LONDONASSEMBLY

Environment Committee

For a Rainy Day

the Mayor's role in managing London's flood risk in case of severe rainfall

July 2011

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Terms of Reference

The Environment committee agreed the following terms of reference for its investigation on 15 July 2010:

To look at flooding risk issues in London and make recommendations for better surface water and river flood risk management, noting advances in flooding policy and practice following the Committee's past work, particularly in areas where the Committee has made recommendations, and focussing on river flooding and surface water flooding to address the risks that most often affect the largest numbers of Londoners, and also the areas where the GLA as a regional authority has the greatest role.

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Foreword

It is estimated that if a comparable amount of rain fell on London as caused the 2007 floods in England, the order of the magnitude of damage caused would be considerably worse, costing tens of billions in property and infrastructure damage, with a high chance of loss of life. Whilst there are a number of flood risks that are commonly recognised, such as tidal, this risk has been greatly reduced by the presence of the Thames Barrier. The report instead concentrates on the less well understood but significant threat of rapid river and surface water flooding arising from severe rainfall.

The risk from this type of flooding is predicted to increase with climate change with periods of intensive rainfall. Unable to soak into the ground, rainfall runs off impermeable roads, pavements and hard paved front and back gardens, rapidly overwhelming the capacity of drains and rivers.

This report looks to the Mayor of London to lead on a number of initiatives to mitigate flood risk. Namely, communicating flood risk to Londoners, supporting practical measures to reduce flood risk, identifying and helping to access potential resources and acting as a clearing house for potential public and third sector partners.

To help Londoners to get a comprehensive picture of flood risk in their local areas, and to complement the tidal and river flood risk maps that are already provided by the Environment Agency, the Mayor must ensure that his 'Drain London' initiative mapping the capitals surface water flood risk is readily accessible to the public. He also has a key role in communicating sustainable drainage solutions in developments, and highlighting the impact that hard paving of front and back gardens has on increasing run off and contribution to flooding.

In the current climate of public spending cuts, the Mayor has a strategic leadership role in bringing funders and planners and also helping third-sector and community groups together to deliver highly beneficial flood protection projects

The report also highlights some of the excellent river restoration and flood mitigation projects that have already taken place in London and supports the London Rivers Action Plan to restore 15km of rivers in London by 2015. It calls on the Mayor for an action plan to help achieve this target. Not only do restored rivers, that have formerly been confined between concrete walls or in a covered channel have a

key role to play in slowing and holding flood water, but they can also provide attractive river access, enhance leisure use and support greater biodiversity.

Thanks are due to all of the contributors who have provided views and information to this investigation, particularly the guests at the Committee meeting in September 2010, and the Environment Agency who attended again in February 2011. Also to all the Members of the Committee for their work on the investigation and this report.

Executive Summary

Because London's built-up land surface does not allow rainwater to soak away into the ground, there is an increased risk that severe rain leads rapidly to flooding. Because London is so densely populated and developed, a major flood would cause great property damage, with a high chance of loss of life.

London is at risk of flooding of various kinds, including from tides, rivers, sewers and surface water. Although the effects of a major tidal flood would be severe, the risk of this kind of flooding has been thoroughly assessed, and greatly reduced by protection measures such as the Thames Barrier. Therefore this report concentrates on risks that are less well understood and that have not been reduced as much by protective measures. In particular, the report considers the risk of surface water and river flooding in the event of severe rainfall over London.

The Mayor has a strategic leadership role in tackling flooding issues – for example through his environmental strategies and through Mayoral initiatives such as the Drain London partnership. His deputy chairs the London Regional Resilience Forum, which co-ordinates planning for emergencies including floods in the capital.

Therefore this report looks to the Mayor to lead action on several further issues that the Committee has identified.

Londoners need to know when they live or work in flood risk areas. For tidal and main river flooding, this information is provided by the Environment Agency. The Mayor's Drain London initiative has compiled information about surface water flood risk, but the Mayor needs to ensure that this information is communicated to the public.

London's vulnerability to flooding in the event of heavy rain is greatly increased by the extent of paved surfaces that do not let water soak into the ground. There are sustainable drainage solutions that enable developments to reduce their water runoff, but these are relatively new and not yet widely implemented. Successful examples would help to overcome developer hesitation, and the Mayor has an opportunity to support such examples by extending the Green Roofs Fund and through the GLA Group's own property works.

Another way of allowing the landscape to absorb flood waters is to restore rivers from concrete channels to a more natural course. The

Mayor has endorsed the London Rivers Action Plan which seeks to restore 15km of rivers in London by 2015, but firm support and an implementation plan would make the target more achievable.

In the current situation of reductions in public spending, resources are under pressure across the traditional funders of flood protection, such as the Environment Agency and local authorities. There are plenty of highly beneficial flood protection projects that could go ahead, and there are potential new sources of funding in the private and third sectors as well as the wider public sector. Strategic leadership with a cross-sectoral reach could play an important role in bringing funders and planners together, and the Mayor would be well-placed to play this role. The Mayor could also help third-sector and community groups become involved in such partnerships.

Introduction

This report assesses London's response to the danger from severe rain flooding. It builds on previous work by the Committee and by the Pitt Review, which followed severe flooding elsewhere in the country in the summer of 2007.

The National perspective

The Pitt review, a national-level investigation of flood risk, was established in the wake of severe flooding in the summer of 2007. It reported in 2008, making 92 recommendations, mainly to national government departments and agencies, and to local authorities and forums across the country. [1] It resulted in a Flood and Water Management Bill, seeking to implement many of its recommendations. However, with the 2010 General Election approaching, the Bill was reduced from 250 clauses to 50 clauses to enable the core provisions to be passed within the term of the Parliament.[2]

The resulting Flood and Water Management Act 2010 is now the legislative framework for the governance of flood risk nationwide – its provisions are outlined in the next section, on the role of the Mayor, and in more detail in Appendix 2.

The Act is now being implemented, and the remaining recommendations of the Pitt Review taken forward, but in a context of retrenchment in public spending and a private sector that has been hit by recession. As discussed below, in the section on resourcing flood risk reduction works, the level of public funding available for 2010/11 represents an 8% reduction from the average for the previous four-year period.

The work of this Committee

Previous work

In 2002, this Committee produced a report, Flooding in London, which addressed a number of flood risk issues, based on the state of knowledge at the time. Issues raised included public awareness,

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[1] *The Pitt Review: lessons learned from the 2007 floods*. Cabinet Office, 2008. (hereafter referred to as The Pitt Review) Now available at http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/final_report.html

[2] Environment Committee meeting of 8 September 2010 (hereafter referred to as September 2010 meeting), transcript page 26 http://www.london.gov.uk/moderngov/Data/Environment%20Committee/20100908/Minutes/10-09-08_transcript-checked.pdf

insurance, climate change, river flooding and sewer flooding, resourcing issues and the role of planning policies. The report welcomed the introduction of sustainable drainage to London's planning regime, and highlighted the multiple benefits that waterside environmental improvements could have.[3]

In 2005, the Committee produced two reports relevant to flooding: London Under Threat? and Crazy Paving.

London Under Threat? looked at flooding risk (particularly tidal) in the Thames Gateway and Thames estuary. It recommended actions to tackle this risk in the areas of funding mechanisms, monitoring and maintenance of defences, green infrastructure, flood risk information and communication, and planning guidance.[4]

Crazy Paving reported how much of London's surface was being covered by front garden paving, and why this increased flood risk (among other impacts). The report led to government action to arrest this trend.[5]

Scope of this report

With the Pitt Review having a nationwide focus, the specific London issues which this Committee's previous work had identified were not specifically detailed there. London faces a number of flood risks including tidal flooding, river flooding, sewer flooding and surface water flooding.[6] Of these, tidal flooding and flooding from main rivers are well-understood and protected against. The focus for this report is on the less well understood risk of flooding in the event of severe rainfall over London, particularly surface water but also river and sewer flooding. Risks of these types of flooding are estimated to be 'high' (surface water) or 'medium' (river), and increasing due to climate

[3] *Flooding in London*. London Assembly Environment Committee report, 2002 (hereafter referred to as *Flooding in London*) http://www.london.gov.uk/who-runs-london/the-london-assembly/publications/environment/flooding-london

[4] *London Under Threat? Flooding risk in the Thames Gateway*. London Assembly Environment Committee report, 2005 (hereafter referred to as *London Under Threat?*) http://www.london.gov.uk/who-runs-london/the-london-assembly/publications/environment/london-under-threat-flooding-risk-thames-gateway

[5] *Crazy Paving: the environmental importance of London's front gardens*. London Assembly Environment Committee report, 2005 (hereafter referred to as *Crazy Paving*) http://www.london.gov.uk/who-runs-london/the-london-assembly/publications/environment/crazy-paving-environmental-importance-london%E2%80%99s-front-gardens

[6] These types of flood risk are explained in Appendix 1

change; the impact of a major flood would be 'high' and also increasing as more building takes place.[7] Severe rain is a particularly large risk in London, because the nature of the urban landscape means that rainwater is not easily absorbed by the ground.

