued valid from 14.33 to 19.00 on 25th July.
- The Environment Agency issued 13 fluvial Flood Alerts and two fluvial Flood Warnings.





- Two Major Incidents were declared by partner agencies on 25 July 2021.
- The Metropolitan Police Service (MPS) declared a Major Incident for Charlie Brown's Roundabout (A406/A1400/A113) due to serious flooding and life risk - several vehicles were stuck in water of approximately 600mm with people trapped inside. A systematic search was undertaken to confirm no persons trapped.
- Following the declaration of a Major Incident, the MPS convened a London Resilience Partnership teleconference with selected partnership organisations held at 18:30. The teleconference was initially convened to assess the situation at Charlie Brown's Roundabout and determine next steps. However, the meeting went on to consider the flooding situation more broadly including properties at risk of flooding and the potential need for evacuation, and impacts on the NHS. The

teleconference resulted in actions to confirm the situation assessment and for further contact between specific partnership organisations. A further teleconference was provisionally scheduled for 21.00 and later cancelled as not required.

- Barts Health NHS Trust also declared a Major Incident due to flooding at two sites. The paediatric emergency department at Newham University Hospital site in Plaistow was impacted due to suspected sewage contamination. The adult Emergency Department and paediatric walk-in service continued to function, although a temporary redirection of London Ambulance Service paediatric patients was implemented.
- Whipps Cross University Hospital in Leytonstone was affected by flooding in their basement and energy centre by up to three feet of water. This impacted their ability to use power and the failure of the back-up generators rendered three wards inoperable. An LAS redirection was implemented to support the hospital.
- 103 patients across three wards were relocated with the help of the London Fire Brigade to move patients to ambulances. LAS crews remained on scene for over 15 hours. NHS England and NHS Improvement (London) did not declare a regional NHS Major incident; however, support was provided to the northeast London System as well as supported to Barts Health.
- The Environment Agency supported the NHS and LFB at Whipps Cross University Hospital overnight helping to pump out flood water from the basement.
- The incident concluded for the NHS on 29 July.
- The LFB received large volumes of calls to weather-related incidents and flooding predominately across the south-west and north-east of London. The Boroughs that were affected included Waltham Forest, Redbridge and Barking and Dagenham. However, many other boroughs saw significant increase in flood related calls.
- At the peak of the incident LFB recorded approximately 1,000 flood related incidents with the total number of calls to totalling 1,545. LFB attended 759 incidents by midnight.
- Most of the services on the Transport for London network were severely disrupted. On the London Underground network, 14 stations had to close fully or partially. On the London Overground the flooding severely damaged and overwhelmed all assets (points, signalling, AC/DC power etc.) in the affected areas. On the Surface road network, several locations were adversely impacted.

Section 19 of the Flood and Water Management Act (FWMA) 2010 requires Lead Local Flood Authorities to conduct a flood investigation after a “significant” flood to provide a clearer understanding of the events leading up to the flooding, numbers of properties flooded, which Risk Management Authorities are exercising their functions in response, and what immediate actions and possible solutions should be implemented. “Significant” is determined by certain criteria, for example flooding of five or more properties and/or damage and disruption to critical infrastructure and buildings such as major roads and hospitals.

As part of producing the Section 19 report, LLFAs should collaborate with the local community and those affected, drawing on detailed local knowledge and proposed solutions in making its recommendations. The LLFA must then publish the results of the investigation and notify RMAs of their findings. There is no required timetable for the publishing of a Section 19 report. Early examples of Section 19 reports covering the Summer 2021 floods have been published by Haringey, Havering, and Westminster. Others are in progress, and in some cases, awaiting the outcome in Summer 2022 of the independent review of the flooding commissioned by Thames Water.

Flooded residential basement property, London, July 2021. (Credit: Local Resident)

Conclusions/next steps

Actions taken to improve procedures and communications in the wake of the July 2021 flooding have already made us more prepared than last summer to respond to future storms. To manage the risk of surface water flooding in the longer term, the Mayor's flooding roundtable has put in place the foundations to enable key partners to work collaboratively to develop the first London-wide strategy and plan for managing the risk in the context of a changing climate.

