

The London Climate Change Adaptation Strategy: Gap Analysis



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1 Introduction

1.1 The context of this Working Paper

This Working Paper has been produced in the context of a wider, multi-disciplinary funded project, the ARCADIA project, running from 2009-2011. The overall aim of ARCADIA has been to provide a system-scale understanding of the inter-relationships between climate impacts, the urban economy, land use, transport and the built environment. Its objective is to develop advanced new analysis, techniques and tools to inform adaptation decision-making, and develop understanding of the landscape of climate change adaptation governance within the UK in general and London in particular. The project is a collaboration between research centres at Newcastle, Cambridge, UEA, UCL and the Met Office Hadley Centre (MOHC), although the strand of the project represented in this Working Paper has been carried out within the School of Architecture, Planning and Landscape at Newcastle University. The analysis is focused on London which, due both to its climate vulnerability and to the relatively advanced stage of its adaptation planning in the UK context, provides a fitting case study for climate change adaptation.

1.2 About the Working Paper

This Working Paper draws from an earlier report which was produced for the ARCADIA project in April 2010 and provided an overview of climate change adaptation governance. The governance aspect of the paper has been updated to end December 2010, when this paper was finalised. The paper also draws from interviews with ARCADIA project stakeholders and a small sample of key actors. The paper focuses on London and more specifically on a gap analysis of the Mayor of London's Draft Climate Change Adaptation Strategy, issued in February 2010. This Strategy is initially reviewed in terms of its 'plan-making' attributes that include: the 'emergency planning' approach adopted, the evidence base and method of prioritisation, civic engagement, implementation and monitoring. General gaps and challenges for the Strategy are then presented in a table. The paper moves on to present a risk-by-risk analysis of climate change adaptation in London, each section setting out the bigger picture regarding the risk and its impacts, before progressing to its treatment in the London Strategy, and the role of the lead actors in implementing it, tabulating any gaps identified by the strategy and/or emerging from research literature and stakeholder and key actor interviews. A final section of the paper summarises the risk-by-risk gaps for London climate change adaptation.

1.3 Background to the issues

In the UK, and London specifically, the opening decade of the 21st century has seen an increase in climate-related events with serious and significant impact. In 2003 London faced overheating that resulted in 600 deaths. In 2006 Thames Water imposed the first company-wide ban for 30 years. The

use of the Thames Barrier to protect the city from both fluvial and tidal flooding more than doubled over the last decade, while the increase in incidence of heavy rainfall events made surface flooding ever more likely. This is in a context where London's population of 7.5 million continues to expand, placing development pressure on some of the floodplain areas and straining an ageing utilities infrastructure. On a risk register of natural hazards for the world's 50 megacities, London was ranked in 9th place, with the potential to rise in rank as the climate continues to change. (Greater London Authority, 2010).

While the urgency of the need to adapt to the hazards and opportunities of climate change has gained greater acceptance, this has to be seen in the context of the major restructuring of the UK planning system currently taking place. The Localism Bill (House of Commons, 2010), due a second reading in early 2011, proposes a smaller number of strategies for London and a shift in the relative balance of power between Boroughs and the GLA on planning issues. These changes would have a significant impact on the adaptation planning approach discussed in this report. On a broader scale, the regional level of governance is in the process of being withdrawn, likewise the recently-introduced system of National Indicators for monitoring local authorities on a range of dimensions, including adaptation planning. The context for this paper is therefore one of considerable uncertainty regarding the resources and institutional framework that will be committed to adaptation planning in London and the UK in the future.

2 Climate Change Adaptation

2.1 Defining adaptation

Unlike mitigation which has a clear focus on reducing global greenhouse gas emissions, adaptation is a diffused concept and highly context-dependent. Within the context of the human dimension of global change, adaptation can be defined as “a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity” (Smit and Wandel, 2006). With particular reference to climate change, the IPCC definition of adaptation as ‘adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects’ (McCarthy *et al.*, 2001) has been the most influential definition and been repeatedly used in the literature. In the context of the built environment, adaptation can be described as the ability of cities and regions to adjust to climate variability and extremes, managing their consequences to minimise their effects. There are two temporal situations of adaptation: anticipatory or *proactive* adaptation denotes those preparatory measures that are introduced prior to the actual occurrence of an event (e.g. flood, drought or heat-wave); whereas *reactive* adaptation refers to an immediate response to the change in conditions in order to avail stability. In terms of its stimulus, adaptation can either be *autonomous*, that is, triggered by variation in social, economic or environmental systems, or *planned*, that is, emerging from policies seeking to achieve balance (IPCC, 2007). It should be noted

that climate change economics suggest that planned adaptation tends to be more cost effective (both socially and economically) than autonomous adaptation (HM Treasury, 2006).

2.2 Governance of climate change adaptation

The governance of climate change adaptation is multi-level and cross-sectoral. It involves a wide range of actors, stakeholders and interests. In the UK, the governance arrangements and institutional landscape of climate change policy have changed substantially over the last decade. An important aspect of this change was the development of specific policy responsibilities and institutional configuration for climate adaptation. Major stepping stones in this respect were: the Climate Change Act 2008, the Adapting to Climate Change Programme (2008), the setting up of National Indicator 188 'Planning to Adapt to Climate Change' and more recently the Departmental Action Plans (DAP) produced by major government departments from March 2010. Report 1 from the governance strand of the ARCADIA project (Mehmood and Davoudi, 2010), on which this Working Paper has drawn, provided an overview of the key institutions with significant responsibility for, or stake in, climate change policies and particularly adaptation measures at international, national, regional and sub-regional levels. It also provided a summary of the key actions proposed in the DAPs. Since the production that report in April 2010, the most important changes in the governance of climate change adaptation have been introduced through the Localism Bill, the revocation of regional level of governance, and withdrawal of the system of National Indicators for monitoring local authorities' progress on adaptation planning.