The report also outlines the governance of flood risk management in London. While there is no specific statutory flood risk role for the Mayor, he does cover flood risk in his environmental strategies and as London's civic leader he has a significant role in ensuring, on behalf of Londoners, that the risks are properly assessed and that effective measures are put in place to address these risks.

[7] Mayor's draft (February 2010) Climate Change Adaptation Strategy (hereafter referred to as Draft CCAS), pages 7-8 and in more detail on pages 36-51

London's severe rain flood risk and the Mayor's role in reducing it

"London is very susceptible to rapid river and surface water flooding following storms. This risk will increase as a result of climate change."[8]

In the event of severe rainfall over London, there could be widespread serious flood damage. There could also be loss of life. This is true of large cities in general, but it is especially true of London. This section briefly outlines the risk; there is a fuller discussion in Appendix 1.

Severe rain generates more floodwater, more rapidly, in London than elsewhere. A great deal of land in London is impermeable: most roads, roofs and pavements do not allow water to soak into the ground. Instead, they shed rain rapidly into drains and rivers; if these become full, water floods across the land surface. Some London streets could flood within minutes of the onset of severe rain, and rivers soon after.[9]

London's built landscape also greatly increases potential flood damage to property. Because London has very extensive high-density development, and high property values, a London flood would cause damage much more costly than the same flood elsewhere.

Rainfall such as caused the UK's 2007 floods could, if it happened in London, cause damage an order of magnitude greater.[10] The estimated insured cost of the 2007 event was £3 billion[11], which suggests that a similar event in London could cost tens of billions. The Committee heard evidence that lives, in addition to property, would also be at significant risk.[12] Again, the density of residential development is a factor: for any given flood, more people are involved.[13] Lack of preparedness would also be a contributing factor. Londoners are less aware than the rest of the country of flood risks, what to do about them and how to receive emergency flood alerts: just 19 per cent of Londoners living or working in flood risk areas are

[8] Environment Agency, written contribution to this investigation
[9] Environment Agency at the September 2010 meeting, transcript page 30; See also Mayor's draft (February 2010) Climate Change Adaptation Strategy (hereafter referred to as Draft CCAS), page 44
[10] Association of British Insurers, at the September 2010 meeting, transcript pages 2 and 31, and written contribution to this investigation
[11] Mayor's draft (August 2009) Water Strategy (hereafter referred to as Draft Water Strategy), page 56
[12] Environment Agency at the September 2010 meeting, transcript page 30
[13] Association of British Insurers, at the September 2010 meeting, transcript page 31

signed up to Floodline Warning Direct, compared to 24 per cent nationally.[14] Basement flats can pose a particular risk, especially in a night-time flood.[15] The Mayor acknowledges that "there are a large number of flood-vulnerable communities. Warning times… are short and public awareness and capacity to act are low."[16]

It is a matter of chance that London has so far escaped rainfall severe enough to cause widespread flooding.[17] Such rain occurred in southern England as recently as 2007, and London properties were affected.[18] Rainstorm severity can be expressed as a likelihood; a storm of a particular severity might be described as having an annual likelihood of 1 in 200, or 0.5 per cent, in a particular place. There are up to 680,000 properties in London thought likely to flood in the event of a rain storm of that severity.[19] One in 200 seems like a small chance of such severe rainfall, but over a period of 20 years (the sort of time a family might occupy a home), the annual 0.5 per cent would amount to 9.5 per cent for at least one such storm. Across London, the probability of river flooding is assessed as 'medium' and of surface water flooding as 'high'.[20] Climate change is expected to bring more extreme winter rainfall events to London, raising the annual likelihood of severe rainstorms; the Mayor's draft Water Strategy therefore acknowledges that floods of the scale seen in 2007 should be expected in future.[21]

The responses so far to previous recommendations, the 2007 floods and the Pitt report, have not yet made London sufficiently safe from flooding. This investigation heard repeatedly that there is more to be done – the Association of British Insurers stated that, 'insurers are very concerned about [London's] current lack of preparedness'.[22]

What is the Mayor's role?

Statutory responsibility for assessing flood risks and doing work to reduce them lies mainly with bodies other than the Mayor or Greater

[14] Draft CCAS, page 44
[15] September 2010 meeting, transcript pages 30-31
[16] Draft CCAS, pages 7-8
[17] Thames Rivers Restoration Trust, at the September 2010 meeting, transcript page 25
[18] Draft Water Strategy, page 65. See also written contribution from the Thames Rivers Restoration Trust to this investigation.
[19] Draft CCAS, pages 41-42
[20] Draft CCAS, pages 7-8
[21] Draft Water Strategy, page 65
[22] Association of British Insurers, written contribution to this investigation

London Authority (GLA). But the Mayor has an important role, as a leader for London and as a voice for Londoners, in ensuring that these bodies can, and do, do their jobs effectively. This section briefly outlines the governance of flood risk in London, focussing on the Mayor's role; there is a fuller outline in Appendix 2.

The Flood and Water Management Act 2010 set out statutory responsibilities for managing flood risk in England. 'Lead Local Flood Authorities' (in London, London Boroughs and the City of London) are responsible for surface water and small watercourses such as streams.

The Environment Agency is responsible for tidal water and main rivers, and has a strategic oversight role for local authorities.[23]

The Mayor's statutory responsibilities include producing environmental strategies relevant to managing flood risk:

- The Water Strategy – which addresses rainwater and wastewater[24]
- The Climate Change Adaptation Strategy – flooding in general, including the flooding benefits of urban greening covered in the 'overheating' chapter[25]
- The London Plan – which addresses building in flood-prone areas[26]

The Mayor is responsible for the London Fire and Emergency Planning Authority, and the Deputy Mayor Richard Barnes also now chairs the London Regional Resilience Forum, which covers flood response planning.[27]

[23] Flood and Water Management Act 2010, available at http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf. See also *Flood and Water Management Act 2010* Local Government Association Briefing, 15 April 2010, available at http://www.lga.gov.uk/lga/aio/10693972
[24] Draft Water Strategy, pages 59-68 and 75
[25] Draft CCAS, pages 35-53 and 69-70
[26] *The London Plan* (Consultation draft replacement plan, October 2009 – hereafter referred to as Draft Replacement London Plan) Policies 5.12 (flood risk management) and 5.13 (sustainable drainage); also 2.18 (green infrastructure), 5.10 (urban greening), 5.11 (green roofs and development site environs), 5.14 (water quality and sewerage infrastructure), 7.24 (Blue Ribbon network), 7.28 (restoration of the Blue Ribbon network) and 7.29 (the River Thames)
[27] http://www.londonprepared.gov.uk/news/news-20101021.jsp see also Environment Agency at the Environment Committee meeting of 3 February 2011 (hereafter referred to as February 2011 meeting), transcript page 2 http://www.london.gov.uk/moderngov/mgConvert2PDF.aspx?ID=4582&T=9

The Mayor also has a key role, on behalf of Londoners, in ensuring that other agencies meet London's needs. For example, in the context of mapping flood risk, the Mayor has secured funding from the Department for Environment, Food and Rural Affairs (Defra) for the Drain London project, to fill gaps in knowledge about surface water flood risks and assist boroughs to work together to produce local flood risk assessments and action plans.[28]

The Mayor is producing his final versions of the Water and Climate Change Adaptation Strategies and we wish to see him use those documents to consolidate his role in assessing and helping to mitigate flood risk. There are four areas where further work is required and they are explored later in this report:

- Communicating risks to Londoners
- Supporting practical measures to reduce flood risk
- Helping identify and access potential resources, both financial and organisational, across the public, private and third sectors

Introductory finding
London is at risk of serious flood damage in the event of extreme rainfall. The Mayor has an important role, as do others, in ensuring that this risk is tackled.

[28] September 2010 (transcript pages 1-6) and February 2011 (transcript pages 4-5) meetings and Mayoral Decision MD455, 28 October 2009 http://legacy.london.gov.uk/mayor/mayor-decisions/docs/20091029-md455-drain-london-defra-signed.pdf

Communicating flood risk and response information

Households and organisations at risk of flooding need to make preparations to deal with the eventuality of flooding. To do this, they need to know and understand the risks.