The London flooding roundtable will continue to meet during 2022 to ensure that its recommendations are implemented and the appropriate actions taken. Continued collaboration among key partners will ensure that learning and expertise are shared to inform other London-wide and national reviews commissioned in response to the July 2021 flooding. These include Thames Water's independent review and the National Infrastructure Commission's study into approaches to managing surface water flooding. And the evidence from these reviews will, in turn, support the development of strategic planning for surface water flood risk management in London.

Alongside the actions identified by the roundtable and task and finish group, partners will continue working together to influence government—using expertise and evidence of London's good practice to make the case for appropriate national funding, policy, and regulation to improve London's resilience to surface water flood risk.

Appendix A: Members of the Mayor's flooding roundtable

Affinity Water
Confederation of British Industry
Department for Environment, Food, and Rural Affairs (Defra)
Department for Levelling Up, Housing and Communities (DLUHC)
Environment Agency
Greater London Authority
London Climate Change Partnership (LCCP)
London Councils (LC)
London Drainage Engineers Group (LoDEG)
London Resilience Group (LRG)
Met Office
Ofwat
SES Water
Thames Water
Transport for London (TfL)
London Chambers of Commerce and Industry
CELC Leaders Committee
Metropolitan Police
London Fire Brigade
London Councils Transport and Environment Committee (TEC)
RB Kensington and Chelsea
RB Kingston upon Thames
Westminster City Council
LB Lambeth
LB Hounslow

Appendix B: Flood risk policies and plans

Regional Flood Risk policies and plans

Policy	Description
Environment Agency Thames Catchment Flood Management Plan 2009	An overview of the flood risk across the river catchment and recommended ways of managing the risk now and over the next 50 to 100 years.
Environment Agency Thames River Basin Flood Risk Management Plan (2015 - 2021) 2016 New Draft FRMP 2021 currently being consulted on.	FRMPs are strategic plans that set out how to manage flood risk in nationally identified flood risk areas (FRAs) for the period 2021-2027, and are statutory plans required by the Flood Risk Regulations 2009. Greater London Thames RoFSW Flood Risk Area
Environment Agency Thames River Basin District River Basin Management Plan 2018 Draft river basin management plans: 2021 - GOV.UK (www.gov.uk)	River basin management plans (RBMPs) describe the challenges that threaten the water environment and how these challenges can be managed and funded
London Plan 2021	The Mayor's strategic spatial plan for London sets out the long term development strategy for London. It includes policies to ensure new development contributes to managing all forms of flooding. The latest version of the plan includes an updated drainage hierarchy designed to set exemplar standards for sustainable drainage to ensure new development reduces surface water flooding, while maximising use of nature-based solutions
London Environment Strategy	The Mayor's integrated plan for the environment and climate change includes policies promoting retrofitting sustainable drainage to reduce surface water flood risk
Water company Drainage and wastewater management plans (DWMP)	Led by water companies, DWMPs are a new approach to provide the basis for more collaborative and integrated long-term planning by organisations that have interests and/or responsibilities relating to drainage, flooding and protection of the environment.

Local flood risk policies and plans

Policy/Plan	Description
Local Plans	Borough strategic and spatial development plans for housing and commercial development include infrastructure and flooding policies
Borough Local Flood Risk Management Strategies	A plan that Lead Local Flood Authorities are required to produce, which sets out an assessment of local flood risk (all sources), objectives for managing the risk, and the costs and benefits of meeting those objectives. It should also set out how these measures will be paid for.
Borough Surface Water Management Plans	A Borough-led plan which outlines the preferred surface water management strategy in a given location. It should establish a long-term action plan to manage surface water in an area and should influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments
Borough level Multi-Agency Flood Plans	These outline local preparation and response arrangements to a flooding incident

Appendix C: Emergency response plans and risk register

The **Civil Contingencies Act 2004** provides the core legislative requirements for preparing for civil emergencies, including flooding. The Act places duties on Category 1 responders (those organisations at the core of emergency response (e.g., emergency services, local authorities)) and category 2 responders ("co-operating bodies" who while less likely to be involved in the heart of planning work, will be heavily involved in incidents that affect their sector (e.g., transport and utility companies)).