The focus of this paper is on London. It should be noted that while our gap analysis of the London Adaptation Strategy provides a useful basis for similar analyses in other cities and regions in the UK, different localities face different adaptation challenges and require their own set of policy measures to respond to these challenges. As mentioned above, local circumstances play a major part in adaptation planning. While centrally designed policies and regulation through, for example, binding intergovernmental and national agreements provide suitable measures for achieving mitigation, adaptation requires a more decentralised and locally-specific approach that allows for flexible responses to local climate-related risks.

2.3 Challenges to climate change adaptation

The UK Adaptation Sub-Committee of the Independent Committee on Climate Change was established as part of the 2008 Climate Change Act. It released a report in September 2010 identifying five adaptation priority areas, in terms of:

1. Taking a strategic approach to land use planning
2. Providing national infrastructure (energy, water, transport, waste and communications)
3. Designing and renovating buildings
4. Managing natural resources sustainably

5. Effective emergency planning.

The same report, however, highlights a number of challenges to climate change adaptation, of which the following are particularly relevant:

- Inaccuracy of the available information on climate risks
- Policy barriers that tend to prevent individuals and business from taking actions to increase resilience
- Adaptation itself being perceived as just another tick box on the environment and sustainability checklist
- Need for adaptation to be given exclusive attention in building regulations.
(Committee on Climate Change Adaptation, 2010).

The progress and effectiveness of adaptation policies needs to be continuously reviewed by identifying the critical gaps between increasing knowledge of adaptation challenges, resilience policy and actual implementation. For example, the UK's 2008 Climate Change Act has been widely commended as a proactive stance but concerns have been raised as to the complicated system of assessment and reporting that it has introduced. One such example is the requirement for all major government departments to produce their respective Departmental Adaptation Plans (DAPs), as mentioned above. While DAPs have begun to emerge since Spring 2010, it remains to be seen whether these plans will be successful in raising awareness and preparing communities for future climatic events.

Several overarching institutional issues also arise with regard to adaptation in terms of its nature as a political decision, its complexity, the characteristics of policies, mechanisms and tools, and organisational characteristics. Many of these issues have been highlighted within the 2010 report by the Royal Commission on Environmental Pollution on 'Adapting Institutions to Climate Change' (RCEP, 2010), while others emerged from the stakeholder and key actor interviews and literature review undertaken by the authors. For reasons of brevity, these overarching gaps are summarised within the referenced table below.

Table 1 Overarching Challenges in Adapting to Climate Change

Aspect of Adaptation	Challenge Identified	Source
Political nature of adaptation decisions		
Political will	Adaptation is not just a technical environmental challenge, but a social, political and normative challenge.	RCEP (2010), point 5.79
Governance structure	Adaptation planning may need to operate within geographical regions that exceed or overlap the catchments of governing authorities.	Authors
Short-termism	The electoral cycle does not favour the kinds of long-term outcomes envisaged in some aspects of adaptation planning.	RCEP (2010), points 4.64-4.65
Political (un) acceptability	There are tensions between the duty to protect the public and the political obligation to respect personal freedoms.	Interview
Complexity of climate planning		
Climate change impacts exceed administrative boundaries	The consequences of climate change impacts are often supra-regional, as in, for example, a flooding river system. They may also be supra-national, interrupting food, goods or energy supply chains; or generating uncontrolled population movement, or epidemic.	Authors
Unresolved equity issues	Adaptation planning is formulated in the face of contesting interests and entails value judgments. ^{1,2}	1.RCEP (2010), points 4.29-4.35 2.RCEP (2010), points 4.66-4.70.
Unresolved funding issues for response and recovery	Criteria are needed for determining what level of government (from local to national) bears costs, and what kinds of costs are met from the public purse.	RCEP (2010), points 4.92-4.99.
Cost-benefit analysis may not apply	The uncertainties of climate projections may make cost-benefit analysis difficult to apply.	RCEP (2010), points 4.38-4.42.
Co-occurrence of severe weather events	Uncontained flash flooding can lead to water shortages because of contamination. Overheating events might coincide with drought or lead to water shortage due to increased user consumption.	RCEP (2010), point 2.61