Information about flood risk from main rivers and the sea is held and publicised by the Environment Agency (EA) and its partners. The EA makes maps of river and coastal flooding risk available on its website, and writes annually to affected households with information about precautions that can be taken.[29] This information is brought together with local flood risk assessments in a London Regional Flood Risk Appraisal, which underlies the London Plan.[30]

Currently, there is little information about the risks of surface water flooding.[31] The Drain London project is designed to plug this information gap. Drain London is explained in more detail in Appendix 2; it has helped boroughs across the capital to produce maps of expected surface water depth and flow speed under a number of different rain severity scenarios.[32] The Committee welcomes this work and its contribution to flood risk knowledge and risk reduction planning. It has not yet been determined how the Drain London flood risk mapping outputs will be made publicly available, promoted, or put alongside other crucial information such as flood risk precautions.[33]

Awareness of flood risk among Londoners is patchy.[34] There is a lower take-up of flood warning services in London than elsewhere in the country.[35] There is a high mobility of population; in many areas ten per cent or more of residents are new arrivals to the borough each year.[36] Rivers are in many cases hidden from public view, behind

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[29] Environment Agency at September 2010 meeting, transcript page 16
[30] Draft Replacement London Plan, pages 130-131
[31] GLA at the September 2010 meeting, transcript page 10
[32] Mayoral Decision MD455, 28 October 2009 and London Councils 2011 Drain London update, pages 5-7. See also discussion at September 2010 meeting, transcript pages 10-17
[33] London Councils 2011 Drain London update, pages 8-9
[34] Environment Agency at the Environment Committee of 8 September 2010, transcript page 30
[35] Draft CCAS, page 44
[36] *Focus on London 2010: population and migration* GLA, October 2010, page 21 http://data.london.gov.uk/datastorefiles/documents/FocusOnLondon-PopulationAndMigration.pdf . Comparison with national figures (Mid-2008 to mid-2009 detailed Components of Change for local authorities, available from Office for National Statistics) shows that the large majority of London boroughs are in the top quartile of authorities in England and Wales for both international in-migration and migration from other local authorities within the UK.

buildings or underground.[37] Since the construction of the Thames Barrier, flood drills in London have much reduced; the Environment Agency estimates that 30 per cent of people would not know what action to take following a flood warning.[38]

This patchy awareness of flood risk means that fewer people take precautions against flooding, and fewer people are able to respond quickly when it becomes known that a flood is about to occur.[39] This Committee has been recommending that the Mayor and Environment Agency take urgent action to tackle public flood awareness since 2002.[40] The National Flood Forum has also called for the Environment Agency to ensure that flood risk from all causes is adequately mapped and that all the maps and flood data, including areas at risk of surface water flooding, are published.[41]

Finding 1
More Londoners who live and work in areas at risk of flooding (especially surface water flooding) need to know about the risk and what they can do to reduce their exposure and prepare for the eventuality of flooding.

The information required by these Londoners will come out of Drain London and will be available to the GLA. Therefore the Mayor is in a position to address the information gap.

Recommendation 1

The Mayor should ensure that the Drain London flood risk data are available to the public, alongside information about what householders can do if they live in a flood risk area. Ways to make the data available could include the Water and/or Climate Change Adaptation Strategies, the London Datastore, the Environment Agency's existing publication of river and coastal flood risk maps and local borough publication.

[37] Environment Agency at February 2011 meeting, transcript page 5
[38] Draft CCAS, page 44
[39] Environment Agency at September 2010 meeting, transcript page 30
[40] *Flooding in London*
[41] National Flood Forum, written contribution to this investigation

Reducing flood risk

The Committee has investigated two specific areas where the Mayor has the ability to take practical steps to reduce rainwater flood risk: promoting sustainable urban drainage systems and river restoration.

Reducing surface runoff of rainfall

A major factor underlying London's flood risk in the event of heavy rain is rapid runoff from impermeable surfaces to drainage systems.[42] The more quickly rainwater flows off the surface, the sharper the peak flow in drains and rivers, and the more likely therefore that the capacity of the drain or river will be exceeded, creating a flood. Also, the quicker the runoff, the quicker the flood can occur and the less warning there is for people to respond to limit the damage or just reach a safe place.

One way of reducing rainwater runoff in built-up areas is the use of sustainable urban drainage systems (SUDS). SUDS features include:

- grass or other water-permeable landscaping instead of paved areas
- water-permeable paving instead of ordinary concrete or tarmac
- green roofs and walls
- directing site drainage into holding tanks, ponds or soak-aways instead of directly into mains drains

Several of these features are shown at the BedZED development in Sutton.[43] As well as flood prevention benefits, SUDS features enhance the local quality of life and environment.[44]

The issue of runoff from impermeable surfaces and the merits of sustainable drainage have been raised several times in recent years. In 2005 this Committee's report *London Under Threat?* emphasised the importance of sustainable drainage in reducing runoff and therefore flood risk[45] and our *Crazy Paving* report highlighted the effects of paving over front gardens in increasing water runoff, and the role of the planning system in regulating front garden paving.[46] In 2008 the

[42] See also Thames Water at the September 2010 meeting, transcript page 21
[43] *Sustainable Drainage Systems (SUDS) an introduction*. Environment Agency http://www.environment-agency.gov.uk/static/documents/Leisure/GEHO0308BNSS-e-e.pdf, page 6; see also Draft Water Strategy, page 61 and Draft Replacement London Plan pages 130-131
[44] Micro Drainage Ltd, at the September 2010 meeting, transcript page 21
[45] *London Under Threat?* page 14
[46] *Crazy Paving*, pages 6-7.

Pitt review of flood risk further highlighted the runoff implications of garden paving.[47]

There has subsequently been action to regulate urban paving further. National planning regulations in 2008 stated that larger areas of impermeable paving in front gardens were no longer 'permitted development'[48] (work for which planning permission is not required)[49]. The London Plan[50], the Water Strategy[51], and the Better Buildings Partnership[52] all promote sustainable drainage in the London context.

However, sustainable drainage is still rarely retrofitted to existing built areas, and the level of sustainable drainage in new developments varies. Under 2006 Supplementary Planning Guidance, it is essential that developments use sustainable drainage wherever practical, and achieve 50 per cent attenuation of the undeveloped site's surface water runoff at peak times; it is the Mayor's preferred standard that developments achieve 100 per cent attenuation.[53] However, developers see obstacles to fully sustainable drainage, pointing out that 96 per cent of development in London takes place on previously developed land.[54] Progress is therefore slow and the UK lags behind other countries in the extent of sustainable drainage.[55]

Site owners and developers see sustainable drainage as a relatively untried new technology, and therefore approach it with caution. More examples of successful sustainable drainage with visible value and demonstrable workability, across a range of development types, could help to overcome this. The same kind of initial problems had to be overcome in the early years of 'traditional' drainage engineering.[56]

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[47] The Pitt Review
[48] Town and Country Planning (General Permitted Development) (Amendment) (No.2) (England) Order 2008
[49] http://www.planningportal.gov.uk/permission/responsibilities/planningpermission/permitted
[50] Draft Replacement London Plan, Policy 5.13
[51] Draft Water Strategy, page 61
[52] GLA at the September 2010 meeting, transcript page 15
[53] Draft Water Strategy, page 61
[54] Examination in Public of the Draft Replacement London Plan, report of the Panel paragraph 5.56 http://www.london.gov.uk/sites/default/files/eip/Panel-report-Vol-1.pdf
[55] Micro Drainage Ltd, at the September 2010 meeting, transcript pages 21-22
[56] Micro Drainage Ltd, at the September 2010 meeting, transcript pages 21-22

Finding 2
Exemplar sustainable drainage projects would help overcome developer doubts and reduce London's flood risk by reducing rainfall runoff.

The Mayor has a role in promoting sustainable drainage, and has tools to do this. Sustainable drainage is an important feature of the flood risk management sections in the Climate Change Adaptation Strategy[57] and the Water Strategy.[58] Both strategies refer to the London Plan policy on sustainable drainage, which sets outs a 'drainage hierarchy' to promote forms of drainage that reduce the runoff from London developments towards greenfield rates.[59] One aspect of sustainable drainage is 'green roofs' – the London Plan has a specific policy on these[60] and the Drain London project includes provision for a £300,000 Green Roofs Fund (which at the time of writing has not been fully allocated).[61]

The GLA Group may have further scope to provide exemplars of sustainable drainage in its own properties, such as transport, fire and police stations.

Recommendation 2

The Mayor should extend the applicability of the Green Roofs Fund to include other forms of sustainable drainage to support more exemplar projects to stimulate commercial interest.

Where possible, the Mayor should also ensure that the GLA Group estate exemplifies sustainable drainage in its own property works.

[57] Draft CCAS, page 51
[58] Draft Water Strategy, pages 59-62
[59] Draft Replacement London Plan, Policy 5.13
[60] Draft Replacement London Plan, Policy 5.11
[61] Mayoral Decision MD455, 28 October 2009

Garden drainage

Although front garden paving has been restricted, there is less control over back gardens. Between 1998-99 and 2006-08, the amount of hard surfacing in London's gardens increased by 26 per cent, or 2,600 hectares (18 times the size of Hyde Park).[62] As described above, there are water-permeable alternative materials and other sustainable drainage solutions, which the Mayor seeks to promote through his environmental and planning strategies.