Category 1 responders are subject to the full set of civil protection duties. These duties apply to all forms of flooding emergencies, as they do all other types of emergencies. Category 1 responders are required to:

- Assess the risk of emergencies occurring and use this to inform contingency planning;
- Put in place emergency plans;
- Put in place Business Continuity Management arrangements;
- Put in place arrangements to make information available to the public about civil protection matters and maintain arrangements to warn, inform and advise the public in the event of an emergency;
- Share information with other local responders to enhance co-ordination;
- Co-operate with other local responders to enhance co-ordination and efficiency; and
- Provide advice and assistance to businesses and voluntary organisations about business continuity management (Local Authorities only).

Category 2 responders have a lesser set of duties: co-operating and sharing relevant information with other Category 1 and 2 responders.

Category 1 and 2 responders in London
London Category 1 responders:

- British Transport Police
- City of London Police
- Environment Agency
- Greater London Authority
- HM Coastguard
- London Ambulance Service
- London Fire Brigade
- London Local Authorities
- Metropolitan Police Service
- NHS Acute (Hospital) Trusts

- NHS England and NHS Improvement (London)
- UK Health Security Agency

London Category 2 responders:

- Airport operators
- Clinical Commissioning Groups
- Electricity distributors and transmitters
- Gas distributors
- Health & Safety Executive
- London Underground
- National Highways
- Network Rail
- Port of London Authority
- Train Operating Companies (passenger and freight)
- Transport for London
- Water and sewerage undertakers
- Telephone service providers (fixed and mobile)

The London Resilience Forum (LRF)
Category 1 and 2 responders are also required to come together to form Local Resilience Forums which help co-ordination and co-operation between responders at the local level.

The role of the London Resilience Forum is to provide strategic, senior level direction for co-ordinated and effective multi-agency emergency planning in London. The LRF brings together national government (via the London Government Liaison Team), the Mayor of London, London's emergency services, other key public services (category one and two responders) and the business, faith and voluntary communities. The LRF ensures that London is prepared to deal with the consequences of a wide range of disruptive incidents, from terrorist attacks through to the impact of climate change, flooding or a pandemic.

The London Resilience Forum provides for the collective governance of the flood emergency preparedness of London's Category 1 and 2 Responders and other response organisations.

London Borough Resilience Forums (BRF)
Borough Resilience Forums are responsible for multi-agency emergency planning at the local level as determined by borough risks and needs. They will also contribute to emergency planning for London, as directed by the London Resilience Forum. They will facilitate co-operation and information sharing between resilience partners at the local authority level and with the London Resilience Forum.

The Mayor of London
As the elected leader of London's regional government, the Mayor of London plays a full part in supporting the effective implementation of the Act and improving the preparedness of the capital.

Flood emergency preparedness
Each category 1 and 2 responder is responsible for their organisation's preparedness for flood emergencies as per the duties under the Civil Contingencies Act.

Members of the London Resilience Forum are collectively responsible for the strategic oversight of flood risk emergency preparedness in London, including the duties to assess the risk of flooding, to put in place emergency plans to respond to flooding, and to put in place arrangements to make information available to the public about flooding and maintain arrangements to warn, inform and advise the public in the event of a flood emergency.

Flood risk assessment
The risk of flooding in London is assessed in the London Risk Register. The risk of surface water flooding is described as:

'Surface water flooding in a large metropolitan area caused by a warm unstable atmosphere, most likely to occur in summer due to the warmer atmosphere having a greater water holding capacity, causes a pattern of convective rainfall events.'

It is assessed as a Very High risk. This means it is a critical risk requiring immediate attention. Surface water flooding has a medium likelihood of occurrence, but the potential consequences are such that it must be treated as a high priority. This may mean that strategies should be developed to reduce or eliminate the risks, but also that mitigation in the form of (multi-agency) planning, exercising and training should be put in place and the risk monitored on a regular frequency.