Aspect of Adaptation	Challenge Identified	Source
Characteristics of policy, mechanisms and tools		
Inadequate mechanisms	Existing policy mechanisms and tools may not have caught up with the powers, ¹ timelines, ² and rigour ³ necessary.	1.RCEP (2010), points 4.75-4.78. 2. Interview. 3. RCEP (2010), points 4.75-4.78
Variable transparency	Some organisations may be unwilling or unable to submit aspects of adaptation planning to public scrutiny.	Authors
Actual or perceived inflexibility of regulatory regimes	The flexibility of a law, directive, policy is important, ¹ but also significant is the degree of flexibility with which they are instituted by organisations. ²	1.RCEP (2010), points 4.21-22 and Box 4A. 2. 1.RCEP (2010), point 4.20.
Weakening monitoring	Monitoring is perceived as costly in terms of time and resources, and thus liable to weakening or removal under budgetary pressures.	Authors
Organisational characteristics		
Conflicting style and goals of public and private sectors	Private sector may have different drivers and timelines compared with the public sector ¹ and may have more stringent requirements for committing time and personnel to partnership working. ²	1. RCEP (2010), points 4.64-4.65. 2. Interview
Narrow organisational goals	For structural ¹ or mission reasons, ² agencies may find it difficult to go beyond their own limited brief.	1. RCEP (2010), point 4.23. 2. RCEP (2010), point 4.54.
Staff shortages	Various kinds of staff essential for adaptation ^{1,2} are in short supply, ³ which can be made more acute due to lost revenues accruing from climate events. ⁴	1.Interviews. 2. RCEP (2010), point4.90. 3 RCEP (2010), point 4.91. 4. Reardon <i>et al.</i> (2009), p392.

3 Governance of London Climate Change Adaptation

3.1 Legislative framework

The impacts of climate change have been experienced across the UK and, as noted above, have intensified over the last decade. The South East of England and London in particular are expected to experience the impact of climate change through warmer, wetter winters and hotter, drier summers. The implications of these climatic changes are that London will face an increasing risk of floods, drought and overheating in the summer months. While, as we have seen, at the national level, legislation, policies and programmes have promoted the embedding of climate change adaptation across all UK government, at the regional and local levels, various partnerships have been established and locally specific adaptation plans have been/are being developed. Uniquely in the UK (although a similar structure may be extended to other major cities through the provisions of the Localism Bill currently going through Parliament) London is governed by an elected mayor and assembly set up through a dedicated body of legislation. The legislation also includes specific requirements regarding the strategies and plans that should be produced for London.

The Greater London Authority Act 1999 established the Greater London Authority (GLA), which, along with its allied agencies – the London Fire and Emergency Planning Authority, the London Development Agency, the Metropolitan Police Authority and Transport for London – are jointly responsible for tackling institutional affairs in London (HMG, 1999). In 2007 the second Greater London Authority Act specifically transferred responsibility for climate change adaptation, mitigation and energy strategies from central government to the Mayor of London (HMG, 2007). It provided the Mayor of London with unique powers including a ‘climate change duty’. This requires the Mayor to assess the consequences of climate change for London and prepare a Climate Change Adaptation Strategy and a Climate Change Mitigation and Energy Strategy. The former needs to indicate how the Mayor in collaboration with partners, and in consultation with parties as recommended by the Secretary of State, will manage the impact of climate change.

In addition, the Mayor has extensive planning powers and is responsible for producing strategic planning policies (in a London-wide spatial strategy) with which all local plans (produced by London boroughs) have to be in conformity. This means that GLA has a uniquely powerful position in the institutional landscape of climate adaptation in London. This enables it to coordinate the actions of other partners and, in some critical climate policy areas, ensure that proposed actions are implemented. However, the recently-introduced Localism Bill (HMG, 2010), as mentioned earlier, proposes amendments to the GLA Acts which will effect the merger of several London strategies into a single Environment Strategy. It will also alter the balance of power between the GLA and boroughs with regard to spatial planning, with greater autonomy accorded to the local level of governance.

3.2 Main governance agencies

The most important governance body in London with regard to climate change adaptation is the **Greater London Authority** and its allied agencies. The GLA is made up of a directly elected Mayor and a separately elected London Assembly of 25 members, each representing two or three boroughs (but who, with one or two exceptions, do not sit on borough councils). The GLA has a number of functional executive bodies including: Transport for London (TfL); the Metropolitan Police Authority; the London Fire and Emergency Planning Authority and the London Development Agency. Compared with other major cities in the UK, London has a significant advantage in terms of governance, due to the powers given to the GLA and the Mayor in particular.

The GLA has acted as a driving force at the international level, through putting its weight behind the C40 Climate Leadership Group and its association with the Clinton Climate Initiative, while at a local level it has taken steps to address the various climate challenges within London. Major policies in this respect include the 2008 London Plan (replacement plan expected 2011), the Mayor's Climate Change Mitigation and Energy Strategy (due 2011), the Mayor's Air Quality Strategy (published December 2010), the London Water Strategy (due 2011), Low Carbon Zoning and the Climate Change Adaptation Strategy (draft strategy published early 2010 Mayor of London, 2010a). The proactive and reactive adaptation measures as proposed and discussed in the latter publication will be the focus of the next and subsequent sections of this paper.

Among the GLA's functional executive bodies mentioned above, the position of **Transport for London** (TfL) is particularly significant in terms of climate adaptation. Created in 2000, its Board is appointed and chaired by the Mayor, and it represents most of the providers of London's transport system. The main body of TfL comprises: London Underground, London Overground, Docklands Light Railways, London Buses, London Trams, London River Services and the Public Carriage Office (taxis). Five other transport providers in London come under the Transport for London Road Network, including: British Waterways, the train operating companies, Network Rail, London Borough Road Network and private hire companies. TfL is responsible for the maintenance of transport services and implementation of the Mayor's Transport Strategy. An important aspect of the Transport Strategy is the plan for climate change adaptation measures (Mayor of London, 2008). TfL is also required to separately report its adaptation plans and risk analyses, through GLA, to DEFRA (TfL Safety, Health and Environment Committee, 2010).