Finding 3

There is a need to reduce the spread of impermeable surfaces within London's existing built developments, for example in gardens.

Recommendation 3

The Mayor, in his final Water and/or Climate Change Adaptation Strategies and their implementation, should raise awareness of the environmental impacts of garden paving and awareness of environmentally sustainable surface materials

River restoration

River restoration (removing artificial walls that channel a river and restoring more natural banks and surroundings) can have significant flood risk benefits – allowing excess flows to spread into open space next to the river, rather than flooding properties downstream. This enables the safe accommodation of high peak flows and therefore mitigates the effects of rapid surface runoff. It can also benefit the quality of the local environment and give opportunities such as leisure use to local people and visitors. There is a fuller discussion of the nature and benefits of river restoration at Appendix 3.

There is widespread scope for river restoration in London. Most of London's rivers flow in artificial channels, in many cases buried under landscaping or structures. Moderate excess flows can be rapidly carried away by these channels, but these downstream flows may exacerbate flooding lower down the river. Also, if the capacity of the

[62] *London Garden City*, report for the London Wildlife Trust, Greenspace Information for Central London and the GLA, June 2011.

channel is exceeded, the resulting flood can affect properties that have been built up to or on top of the channel structure. However, a more 'natural' river channel, with low-lying open areas nearby that can harmlessly flood, can hold flood waters safely upstream and reduce the damage caused by flooding across the whole catchment area.[63]

River restoration, and associated flood risk reduction landscaping, does require more space than constricted artificial channels. In heavily built-up parts of London opportunities are therefore limited (though still present in some cases, especially where extensive redevelopment is taking place). However, in outer London there are many opportunities. The Committee heard that 'every outer London borough has the potential to use green spaces, parks, playing fields and school grounds as part of an integrated [floodwater management] system.'[64]

The London Rivers Action Plan has identified many potential restoration sites, with a target to restore 15km of rivers by 2015.[65] The Mayor supports this plan: river restoration is promoted in the London Plan with specific reference to the London Rivers Action Plan[66], and the Mayor has proposed the 15km target as part of his Climate Change Adaptation Strategy.[67] The London Green Grid also includes riverside areas where appropriate works could have flood protection benefits.[68]

[63] London Rivers Action Plan http://www.therrc.co.uk/lrap.php ; Draft Replacement London Plan page 198
[64] Thames Rivers Restoration Trust, at the Environment Committee meeting on 8 September 2010, transcript pages 24-25; see also Draft CCAS, page 30
[65] London Rivers Action Plan
[66] Draft Replacement London Plan, policy 7.28
[67] Draft CCAS, page 98
[68] Draft CCAS, page 96 – this Committee first highlighted the importance of taking forward and resourcing the Green Grid as a flood defence measure in its 2005 report *London under threat?*

Finding 4

River restoration is in many cases an effective flood risk management measure – it can have other benefits too. The London Rivers Action Plan identifies many sites where restoration may be possible and shares with the Mayor's draft Climate Change Adaptation Strategy a target to achieve 15km of restoration by 2015.

Recommendation 4

The Mayor should retain the target to restore 15km of rivers in the final version of his Climate Change Adaptation Strategy, and set out a plan for how this can be realised.

Misconnected sewers

When a river is restored from a covered channel to an open state, it is often found that domestic sewage drains need to be re-directed so as not to run into the river.[69] Local authorities have powers to rectify misconnected drains, and water companies need to work through local authorities to solve these problems. The water companies would be more effective if they could do this directly with households. A clause enabling this was part of the Flood and Water Management Bill in 2010[70], but was dropped, along with many other measures, so that the Flood and Water Management Act 2010 could be passed before Parliament was dissolved for the 2010 General Election.[71]

Recommendation 5

The Mayor should join the Assembly in calling for the forthcoming Water White Paper to address Thames Water's need to work directly with households to rectify misconnected drains.

[69] Thames Water and the Thames Rivers Restoration Trust, at the September 2010 meeting, transcript page 26; see also Environment Agency at the February 2011 meeting

[70] Draft Flood and Water Management Bill, published April 2009, clause 253

[71] Thames Water and the Thames Rivers Restoration Trust, at the September 2010 meeting, transcript pages 26 and 30; See also Draft Water Strategy, pages 75-76

Making flood protection works happen

Funding

There is no shortage of potential flood risk management works to undertake in London.

As detailed in the previous section, there are many opportunities for river restoration works, particularly in outer London and where built-up riversides are redeveloped. There is a target in the London Rivers Action Plan and the Mayor's Climate Change Adaptation Strategy to restore 15km of rivers by 2015.

The Drain London project will shortly generate a prioritised list of works to reduce the risk of surface water flooding. It will model flows of water across London under a range of heavy rain scenarios, and thereby map which areas would be likely to flood under different rainfall severities. These maps will identify flood risk hotspots, which will be assessed for the number and type of properties at risk, and what work might be possible to reduce the risks.[72] The project will enable a regional submission to be made for government funding to manage surface water flood risks in London.[73]

The Environment Agency also has a list of flood defence works, primarily aimed at reducing the risk of tidal flooding and main river flooding.

All of this work is facing public funding constraints. Progress of the London Rivers Action Plan depends on funding not yet committed. With funding cuts taking place across the public sector, the 15km restoration target could be 'challenging'.[74] Funding for the Green Grid has hitherto come from the London Development Agency. With the winding-down of that agency and cessation or transfer of its associated funding, the Green Grid resources are therefore uncertain.[75]

The Drain London project is funded to map risks, identify potential work and develop a small number of local action plans. Only a small

[72] Mayoral Decision MD455, 28 October 2009; *Drain London – update on delivery and implications for* Boroughs, report to London Councils Transport and Environment Committee, 17 March 2011 (hereafter referred to as London Councils 2011 Drain London update) pages 5-7; written contributions from Environment Agency and GLA to this investigation
[73] Draft Water Strategy, page 64
[74] Environment Agency at the February 2011 meeting, transcript page 10.
[75] Environment Committee meeting of 6 April 2011
http://www.london.gov.uk/moderngov/mgConvert2PDF.aspx?ID=4667&T=9

amount of funding is available within that project to undertake work on the ground[76] and the funding expires when the current work is completed.[77]

Defra has a substantial budget for flood defence – it averaged £590 million per year from 2007/08 to 2010/11 (mainly spent via the Environment Agency). But, under a new funding structure, the average annual spend is expected to be about 8 per cent lower from 2011/12 to 2014/15.[78] The Environment Agency has assessed that to maintain that protection would require overall investment, including from other sources, to rise from 2010/11 levels, reaching £1 billion per year by 2035.[79]

There are also local authority resources for flood defence, which may be spent on staff, local works or contributed via a levy to a regional pot. However, these resources are not tied to flood defence and are in many cases thought likely to be subject to reduction in the current public spending climate.[80]

Could other funding become available?

There is a wide range of other potential sources of funding, especially in the medium term.

Funding can come from private sector sources. The Environment Agency estimates that about two-thirds of the benefit of flood risk management assets accrues to the private sector, particularly the insurance industry.[81] Developers and private property owners may often be able to put a valuation on the flood protection offered to their property by certain works, and may therefore be willing to pay for works up to that value.[82]

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[76] Mayoral Decision 455, 29 October 2009
[77] Environment Agency at the February 2011 meeting, transcript page 9
[78] *Defra Arm's Length Bodies SR10 Allocations*; see also Environment Agency at the 3 February 2011 meeting (transcript pages 7-8), though the exact figures discussed there are on a different basis. Current EA funding by region is shown on the EA website http://www.environment-agency.gov.uk/research/planning/118129.aspx
[79] *Investing for the future: flood and coastal risk management in England – a long-term investment strategy*. Environment Agency 2009 (hereafter referred to as *Investing for the future*), page 4 http://publications.environment-agency.gov.uk/pdf/GEHO0609BQDF-E-E.pdf
[80] September 2010 and February 2011 meetings
[81] *Investing for the future*, page 8
[82] Environment Agency at the February 2011 meeting, transcript pages 8-9 and 12-13

Private companies may also make grants as an element of their corporate social responsibility, and grants can also come from the third sector. The river restoration at Mayesbrook Park, which this Committee heard about as part of the investigation, received funding from the insurer Royal Sun Alliance and the SITA Trust.[83]

Works with flood risk benefits can also, depending on their nature and situation, have a range of other benefits including leisure, biodiversity, urban cooling and other local enhancements.[84] This can attract funding from public sources other than flood protection budgets – such as other environmental budgets, leisure budgets, or funding to improve local places.[85] Multiple funding streams from different sources can come together to make possible projects that no one funder could support on its own.[86]

Defra has recently consulted on a proposed new flood works grant-in-aid system called Payment for Outcomes, which is intended (among other benefits) to facilitate and increase the contribution of local authority, private and other funding sources to flood mitigation works, and to make surface water flooding measures eligible for Environment Agency support. However, it is uncertain how much additional funding can be expected in the short term, given the fiscal and economic situation.[87]

Therefore while historic funding sources for flood risk reduction are subject to risk or reduction, there may be other sources, but work is required to fully access these sources and make the case for their use in flood defence.