Flood emergency plans
Flood emergency plans are maintained at two levels in London. The London Resilience Forum maintains two plans specifically in relation to surface water flood risk:

- London Strategic Flood Response Framework
- London Severe Weather and Natural Hazards Framework

These documents describe the coordinated strategic level planning for, and response to a flooding incident in London. The flood response framework describes the response to a flood event, causing or with the potential to cause significant and severe impacts. This includes flooding from rivers (fluvial), the sea (tidal), surface water, groundwater and reservoirs. This may be severe flooding in one or more locations or a greater number of less severe flooding incidents in multiple locations within London. The severe weather framework provides an overview of weather events and other natural hazards (including heavy rainfall and surface water flooding) which can impact London, and the planned emergency response.

At a local level, each of London's Borough Resilience Forums maintains a Multi-Agency Flood Plan (MAFP). MAFPs support a cohesive multi-agency approach to managing local flood risk.

Each MAFP addresses river, coastal / tidal, surface water and groundwater flood risk (as applicable to the risk faced in each Borough) and the associated emergency response arrangements.

Appendix D: Scrutiny of the flood response

The London Assembly holds the Mayor and Mayoral advisors to account through public examination of policies and programmes in committee meetings, plenary sessions, site visits, and investigations. The Assembly's Fire, Resilience, and Emergency Planning (FREP) Committee and its Environment Committee both convened scrutiny sessions following the flooding to investigate London's preparedness and response.

The Fire, Resilience and Emergency Planning (FREP) Committee has launched an investigation, "How resilient is London when faced with flooding?" Running from October to December, this investigation focused on the following key areas:

- The potential risk of flooding in London and the impact on Londoners.
- London's Resilience to flooding – including the London Resilience Partnership's strategic level planning and response to flooding incidents.
- The London Fire Brigade's preparedness and response to flooding and whether it has sufficient resources to respond to future flood events.
- The role of the Environment Agency, London's Boroughs and other stakeholders in responding to flooding.

A FREP committee meeting on 21 October included evidence from London Resilience, Thames Water, the London Fire Brigade, the Environment Agency, TfL, and London boroughs. A transcript and minutes can be found here.

The Assembly Environment Committee held a session entitled "Climate Adaptation and Climate Risks in London" on 30 September. In two panels, representatives from the Environment Agency, Met Office, Thames Water, London Boroughs, and TfL, along with GLA officers, were asked to provide evidence about the impacts of extreme weather, with a strong focus on surface water flooding, on local areas and infrastructure and about the role and effectiveness of policy, including the London Environment Strategy and the London Plan, in helping to mitigate the risks. Minutes of the session can be found here.

Appendix E: Relevant publications

Flood risk management: information for flood risk management authorities, asset owners and local authorities, Defra, updated June 2014.
https://www.gov.uk/guidance/flood-risk-management-information-for-flood-risk-management-authorities-asset-owners-and-local-authorities

Internal Review into the 12 and 25 July 2021 storms in London: Actions taken, lessons learnt and further actions to be taken. Thames Water, November 2021
https://www.thameswater.co.uk/media-library/home/about-us/investing-in-our-region/flooding-review/july-flooding-internal-review.pdf

London Environment Strategy, 2018, Mayor of London
https://www.london.gov.uk/what-we-do/environment/london-environment-strategy

London Plan, 2021, Mayor of London
https://www.london.gov.uk/what-we-do/planning/london-plan

London Strategic SuDS Pilot Study: Executive Summary. London Drainage Engineers Group (LoDEG), 2021
1_lssps_executive_summary.pdf (susdrain.org)

Surface Water Management: A government update. Defra, 29 July 2021
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015182/surface-water-management-government-update.pdf

Surface Water Management Plan Technical Guidance, Defra, March 2010
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69342/pb13546-swmp-guidance-100319.pdf

Working together to improve drainage and environmental water quality: an overview of Drainage and Wastewater Management Plans. Atkins, updated September 2021.
https://www.water.org.uk/wp-content/uploads/2021/10/Working_Together_an_overview_of_Drainage_and_Wastewater_Management_Plans.pdf

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