In addition to its direct actions, GLA has also been a key driver in establishing and sustaining a number of climate related partnerships in London such as the London Climate Change Partnership (LCCP), London Energy Partnership (LEP), London Resilience Partnership (LRP), London Hydrogen Partnership (LHP) and also Drain London Forum. The **London Climate Change Partnership (LCCP)** was created to help London better understand and prepare for climate change impacts, especially with respect to the challenges of adaptation to the increasing risk of flooding, drought and

temperature rise (LCCP, undated a). LCCP has produced a number of guidelines on climate change adaptation and has been instrumental in accommodating climate change adaptation issues in the London Plan (LCCP, undated b). The Partnership is comprised of groups undertaking work in various areas including economic incentives and public procurement. It is a stakeholder group, co-ordinated by the GLA, with membership comprising over 30 organisations representing government departments, climate scientists, developers, as well as finance, health, environment and communication sectors. LCCP is linked to the UK-wide network of regional climate change partnerships through Climate UK (Climate UK, 2010). Climate UK is facilitated by the UK Climate Impacts Programme (UKCIP), managed by the Environment Agency and supported and part funded by DEFRA's Adapting to Climate Change programme. The platform provides LCCP with an opportunity to share knowledge and learning about adapting to climate change. The funding is extended to September 2011 but its availability after that date is uncertain, given the current constraints on public finance.

LCCP's main concerns are to disseminate high quality information about expected climate change, its impacts on London and best practice examples for adaptation. The Partnership also commissions research and aims to build adaptation actions into the decision making systems of its partners. It has assisted in the development of London's climate change adaptation strategy and contributed to the production of a number of reports such as, in 2009, *Adapting to Climate Change: Creating Resilience* (LCCP, 2009a); *Wild weather warning* (LCCP, 2009b), *Adapting to climate change: the role of public procurement* (LCCP, 2009c); and, *London's Commercial Building Stock and Climate Change Adaptation* (LCCP, 2009d).

The **London Resilience Partnership (LRP)** was established in May 2002 to plan and prepare for potential emergencies and co-ordinate planning across London. It has two sub-bodies: the London Regional Resilience Forum which sets the work plan for the partnership, and the London Resilience Team which acts as secretariat to the Forum. The scope of the Partnership ranges from pandemics to terrorism and from severe weather events to strategic measures for climate change (London Resilience, 2010a). The partnership comprises a very broad range of members: from all key Government departments and agencies, to GLA, affiliated concerns and boroughs; from Health and Transport services to utility bodies; and from emergency and rescue services to faith based and other social actors. LRP strongly favours an awareness raising campaign for citizens promoting energy saving measures and adapting lifestyles and behaviours to the changing climate.

The complex system of drainage in London requires a multi-agency approach to dealing with surface water flood risks. The agencies responsible for drainage in London include Thames Water, the London boroughs, private land owners, TfL and the Highways Agency. Regulatory oversight is provided by the Environment Agency and OfWat. However, there has been little or no mechanism for coordination between these agencies for information on drainage infrastructure and the location, duration, causes, severity and extent of surface water flooding. To fill this gap, the **Drain**

London Forum was established by the GLA in 2007. It also serves as a response to the recommendations offered by the Pitt Review for including local authorities in flood risk management (MWH, 2009). The Forum aims to develop a strategic level Surface Water Management Plan for London (both for sewers and watercourses) and develop real-time information sharing on flood risks between London boroughs along with an online flood reporting system. Its members include the GLA, TfL, LDA, London Councils, the London Boroughs, Thames Water, DEFRA, the Environment Agency, London Borough Technical Advisers Group (LoTAG) and the Association of London Borough Environmental health managers (ALEHM). Other key stakeholders are: British Waterways, the Highways Agency, the Port of London Authority, the Met Office, Ordnance Survey and major land owners. A major advantage of Drain London is that it supports the development of a concerted response, rather than making the 33 London authorities act independently.

A number of **London's mitigation partnerships** although predominantly focused on climate mitigation also have some bearing on adaptation issues. Among these **London Energy Partnership (LEP)** and **London Hydrogen Partnership (LHP)** are notable.

At the local tier of government in London are 32 **London Boroughs** plus the City of London Corporation, which covers the 'square mile' of the City of London. This is counted as a Borough for most purposes although it has an anomalous electorate and constitution, including its own Lord Mayor. With one or two exceptions, London Boroughs' elected members do not sit as Members of the London Assembly, the body that scrutinises and checks the power of the elected London Mayor. There is therefore a clear separation between the GLA and the London Boroughs in terms of representation.

The representative body for the London Boroughs is known as **London Councils** (until October 2006 known as the Association of London Government which itself came into being in 1995 with the unification of the London Boroughs Association and the Association of London Authorities). The membership of London Councils is based on subscription and comprises the 32 London boroughs, the City of London Corporation, the Metropolitan Police Authority and the London Fire and Emergency Planning Authority. Internally, it acts as the employers' organisation for the London boroughs, providing advice, support and training, and representing them in negotiations. Externally, it provides a range of housing, consumer protection and other services, and distributes grants to voluntary groups in London. For issues related to climate change adaptation, London Councils has developed the network '**London Borough Climate Change Group**' composed of representatives from all London boroughs, the City of London, Government Office for London, GLA, TfL, LDA, the Environment Agency and other regional and national stakeholders (London Councils, undated). There are also a few environmental NGOs in the network that work on climate change and related areas in London. One of the key areas of focus is to help London boroughs meet the government's

demands for climate change resilience. It also facilitates implementation of the Mayor's Climate Change Action Plan and provides input into other strategies.