Can the value of flood risk reduction be more effectively realised?

The Environment Agency has assessed the costs and benefits of river and coastal defence spending, finding that the benefits are on average eight times greater than the costs (a benefit-cost ratio of 8:1), and

[83] http://www.trrt.org.uk/index.aspx?articleid=15955; http://www.naturalengland.gov.uk/regions/london/press_releases/2010/221210.aspx; http://www.sitatrust.org.uk/about-us

[84] See Draft Replacement London Plan, chapters 5 and 7.

[85] For example http://www.wandlevalleypark.org.uk/ see also http://www.naturalengland.org.uk/regions/london/ourwork/integratedprojects.aspx

[86] Thames Rivers Restoration Trust, at the September 2010 meeting, transcript pages 25-26.

[87] http://www.defra.gov.uk/corporate/consult/flood-coastal-erosion/index.htm ; see also Environment Agency at the February 2011 meeting, transcript pages 11-15

that investment could increase by 82 per cent with the benefit-cost ratio sustained at 7:1.[88]

The costs of flooding depend on the area affected, the number of buildings and other vulnerable properties affected, and the financial value of those buildings. In most of London, building density is very high and property values and repair costs are also high. Therefore, the costs of flooding, and hence the financial benefits of flood prevention, are likely to be particularly high in London.[89]

The quantifiable costs of flooding initially fall on property owners, and could be devastating to household and even business finances if a flood seriously damages the main home or premises and its contents. This risk of catastrophic financial loss can be spread over time and among all properties at risk of flooding by buying insurance – everyone at risk pays a regular premium, which funds a payout to cover the main financial costs for the minority who do suffer flooding each year.

However, the insurance industry has, for business reasons, some reluctance to cover properties at the highest risk of flooding. It has agreed with the government a 'statement of principles', stating that the insurance industry will (until 2013) insure existing (pre-2009) properties with an annual flood risk less than 1.3 per cent or where there are plans in place to reduce the flood risk within five years. It may therefore not insure properties at severe risk without plans to reduce the risk.[90] This means that any reduced action on flood defence may mean that some risks become impossible to insure against, and therefore that the costs can no longer be spread across the at-risk population and over time, but instead fall fully and immediately on those with the misfortune to be flooded.

Therefore, it is possible to financially quantify the benefits of flood defence works, and these benefits are typically several times the costs of the work. There is plenty of scope to increase investment at these

[88] *Investing for the future*, pages 8 and 14-15; see also Association of British Insurers at the September 2010 meeting, transcript page 18
[89] Environment Agency at the February 2011 meeting, transcript page 9.
[90] 'Revised Statement of Principles on the Provision of Flood Insurance', ABI, July 2008 http://www.abi.org.uk/Publications/Revised_Statement_of_Principles_on_the_Provision_of_Flood_Insurance1.aspx; see also Association of British Insurers at the September 2010 meeting, transcript pages 11-12 and 19

high benefit-cost ratios. This is likely to be especially true in London. Much of this quantifiable benefit goes to property owners and occupiers, including private companies and households.

Finding 6
Work by the Mayor, the Environment Agency and others is identifying a number of projects that would have significant flood risk reduction benefits. We have heard that many of these are likely to generate benefits that far exceed the cost of the projects. There are options for funding to come from outside of traditional public grant direct from central government.

Recommendation 6

The Mayor should set out, in the final Water and/or Climate Change Adaptation Strategies, steps to identify and secure sources of short, medium and long-term funding from public, private and third sectors for the delivery of priority flood protection projects, including those in the Drain London, London Rivers Action Plan and London Green Grid programmes.

Potential partnerships are being missed

There is potential for multi-agency partnerships to take forward flood risk mitigation works, and to bring other benefits to the areas concerned. The Mayesbrook Climate Change Park and the Wandle Valley Regional Park are examples from within London.[91] Benefits of the multi-agency approach may include access to funding, a broad range of expertise and perspectives so that the works can be designed and managed to optimise benefits of several different kinds, and engagement of residents, owners, users and other stakeholders.[92]

Connections between major public sector bodies, including the Environment Agency, the GLA and London boroughs, are well-established. However, the third sector can have a significant role to

[91] http://www.trrt.org.uk/index.aspx?articleid=15955; http://www.wandlevalleypark.org.uk/
[92] Thames Rivers Restoration Trust, at the September 2010 meeting, transcript pages 25-26; also Environment Agency at the February 2011 meeting, transcript page 5

play in establishing broad partnerships and crossing institutional boundaries. This Committee heard from the Thames Rivers Restoration Trust (TRRT) about its work to bring together partners and funders for the Mayesbrook Climate Change Park. [93] However, many boroughs seem to be unaware of organisations like the TRRT.[94] Therefore the local authority knowledge of the scope for works in their areas may not come to the attention of third sector partners. Third sector organisations may be particularly short of the staff resources needed to make contact pro-actively with the right part of larger public sector bodies, at the right time.

Suitable forums for sharing information and contacts about partnership working in flood management between local authorities may include the Thames Regional Flood and Coastal Committee, the Drain London Forum and/or London Councils. The Mayor needs to support a mechanism to make these potential partnerships active.

Finding 7
Third sector organisations and local authorities need help to make the right connections to take forward opportunities for flood protection works.

Recommendation 7
The Mayor should set out, in the final Water and/or Climate Change Adaptation Strategies, what steps he can take to support a mechanism to develop partnerships to take forward flood risk mitigation works.

[93] Thames Rivers Restoration Trust, at the September 2010 meeting, transcript pages 25-26.
[94] Email from Thames Rivers Restoration Trust to London Assembly Secretariat, 24 March 2011.

Conclusion – leading the response to rainwater flood risk in London

London is particularly at risk of serious flood damage in the event of heavy rain, as outlined in the Introduction and in Appendix 1. As set out in the main body of this report, action is required to:

- assess and communicate the risk of surface water flooding
- slow and reduce the runoff of heavy rain
- secure greater investment in reducing London's flood risk
- remove other obstacles to river restoration projects

The Mayor is well placed to increase effective action in all of these areas, by using his direct powers and his indirect leadership and influence. As this report has shown, these actions have not so far been fully tackled by other bodies, nor are they set to be fully tackled in the immediate future.

The Drain London initiative, first established by the then Mayor in 2007 and taken forward by the current Mayor, is assessing surface water flood risk, and therefore creates the potential for the Mayor to ensure that this information is communicated to households and businesses affected. Surface water flood risk is not a statutory responsibility of the Environment Agency and has not yet been effectively assessed or communicated by most local authorities.

Developers in the UK are behind those in some other countries at adopting sustainable drainage systems. The Mayor is already seeking to change this through the London Plan and, by extending the Green Roofs Fund, could help tackle the identified need for successful exemplars of sustainable drainage.

There is no shortage of high-value flood risk reduction work seeking funding. As well as the GLA Group's own budgets, the Mayor has influence over investment decisions by national and local government, the private sector and the third sector. Any of these could be potential sources for investment in flood risk reduction.

The Mayor has influence over, and is able to facilitate, partnership working and mutual support by different sectors and by different tiers of government, especially as it relates to strategic issues for London.

Appendix 1 Flooding risks in London

Types and sources of flood risk

Surface water flooding

Surface water flooding occurs when the rainfall in a certain period exceeds the rate at which water soaks into the ground or runs into drains and rivers. The water then must run across the surface of the ground, from higher to lower. It may collect in low-lying areas, and may run strongly in natural gullies.

The risks of surface water flooding are, so far, poorly known. It is estimated that up to 680,000 properties in London are at risk from surface water flooding with a probability of at least 0.5 per cent in a year[95] and that 400,000 of these are additional to those properties vulnerable to rivers and the sea.[96] The Drain London project is working to significantly improve this information.[97]

Surface water flooding is a priority for London; 14 of the 15 settlements most at risk of surface water flooding nationwide are London boroughs, and 28 of the 33 London boroughs are in the top 50 nationwide.[98]

Sewer flooding

Sewer flooding occurs when the flow of water through drains and sewers exceeds the capacity of the sewer network at certain points. Sewer flooding, and its link to surface flooding, was identified as a critical issue for London by this Committee in its 2002 report *Flooding in London*.[99] Sewer flooding tends to go alongside surface water flooding – both are caused by heavy rainfall, and when sewers fill up, further rainfall cannot drain away from the surface.

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[95] Draft CCAS, pages 40 and 42

[96] Environment Agency, written contribution to this investigation, citing the evidence base for the Defra consultation on 'Distributing Funding to Lead Local Flood Authorities for Local Flood Risk Management'

[97] Mayoral Decision MD455, 28 October 2009 and London Councils 2011 Drain London update, pages 5-7

[98] *National Rank Order of Settlements Susceptible to Surface Water Flooding*, Environment Agency 2009

[99] http://www.london.gov.uk/who-runs-london/the-london-assembly/publications/environment/flooding-london

Thames Water has a register of over 12,000 properties at specific risk of sewer flooding with a probability of at least 5 per cent in a year. It is working to reduce these risks.[100]

River flooding

River flooding occurs when the flow of water down a river exceeds the capacity of the river channel. About 100,000 properties in London are at risk from river flooding. With existing protection, the risks are typically about 1 to 5 per cent in a year.[101]

Tidal flooding

Tidal flooding occurs when a combination of factors creates an especially high tide. On a tidal estuary such as the Thames, the flow of water down the river is an important element in the total estuary water level.

The Thames is tidal as far as Teddington Weir in West London; the tidal flood plain in London is now occupied by about 1.25 million people and 480,000 properties. However, the Thames Barrier and other protections reduce the tidal risk to these properties to less than 0.1 per cent in a year. The likelihood of a major tidal flood affecting central London is reduced to less than 0.01 per cent in a year.[102]

The Thames Estuary 2100 project has reviewed London's tidal defences in the light of climate change projections for the current century.[103] Therefore this project has not re-examined tidal flood risk.

Surface water, sewer and river flooding

The four main types of flood risk in London are surface water, sewer, river and tidal flooding. Because the management of tidal flood risk in London is highly effective and has recently been subject to a major forward-looking review, this report concentrates on surface water, sewer and river flooding.

[100] Draft Water Strategy, pages 74-75 and Thames Water written contribution to this investigation. See also Regional Flood Risk Appraisal, page 24
[101] Draft Water Strategy, page 62
[102] Draft CCAS, pages 39 and 41. See also City of London, written contribution to this investigation
[103] Environment Agency; Thames Estuary 2100 http://www.environment-agency.gov.uk/homeandleisure/floods/125045.aspx. See also City of London, written contribution to this investigation

Flood risk in the event of heavy rain

Interconnection of flood risks

Surface water flooding, sewer flooding, and river flooding risks are interconnected by a common cause – heavy rain – and by knock-on effects from one flood type to the risk of another.

Rainfall is the main source of water for surface, sewer and river flooding. Heavy rainfall in an area is likely to create a tendency for all three types of flooding.

Also, the occurrence of one type of flooding can make another type more likely in a knock-on effect. If a river floods, river water may cover drain outflows, stopping or slowing the exit of drain water and making sewer flooding more likely. Likewise, if the drainage network fills with water, drain inlets may cease to allow water in, so that further rainfall must remain as surface water.

Older parts of London's drainage system (broadly, inner London) are based around what were once natural streams and rivers. In many cases foul sewers, when filled to capacity, overflow into drains normally used for surface water runoff. This increases the effects of one type of flooding on the risks of others.[104]

Impermeable surfaces

Surfaces can be classed as permeable – those that soak up rain water – or impermeable – those that do not soak up rain water. Soil with natural or agricultural vegetation cover is permeable, and so in green areas a large percentage of rainfall soaks into the ground, draining slowly into rivers.

However, in urban areas such as London, a very large percentage of the surface is impermeable, being made of tarmac, concrete, roof tiles and similar materials.[105] Therefore, a much larger percentage of rainfall in urban areas immediately becomes runoff, initially across the

[104] Thames Water, written contribution to this investigation and at the September 2010 meeting, transcript page 20; see also Draft Replacement London Plan, page 198 and Draft Water Strategy, pages 70-71

[105] Draft CCAS, pages 50-51

ground surface and then in most cases into drains, which channel into main drains and/or watercourses and rivers. This means that heavy rain rapidly finds its way to drains and rivers, potentially exceeding their capacity and causing flooding. Peak flows are high if little of the rainfall is absorbed by the ground surface and released over a period of time. Because of the rapidity of runoff, flooding can occur very soon after the onset of heavy rain.

Trends in flood risk

There are a number of trends increasing London's flooding risks and the exposure of people and properties to these risks.

With climate change, there is likely to be more and heavier winter rainfall. There has already been more intense winter rainfall over the past 40 years; an increase of 15 per cent is estimated by the 2050s, compared to the baseline of 1961-1990. There are expected to be 'significant increases in peak Thames and other river flows and the potential for more surface water flooding', with 'appreciable changes seen by the 2020s'. There will be an increased probability of flooding and a need to cope with greater consequences when it does happen.[106]

With new development and changes to existing developments, the percentage of London's surface that is impermeable has increased significantly in recent decades – in west London, by 20 per cent between 1970 and 2007.[107] This trend is sometimes known as 'urban creep': where an increase in paving has taken place without an increase in the number of properties, it can be difficult to quantify the increased pressure on the drainage system and therefore difficult to make the case for funding to improve main drains.[108] However, since 2007 there have been changes to planning regulations that may slow this trend (see pages 18-20 above).

[106] Draft Water Strategy, pages 39-40 and 59-61; see also Draft Replacement London Plan pages 21 and 113-114
[107] Thames Water at the September 2010 meeting, transcript page 21
[108] Association of British Insurers and Thames Water, written contributions to this investigation.

The population of London is increasing and development is becoming denser, including in flood risk areas.[109] This means that, for any given extent of flooding, more people and properties would be affected.

Flood risk in the event of heavy rain
London is at significant and increasing risk of surface water, sewer and river flooding, probably in combination, in the event of heavy rainfall.

Flood risk management

Catchment area approach

Modern flood risk management is based around a whole drainage network – often a river catchment area.

A more location-focussed approach runs the risk that flood barriers or drainage channels put in place to protect one site may increase the risk of flooding upstream or downstream of that location. The catchment area approach seeks to avoid these side-effects.

The catchment area approach also recognises that the best way to reduce flood risk in one location may be through measures some distance away – for example, if rainwater is held high in the catchment area and gradually released, flooding in the rivers lower down may be avoided. Often, risk across the catchment can be reduced by slowing the flow of water in the upper parts of the catchment area, and facilitating the drainage of excess water in the lower parts.[110]

A catchment area approach also enables flood risk management to be integrated with other aspects of river basin management, such as ecological standards, as required under the EU Water Framework Directive of 2000.[111]

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[109] September 2010 meeting, transcript pages 9 and 19-20; Draft CCAS, page 8; See also London Assembly Planning and Spatial Development Committee, 5 September 2007 – item 6 – Flooding Risk in the Thames Gateway.
[110] Draft Water Strategy, page 59. See also Thames Water written contribution to this investigation.
[111] Defra water management strategy document *Directing the Flow*, discussed in written contribution to this investigation from Thames Rivers Restoration Trust, page 4.

Methods of flood risk management

Ways to manage flood risk include runoff attenuation, river channel works, drain and sewer works, risk avoidance and resistance, and information and communication.

Runoff attenuation is covered in some detail in the body of this report (pages 18-20), particularly the use of sustainable urban drainage systems, such as unpaved landscaping, permeable paving, green roofs and walls, and site drainage holding tanks or soak-aways. The report also discusses steps to limit further impermeable paving of gardens and other surfaces in the city.

River channel works traditionally reduce the risks of flooding upstream of the works, by enabling the river to carry water away more swiftly. In a modern catchment-area approach, river channels higher in the catchment can be modified or restored to slow flood waters or divert them to an open flood plain area, reducing the flood risk downstream as well. A fuller discussion is at Appendix 3

Works to drains and sewers can reduce the risks of surface water and sewer flooding by increasing the capacity of the sewer network to take in and channel away water. When modern drainage design features are added, the networks can be managed to slow and hold water or even to divert it from an over-burdened channel to one with space capacity. This can manage flood risk more effectively over a catchment area and reduce the risk or severity of river flooding.[112]

Flood risk reduction is a slow process, and no feasible measures will reduce all flood risks to zero in any large area. Some flood risk must be acknowledged and planned for.[113]

Therefore, flooding must be anticipated and steps taken to reduce the vulnerability of people, property and infrastructure to flooding. As most of London's floodplains are already developed, there is an increasing emphasis on adapting the character of buildings in the floodplains as redevelopment occurs. Planning Policy Statement 25 and policy 5.12 in the London Plan seek to avoid inappropriate further development in flood-prone areas and to ensure that development that does take place is suitably safe and resilient. The Environment

[112] Thames Water at the September 2010 meeting, transcript page 28
[113] Environment Agency, written contribution to this investigation and at the September 2010 meeting, transcript page 8 (see also 17-18)

Agency must be consulted about planning applications in flood risk areas – if the Environment Agency, following discussions, advises against a major application in a medium or high risk area, the planning authority must notify the Secretary of State before proceeding.[114] The GLA also promotes flood resilience in at-risk developments.[115]

Where there are homes and other properties at risk in a flood-prone area, then there are many things that owners and occupiers can do to reduce their flood vulnerability or to protect themselves and their property in the event of a flood.[116] In order to take these steps, owners and occupiers need to be aware of flood risk, both in the long term and when a flood may be imminent. Flood risk information and its communication are covered in the body of this report, on pages 18-19.