Finally, representing business, education and health interests, **London First** speaks for leading employers in London from the sectors that cover finance, business services, property, transport, ICT, creative industries, hospitality and retail. Furthermore, it includes all of London's higher education institutions as well as further education colleges and NHS hospital trusts. London First collects data, publishes reports, discussions and solutions about both adaptation and mitigation options (London First, undated a). In 2008, the forum launched 'Clean Tech Network' for technology entrepreneurs, in cooperation with Imperial College London, with the purpose of developing new technologies that help adapt to and/or mitigate climate change effects (London First, undated b). Over the last three years London First has been involved in conferences and round tables about flooding, housing (2009), the effects of climate change on London's economy (2008) and the further alteration to the London Plan (London First, 2010) as well as about water supply, sewerage infrastructure and air quality. In terms of adaptation, London First provides advice to risk managers in businesses on interpreting the relevant Planning Policy Statements from CLG.

3.3 Challenges to London Adaptation Planning

With regard to the main challenges for climate adaptation in London, interviews with stakeholders and key actors, as well as a literature review, have raised several important issues including: capacity to plan for newly emerging threats, coordination, organisational issues affecting adaptation at the local (borough) levels, mainstreaming of adaptation into other policies, and extra-regional impacts. This section reviews each of these issues in turn.

In adaptation planning, one of the major issues at stake is the capacity of London boroughs to prepare emergency plans for **newly emerging threats**. This is linked to the issue of London boroughs' access to government funding, which is usually channelled through a number of mediating institutions. Resource constraints, as boroughs are allocated additional responsibilities for reactive adaptation, may also play a role. It is not clear what action, if any, London Councils is taking on these issues.

In terms of **coordination**, interviewees involved in partnership building suggested that their work is often inhibited by political rivalries between local councils and between individual members and organisations. These issues may exist regardless of the core topic, but become more intense when the discussions relate to issues such as adaptation measures in comparison with mitigation. Furthermore, the participation in climate change governance in London is very diverse, with representatives coming from the local and regional authorities, national government and private sector. They work on a wide range of issues related to for example, environment, sustainability, infrastructure and heritage. They also have varying degrees of knowledge and understanding of the

climate change problems, challenges and solutions. All this makes communication and feedback a challenging task.

Due to the long-term nature of adaptation planning, it is also important to extend the usually perceived planning and decision-making horizons of 5-10 years to 20-40 years or more. Such a long term approach requires more convincing arguments from the policy makers in order to get stakeholders' support, particularly as the **timelines** in individual organisations may be at odds with a more far-sighted approach. In this context, climate change projections, modelling and emissions scenarios can play a potentially key role in helping visualise the impacts in the longer term. Decision support tools that allow access to climate scenarios at the end of the century, for example, can trigger effective policy measures on adapting the housing, transport and health infrastructure to prepare for climate impacts.

As regards the **organisational** issues for the London Boroughs, these include the 'silo' effect where adaptation is seen as a departmental rather than a corporate issue; the issue of the real degree of leverage exercised by GLA over the Boroughs; and the political will at the local level, which may vary according to competing pressures on the Local Authority purse and the perceptions of local vulnerability. One pertinent example of the variation in political commitment to the adaptation agenda was the sign up to NI188. As of December 2009, only 22 out of 33 boroughs (including City of London) had signed up to this indicator, of which only six boroughs had committed to reporting on the indicator. The response rate to the other relevant national indicators (NI185 and NI186) on climate mitigation was much higher. This may be due to the more tangible nature of mitigation actions (such as emissions reduction) compared with the less-defined actions on adaptation. It may also be due to the relative infancy of the agenda compared to mitigation concerns. Furthermore, the forward-looking nature of adaptation, along with the uncertainties of impacts, may have exacerbated this perceived lack of enthusiasm. Across England authorities, NI 188 has been relatively successful in initiating adaptation awareness among local authorities. Of those local authorities and Local Strategic Partnerships which adopted NI 188, 82% had met their first year target in 2008-09 (Environmental Audit Committee, 2010). By the second year of operation, all 354 authorities reported their level and most authorities had progressed from level 0 ('getting started') to level 1 ('public commitment and impacts assessment' – 43.2%) or level 2 ('comprehensive risk assessment' - 42.5%). However, only 3% had reached the stage of having a comprehensive action plan and none had attained level 4 – implementation, monitoring and continuous review (DEFRA, 2010).

As mentioned above, NI188 along with other indicator sets and the Local Area Agreements which deployed them have been recently abolished. The Audit Commission Review of the indicator, reported in a recent letter from the Director of Climate Change Adaptation at DEFRA (Mortimer, 2010), noted that the pressure to complete a return might be at the expense of more tangible action and that future efforts might be better directed to improving the information available and sharing good practice between authorities. However, the letter noted the importance of immediate action

on adaptation at local level in the context of the abolition of central government performance monitoring. An 'adaptation ladder' is suggested "progressing from building understanding and capacity, to incorporating the impacts of climate change into key decisions, and ultimately taking tangible action to reduce the risks". Authorities may continue to self-assess but are no longer required to communicate the results of the assessment with central government.