Modern flood risk management
The modern approach to flood risk management operates at the level of a river catchment area, using a suite of different methods but accepting that some risk will remain and that people and properties in flood-risk areas must be prepared for flooding.

[114] Environment Agency, written contribution to this investigation; Draft Replacement London Plan pages 129-130; Association of British Insurers at the September 2010 meeting, transcript page 9
[115] GLA at the September 2010 meeting, transcript page 19
[116] Information is available from the Environment Agency at http://www.environment-agency.gov.uk/homeandleisure/floods/31624.aspx and http://www.environment-agency.gov.uk/homeandleisure/floods/31632.aspx, and from the National Flood Forum at http://www.floodforum.org.uk/index.php?option=com_content&view=article&id=8&Itemid=4

Appendix 2 Flood risk governance in London

The Environment Agency and London boroughs

The 2010 Flood and Water Management Act divides statutory responsibility for flood defence in England between the Environment Agency and Lead Local Flood Authorities.

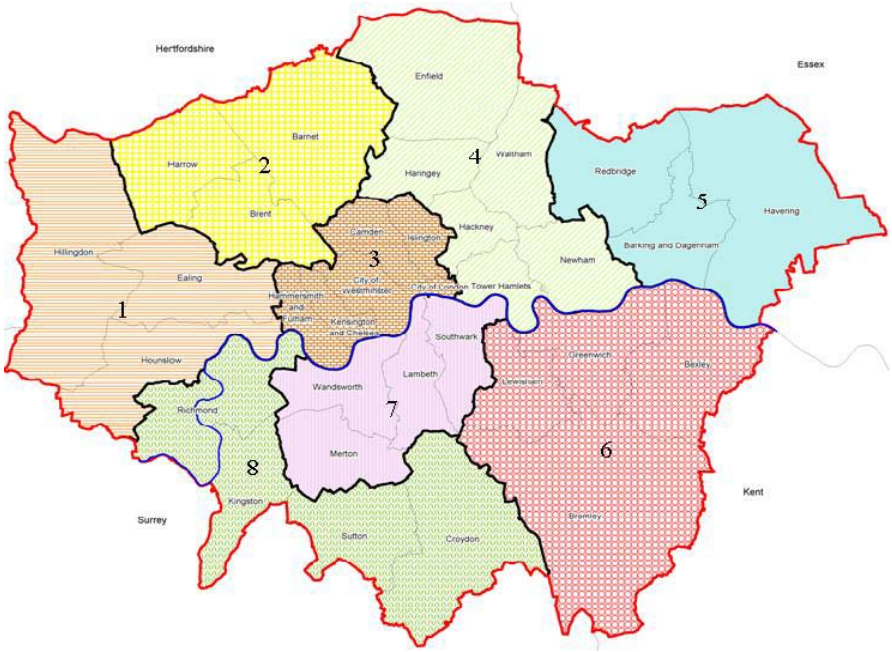
The Environment Agency is responsible for managing the risk of flooding from the sea and main rivers, and for strategic co-ordination at the regional level.[117] The relevant region for London was the Thames region. This is in the process of merging with the Southern region to create a larger South-Eastern region, with a special liaison office for London.[118]

Lead Local Flood Authorities (in London, London boroughs), are responsible for flooding risk from surface water and from 'ordinary watercourses' (smaller rivers and streams), and for local action to tackle flood risk.[119]

To assist co-ordination between these levels, there is a Thames Regional Flood and Coastal Committee (RFCC, formerly known as the Thames Regional Flood Defence Committee). This agrees a local levy of borough funds, and its expenditure to support additional flood defence work in the region. London boroughs are represented on this committee by elected Members, one from each of a number of borough groupings organised along river catchment lines.[120] These groupings now match the Drain London partnership groupings (see map overleaf).[121]

The Environment Agency has stressed the need for these borough groupings to engage fully with the RFCC.[122]

[117] Environment Agency, written contribution to this investigation; see also September 2010 meeting (transcript ages 7-10) for a discussion of oversight or audit of local authority flood risk management, and the Environment Committee's role in this regard.
[118] Environment Agency at the February 2011 meeting, transcript pages 1-2
[119] Environment Agency, written contribution to this investigation
[120] Environment Agency, written contribution to this investigation
[121] London Councils 2011 Drain London update, pages 5-6
[122] Environment Agency, written contribution to this investigation and at the September 2010 meeting, transcript page 2



Map – Drain London Borough groupings

The Mayor

The Mayor also has statutory roles relevant to flood risk. Under the GLA Acts of 1999 and 2007, he is required to produce a Water Strategy and a Climate Change Strategy, and also a London Plan. The Water Strategy devotes a chapter to 'managing rainwater', touching on many of the issues raised in this report. [123] The chapter on disposing of wastewater deals with other issues, such as sewer flooding and the misconnection of sewers to surface water drains.[124] The Climate Change Adaptation Strategy flooding chapter includes actions to assess and reduce surface water flood risk and help manage flood risk response.[125] It also notes the flood risk benefits of several actions in the 'overheating' chapter[126] as well as addressing some governance and impact issues in their respective sections. The London Plan regulates building in flood-prone areas and the impact of development on flood risk elsewhere, seeking to keep down and reduce the risks of flooding in London and the exposure and vulnerability of London's people and buildings to those risks.[127]

Using his London-wide strategic role and his statutory powers, the Mayor has further developed his role in tackling flood risk.

[123] Draft Water Strategy, pages 59-68
[124] Draft Water Strategy, page 75
[125] Draft CCAS, p 35-53
[126] Draft CCAS, p 69-70
[127] Draft Replacement London Plan Policies 5.12 (flood risk management) and 5.13 (sustainable drainage); also 2.18 (green infrastructure), 5.10 (urban greening), 5.11 (green roofs and development site environs), 5.14 (water quality and sewerage infrastructure), 7.24 (Blue Ribbon network), 7.28 (restoration of the Blue Ribbon network) and 7.29 (the River Thames)

The Mayor established the city-wide Drain London Forum, chaired by the GLA to bring together organisations involved in managing surface water drainage in London. The GLA also secured funding from Defra for Drain London to assess risk and develop actions to tackle surface water flooding at the London level[128] – supporting and bringing a regional strategic approach to the work of boroughs to fulfil their responsibilities under the Flood and Water Management Act 2010. Drain London has also catalysed working between relevant officers from different boroughs, along catchment area lines similar to those shown above for representation on the RFCC.[129]

The Mayor has established the London Waterways Commission, including representatives of statutory authorities, the boroughs, the voluntary sector and water amenity groups to advise him strategically on waterways issues.[130] The London Resilience Partnership brings together key agencies to plan and prepare for emergencies strategically across London; since 2010 it has been led by the Mayor.[131] The Mayor has contributed to and is the lead signatory of the London Rivers Action Plan, which is also reflected in the London Plan and the Climate Change Adaptation Strategy.[132]

The Mayor's role in flood risk in London

By fulfilling specific statutory responsibilities, by setting up or taking leadership of strategic partnerships, and by exercising his general role as strategic leader for London, the Mayor has a prominent and crucial role alongside the Environment Agency and London boroughs in tackling flood risk in London.

[128] Mayoral Decision MD455, 28 October 2009 and London Councils 2011 Drain London update, pages 5-7

[129] Environment Agency and London Boroughs at the September 2011 (transcript pages 1-6) and February 2011 (transcript pages 4-5) meetings

[130] http://www.london.gov.uk/waterways/lwc/

[131] http://www.londonprepared.gov.uk/news/news-20101021.jsp see also Environment Agency at the February 2011 meeting, transcript page 2

[132] London Rivers Action Plan, Draft Replacement London Plan, policy 7.28 and Draft CCAS, page 98

Appendix 3 River restoration

Benefits of river restoration

Many of London's rivers are confined between concrete walls or in covered channels (culverts). This has been done in many cases as a flood risk reduction measure – the channel contains the river within the same area, even when the water level rises (up to a certain point).

However, the building-up of the river banks and the walling-off of the river have often encouraged development closer to the river, even up to the channel walls or over the culvert.[133] These areas are where flooding will occur when excess flow exceeds the channel capacity, as sooner or later it will.

The channel also tends to speed the flow of water downstream, which can help prevent flooding of that stretch of river. However, the accelerated water movement can increase the downstream flood risk.