Another major challenge is the **mainstreaming** of adaptation challenges into other policy areas, a point repeatedly raised by the interviewees. This was despite the fact that climate adaptation measures can be viewed, as mentioned by the interviewees, as integrating factors in terms of:

- A management cycle of deciding on objectives, looking at options, evaluating, making decisions, monitoring and review
- Short term emergency planning as well as long-term changes such as population growth and ageing
- Land use and development of greenfield or brownfield sites to support biodiversity and avoid overheating

Finally, some interviewees highlighted a number of areas which have not received sufficient attention from the existing partnerships, which included the **effects on the surrounding regions** such as the coastal communities that are largely composed of low income groups. With rising sea-levels, these communities are under severe threat. The regional partnerships are well placed to broker between the larger regional or national bodies and these local communities. However, regional-level inputs may be weakened due to the revocation of the regional level of governance within and outside of London. Up to this point, the Government Office for the South East (GO-SE) and the South East Development Agency (SEEDA) were the two most relevant regional bodies involved in climate change governance for the South East. The South East region covers the geographical areas of Berkshire, Buckinghamshire, Hampshire, Isle of Wight, East Sussex, Kent (including the Thames Estuary), Oxfordshire, Surrey and West Sussex. SEEDA will be replaced by one or more Local Enterprise Partnerships – 'joint local authority-business bodies brought forward by local authorities themselves to promote local economic development' - with catchment areas that reflect 'functional economic and travel to work areas' (HM Government, 2010a).

Two other higher level governance bodies, the London Development Agency (LDA) and the Government Office for London (GOL), will also go with the removal of the regional level of governance. The LDA has functioned as a regional development agency that aimed to ensure sustainable economic, social and environmental development for London. It will be replaced by Local Enterprise Partnerships under separate arrangements from those initiated to replace other England RDAs in June 2010 (HM Government, 2010b). The Agency worked with partners from industry, and the public and voluntary sectors. With the integration of the former London Climate Change Agency (LCCA) in 2008 (which is now subsumed in the GLA), the LDA became responsible for looking at

development issues related to climate change mitigation and adaptation in London (LDA, 2010). The Government Office for London (GOL) represented the interests of 11 government departments and in terms of climate change adaptation has facilitated implementation and use of UKCIP's climate projections at local and regional levels. It has also supported the Local and Regional Adaptation Partnerships (LRAP) in adopting NI188 (GOL, 2009).

These governance challenges for climate change adaptation in London are summarised in Table 2 below.

Table 2 Governance Challenges to Climate Change Adaptation in London

Topic	Challenge
Reactive planning	Capacity to plan for newly emerging threats at borough level is unclear, as are funding streams for these.
Coordination	The range of partnerships and collaborations in adaptation planning can provoke tensions emerging from individual and organisational rivalry, create duplication and overlaps between networks, problems of communication and co-ordination.
Different regulatory requirements	Adaptation plans and monitoring may be obligatory or voluntary, depending on the organisation.
Disparate timelines	Different organisations and regulatory regimes impose different planning periods – ranging from 5 to 100 years.
Fixed-term partnership funding	Funding for partnerships and collaborations is often time-limited which can affect continuity.
A degree of competition between mitigation and adaptation issues.	There may be resistance among those committed to mitigation in taking on the adaptation agenda.
Organisational characteristics of London Boroughs	'Silo' effect that confines adaptation planning with departments, plus lack of political will and limited leverage of GLA, may affect Boroughs' response to adaptation agenda.
Mainstreaming adaptation to other policy areas	Mainstreaming of adaptation has not yet happened in spite of the integrating potential of the adaptation agenda.
Removal of the regional level of governance	Both in London itself, which is set to lose the London Development Agency and the Government Office for London, and the South East region, which will lose its equivalent bodies, the coordination across authorities provided by the regional level of governance will go. The replacement bodies, such as Local Enterprise Partnerships, are unlikely to be able to provide an equivalent coordinating role, due to both their lack of a spatial relationship to relevant features such as river systems and flood plains, and their more limited functional remit.

4 London Climate Change Adaptation Strategy

4.1 GLA strategic actions on climate change adaptation

The GLA's strategic actions on climate change adaptation are encapsulated in two major documents: one is the statutory development plan (The London Plan), and the other is the GLA's adaptation strategy. However, as noted earlier it is likely that if the proposed Localism Bill receives Royal Assent in its current form, London's planning requirements will be simplified and climate change adaptation planning will be resumed with mitigation planning (and other strategies) in an overall London Environment Strategy (House of Commons, 2010).

London Plan. First prepared in 2004 as a replacement to the Regional Planning Guidance (RPG3), it sets out the Mayor's vision for a spatial development strategy (GLA, 2004). Although climate change was partially included in the first plan, the subsequent experience of climate change impacts across the country supported integration of the adaptation agenda into the revised plan, in terms of the discussions on social, economic and health effects on vulnerable communities (GLA, 2008a). Particular attention has been paid to measures to avoid the urban heat island effect, minimising solar gain in summers, reducing flood risk, creating sustainable drainage, lowering water consumption and encouraging green infrastructure development (GLA, undated a). In October 2009, a draft replacement plan was published by the Mayor that was updated with minor alterations in December 2009 and September 2010 respectively (Mayor of London, 2009a).