An alternative approach is to restore a more natural profile to the river bank, with low-lying open areas where flood waters can harmlessly collect. This can slow and hold flood waters, reducing the risk of damaging flood both at the site and further downstream.

Restored rivers, and green spaces with river access, offer other benefits too. These include supporting greater biodiversity, offering enhanced leisure use, and increasing resilience to extreme weather and climate change.

The Thames Rivers Restoration Trust also argues that river restoration can be less costly than traditional 'hard engineering'.[134]

Opportunities for river restoration

There are opportunities to restore rivers and/or to bring open spaces into use for flood water storage in London.

London does have a built legacy of confined rivers and developed flood plains, which often make it difficult to restore rivers or to use adjacent areas as low-lying open space. However, opportunities do arise when an area is redeveloped. There are also many remaining riverside open spaces, especially in outer London. In these cases river restoration or other works can create flood protection. There are

[133] Environment Agency at the also September 2010 meeting, transcript page 27
[134] Thames Rivers Restoration Trust, written contribution to this investigation. See also September 2010 meeting, transcript pages 17-18 and 24-26

benefits even to restoring some stretches of a river, among other stretches which remain canalised because of existing development.[135]

Examples include

- Sutcliffe Park, Greenwich
- Cornmill Gardens, Lewisham
- Mayesbrook Park, Barking and Dagenham
- Wandle Valley Regional Park in south London

The London Rivers Action Plan identifies many rivers where restoration may be possible. The Mayor has acknowledged this potential by supporting the London Rivers Action Plan and including its target to restore 15km of river by 2015 in his draft Climate Change Adaptation Strategy[136]

River restoration potential
There are many sites in London where restoring rivers could reduce flood risk and potentially provide other benefits.

[135] Environment Agency at the also September 2010 meeting, transcript page 27
[136] London Rivers Action Plan – lead signatory, foreword; Draft CCAS, page 98

Appendix 4 Key findings

Introductory finding
London is at risk of serious flood damage in the event of extreme rainfall. The Mayor has an important role, as do others, in ensuring that this risk is tackled

Finding 1
More Londoners who live and work in areas at risk of flooding (especially surface water flooding) need to know about the risk and what they can do to reduce their exposure and prepare for the eventuality of flooding.

Finding 2
Exemplar sustainable drainage projects would help overcome developer doubts and reduce London's flood risk by reducing rainfall runoff.

Finding 3
There is a need to reduce the spread of impermeable surfaces within London's existing built developments, for example in gardens.

Finding 4
River restoration is in many cases an effective flood risk management measure – it can have other benefits too. The London Rivers Action Plan identifies many sites where restoration may be possible and shares with the Mayor's draft Climate Change Adaptation Strategy a target to achieve 15km of restoration by 2015.

Finding 6
Work by the Mayor, the Environment Agency and others is identifying a number of projects that would have significant flood risk reduction benefits. We have heard that many of these are likely to generate benefits that far exceed the cost of the projects. There are options for funding to come from outside of traditional public grant direct from central government.

Finding 7
Third sector organisations and local authorities need help to make the right connections to take forward opportunities for flood protection works.

Appendix 5 Recommendations

Recommendation 1
The Mayor should ensure that the Drain London flood risk data are available to the public, alongside information about what householders can do if they live in a flood risk area. Ways to make the data available could include the Water and/or Climate Change Adaptation Strategies, the London Datastore, the Environment Agency's existing publication of river and coastal flood risk maps and local borough publication.

Recommendation 2
The Mayor should extend the applicability of the Green Roofs Fund to include other forms of sustainable drainage to support more exemplar projects to stimulate commercial interest.
Where possible, the Mayor should also ensure that the GLA Group estate exemplifies sustainable drainage in its own property works.

Recommendation 3
The Mayor, in his final Water and/or Climate Change Adaptation Strategies and their implementation, should raise awareness of the environmental impacts of garden paving and awareness of environmentally sustainable surface materials

Recommendation 4
The Mayor should retain the target to restore 15km of rivers in the final version of his Climate Change Adaptation Strategy, and set out a plan for how this can be realised.

Recommendation 5
The Mayor should join the Assembly in calling for the forthcoming Water White Paper to address Thames Water's need to work directly with households to rectify misconnected drains.

Recommendation 6
The Mayor should set out, in the final Water and/or Climate Change Adaptation Strategies, steps to identify and secure sources of short, medium and long-term funding from public, private and third sectors for the delivery of priority flood protection projects, including those in the Drain London, London Rivers Action Plan and London Green Grid programmes.

Recommendation 7

The Mayor should set out, in the final Water and/or Climate Change Adaptation Strategies, what steps he can take to support a mechanism to develop partnerships to take forward flood risk mitigation works.

Appendix 6 Orders and translations

How to order

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Chinese

如您需要这份文件的简介的翻译本，
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Email 与我们联系。

Hindi

यदि आपको इस दस्तावेज का सारांश अपनी भाषा में
चाहिए तो उपर दिये हुए नंबर पर फोन करें या उपर दिये
गये डाक पते या ई मेल पते पर हम से संपर्क करें।

Vietnamese

Nếu ông (bà) muốn nội dung văn bản này được dịch sang
tiếng Việt, xin vui lòng liên hệ với chúng tôi bằng điện
thoại, thư hoặc thư điện tử theo địa chỉ ở trên.

Bengali

আপনি যদি এই দলিলের একটা সারাংশ নিজের ভাষায় পেতে চান,
তাহলে দয়া করে ফো করবেন অথবা উল্লেখিত ডাক ঠিকানায় বা
ই-মেইল ঠিকানায় আমাদের সাথে যোগাযোগ করবেন।

Greek

*Εάν επιθυμείτε περίληψη αυτού του κειμένου στην γλώσσα
σας, παρακαλώ καλέστε τον αριθμό ή επικοινωνήστε μαζί
μας στην ανωτέρω ταχυδρομική ή την ηλεκτρονική διεύθυνση.*

Urdu

اگر آپ کو اس دستاویز کا خلاصہ اپنی زبان میں
درکار ہو تو، براہ کرم نمبر پر فون کریں
یا مذکورہ بالا ڈاک کے پتے یا ای میل
پتے پر ہم سے رابطہ کریں۔

Turkish

Bu belgenin kendi dilinize çevrilmiş bir özetini
okumak isterseniz, lütfen yukarıdaki telefon
numarasını arayın, veya posta ya da e-posta
adresi aracılığıyla bizimle temasa geçin.

Arabic

الحصول على ملخص لهذا المستند بلغتك،
فرجاء الاتصال برقم الهاتف أو الاتصال على
العنوان البريدي العادي أو عنوان البريد
الإلكتروني أعلاه.

Punjabi

ਜੇ ਤੁਸੀਂ ਇਸ ਦਸਤਾਵੇਜ਼ ਦਾ ਸੰਖੇਪ ਆਪਣੀ ਭਾਸ਼ਾ ਵਿਚ ਲੈਣਾ
ਚਾਹੋ, ਤਾਂ ਕਿਰਪਾ ਕਰਕੇ ਇਸ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ
ਉਪਰ ਦਿੱਤੇ ਡਾਕ ਜਾਂ ਈਮੇਲ ਪਤੇ 'ਤੇ ਸਾਨੂੰ ਸੰਪਰਕ ਕਰੋ।

Gujarati

જો તમારે આ દસ્તાવેજનો સાર તમારી ભાષામાં
જોઈતો હોય તો ઉપર આપેલ નંબર પર ફોન કરો
અથવા ઉપર આપેલ ટપાલ અથવા ઈ-મેઈલ સરનામા
પર અમારો સંપર્ક કરો.

Appendix 7 Evidence for the investigation

The Environment Committee took views and information on this topic from guests at two meetings – on 8 September 2010[137] and 3 February 2011[138]. Organisations meeting with the Committee were:

- the GLA
- the Environment Agency
- the London Borough of Richmond Upon Thames
- the London Borough of Tower Hamlets
- the Association of British Insurers
- the Thames Rivers Restoration Trust
- Micro Drainage Ltd
- Thames Water

The September meeting discussed how public agencies work to tackle flood risk, flood risk information and communication, and how flood risk can be reduced. The February meeting heard again from the Environment Agency, about the implications of the 2010 Spending Review, Environment Agency restructuring, and how flooding works are resourced.

The investigation also received views and information in writing[139] from:

- the GLA
- the Environment Agency
- the City of London Corporation
- the Association of British Insurers
- the Thames Rivers Restoration Trust
- Thames Water.

[137] Transcript available at http://www.london.gov.uk/moderngov/Data/Environment%20Committee/20100908/Minutes/10-09-08_transcript-checked.pdf
[138] Transcript available at http://www.london.gov.uk/moderngov/mgConvert2PDF.aspx?ID=4582&T=9
[139] Written contributions can be found at the publication page for this report http://www.london.gov.uk/publication/rainy-day

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