London Climate Change Adaptation Strategy. In August 2008, the GLA published a 'London Climate Change Adaptation Strategy' that set out priorities and actions seen as critical for managing climate related risks (GLA, 2008b). A draft for public consultation was made available for three months in February 2010 (GLA, 2010a). The draft **Climate Change Adaptation Strategy for London** (from here on referred to as the 'Strategy') identifies a framework of Actions to facilitate adaptation actions and decisions through an emergency planning framework. Its timeframe encompasses the period of the 21st century but is especially focused on the years up to 2031. The Strategy is structured in four parts, with the first introducing the London context in terms of climate issues and impacts, as well as the key actors in adaptation planning; the second looking in detail at the three prioritised climate threats of **flood, drought and overheating**; the third looking at the cross-cutting issues of health, environment, economy and infrastructure; and the fourth presenting an 'Implementation Road Map'.

Altogether 34 climate change adaptation Actions are proposed in the Strategy, as follows: 9 Actions for flooding, 5 for drought, 13 for overheating, and 7 for crosscutting issues of health, environment, economy and infrastructure. Over two thirds of these Actions are to be carried out by the GLA, either in the lead role or in cooperation with an array of institutions, including the London boroughs. The 34 Actions proposed by the Strategy are described as focused on 'increasing [...] understanding

of the challenges' (p.7) and can be divided between non-structural and structural activities, with a bias to the former, which might be seen as largely concerned with 'adaptation capacity building'. These non-structural activities include mapping and information gathering, creating portals and reporting systems, auditing vulnerable assets and communities, priority-setting, partnership-building, lobbying and awareness-raising. Structural activities are largely confined to strengthening green space infrastructure, increasing tree cover, increasing water and energy efficiency, supporting a model of heat-resistant retrofitting for social housing, and restoring parts of the river network. It is suggested that a more 'detailed plan of actions' will be developed in the future reviews of the Strategy.

The Strategy is focused upon three areas of climate change risks (flooding, drought and heatwaves) which have been selected from among a slightly wider range of climate risks on the grounds of their relative predictability. To each of these it has applied a risk-based approach with four components: probability, consequence, exposure and vulnerability (p.18). Also within the risk assessment approach, the Strategy suggests that, while preparing their respective adaptation strategies, all London boroughs and their strategic partners should bring together the various assessments required by policy (community risk registers and sustainability and flood risk appraisals etc.) in an integrated manner. However, in its capacity as a plan for adaptation, the Strategy goes beyond risk assessment to aim for recovery in due course and with this purpose a framework taken from Emergency Planning, known as ***Prevent-Prepare-Respond-Recover*** (P2R2) is adopted. The framework is particularly highlighted in Chapter 2 of the Strategy, on mapping adaptation, but also informs its risk-specific chapters, where it is integrated with the risk-based approach outlined above. It sets out to address climate change adaptation challenges in London, identify the distribution of responsibilities between strategic actors and identify any gaps between policy and implementation. The next section will analyse this approach, followed by an evaluation of other important aspects of the Strategy.

4.2 The Risk by Risk, Emergency Planning Approach

The emergency planning approach used in Strategy envisages actions as situated within a four-step emergency response framework. Preventive actions aim to reduce the probability and/or consequences of an event. Preparatory measures envisage its opportunities and risks in order to proactively devise effective response and recovery measures (such as contingency planning). Responsive actions help to limit the impact of a disaster. Finally, the recovery phase relates to the actions taken subsequent to the event, aiming for a rapid, cost-effective and sustainable return to normality.

This approach is able to broach climate adaptation issues through a structure that unifies a range of sectors and city locations under prospective climate change events. Alternative approaches would include division according to sectoral (water, housing, business) or geographical issues (coastal,

riparian, inner city). The event-themed approach means that right from the outset, potential emergency situations may be grasped from a holistic perspective - although there are still limitations to this in the way that the implications for particular sectors are dispersed across several different chapters. For example TfL's climate adaptation planning, although mentioned in the risk-by-risk chapters, is only explored in depth in Chapter 9, on 'Infrastructure'.

It is unclear whether the temporal prioritisation implied by the P2R2 structure, or other factors, have influenced the emphasis in the Actions in favour of collaborative, partnership-based interventions concerned with building adaptive capacity between institutions. This can be seen more clearly through a comparison with the planning that has so far taken place in New York. The New York City Panel on Climate Change (NPCC), hosted by Columbia University, was set up to give scientific advice to the New York City Climate Change Adaptation Task Force. Its first report was published as an entire issue of an academic journal (NPCC, 2010) and includes an Adaptation Assessment Guidebook (AAG) that outlines a process through which stakeholders can develop and implement adaptation plans (Major and O'Grady, 2010). This approach envisages organisations making their own adaptation plans preliminary to initiating partnership working within a risk management framework, and early actions focus upon climate risks to infrastructure and assets, as seen in its eight adaptation steps:

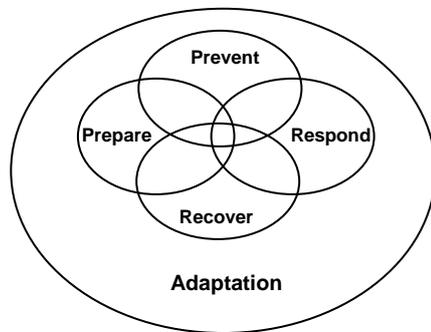
1. Identify current and future climate hazards
2. Conduct inventory of infrastructure and assets
3. Characterize risk of climate change on infrastructure
4. Develop initial adaptation strategies
5. Identify opportunities for co-ordination
6. Link strategies to capital and rehabilitation cycles
7. Prepare and implement adaptation plans
8. Monitor and reassess. (Major and O'Grady, 2010, p235).

However, it would be easy to overestimate the difference between the two approaches. The London Strategy's ability to focus upon adaptive capacity building in partnership may reflect the fact that much of the evaluation regarding risks to key assets has already been carried out by the organisations in question – for example Section 5 below on London's flooding, where the preparatory actions of the utilities companies appear to slot very much into the New York style temporal framework.

Three further questions regarding the P2R2 , besides the focus on collaborative interventions, can also be raised: its temporal linearity, its focus on climate change disbenefits and on rapid rather than gradual changes. Regarding linearity, the Strategy appears to conceive of the four phases as having a

linear relationship, whereas they may be more usefully perceived as overlapping, as represented in the diagram below.

Figure 1 Adaptation management framework



Source: authors

The absence of a more interwoven sense of the P2R2 dimensions could result in a temporal linearity that does not correctly represent the relative urgency of the various actions and gaps. For example, in some cases, preparation for the ‘Response’ or ‘Recovery’ actions is urgent, in the sense of allocating responsibilities that must be organised and resourced well in advance of the ability to exercise them.

The second limitation of the approach is that in spite of the emphasis on a range of positive opportunities in both the Strategy’s Foreword and under the relevant subheadings in the body of the report, the emergency planning headings as well as the types of Actions, tend to steer attention away from these, in focusing attention upon averting harm, damage and loss of life. While there are exceptions to this, for example, the three Actions that envisage an increase in tree cover, green space, and river reconstruction, the focus on negative impacts could weaken the Strategy’s communicability, while also potentially sidelining some ‘no regret’ actions that could be undertaken in the short term. This comes out particularly through comparing the London Strategy with that evolved for Cape Town. Of the nine cities whose adaptation studies and strategies were reviewed for Birkmann *et al.* (2010), Cape Town stood out as having an approach with a distinctively practical focus dividing the adaptation options according to: 1) Immediate options (‘no regret’); 2) second resort strategies and measures that require further funding; 3) third resort strategies that require further investigation; and 4) future measures (City of Cape Town, 2009, p40 cited in Birkmann *et al.*, 2010). Birkmann *et al.* note that: “This differentiation implies a stronger management approach, including timelines for the implementation of the different goals and measures.” At the same time, this observation can be met with the caution that immediate action in adaptation may take place at the expense of building adaptive capacity (RCEP, 2010, points 5.47-5.52).

The third question about P2R2 concerns its tendency to focus upon adapting to extreme impacts of climate change – the dramatic events of flood, drought and heatwave – at the expense of

recognising the slow, incremental effects for which a range of adjustments also need to be made. Recognition of the importance of balance between both aspects is a feature of the approaches taken by New York City Panel on Climate Change, and appears as the seventh out of its eight 'Recommendations for Action' (NPCC, 2010, p10). Although incremental changes are also addressed in thematic chapters of the London Strategy, alongside the emergency planning structure, the distinction between the two kinds of adaptation is not explicitly recognised and systematically distinguished.

4.3 The Strategy's evidence base

It was observed by one of this study's interviewees that policies become quickly outpaced by the rate of scientific advance in the climate change field. There is a degree of responsiveness to this problem in the evidence-base for the London Strategy, built in through the focus on a relatively limited 20 year time frame (up to 2031), which notes that the plan can be revised at any point in the light of new climate projections, sea level rise scenarios or climate impacts. It is also made clear that part of the aim of the Strategy is to build the evidence base, for example, regarding surface water flooding, about which not enough is known.

Compared with the detailed and systematic academic evidence base prepared for the New York strategy (NPCC, 2010), the evidence base for the London Strategy is somewhat diffused across the Strategy. While Chapter 1 presents the main contextual evidence chapter for the Strategy, this is largely causal evidence from UKCP09 and IPCC projections, looking at the likelihood of events as a basis for preparing for them, rather than including information about their likely impacts, an issue which also needs to be taken into account in prioritising adaptation actions. Evidence is largely presented with an 'advocacy' thrust, addressed to convince and allay public doubt, exemplified in such features as an explanatory box presenting the difference between climate and weather. Such an approach may, however, underplay the degree of uncertainty (see RCEP, 2010, Box 2C) which, for example, includes the possibility that UK summers could actually get wetter rather than drier (RCEP, 2010, p14, point 2.27).

Furthermore, while, as noted above, there are communicative perils to overly negative policy messages, both diagrams and their framing text may be difficult for a lay person to evaluate without basic contextualising information. A helpful example, as noted in the RCEP report, is that while some of the projected temperature changes may not be very large,

even a 2-3 degree increase in average temperatures is far from trivial if it is compared with a global mean temperature change of 4 to 7 between a full-blown ice age and the peak warmth of an interglacial period. (RCEP, 2010, point 2.29).

While climate change causes are the focus of Chapter 1, and evidence about impacts, often unreferenced, is scattered throughout the report, it is not until Chapter 9 on London's Economy that

the evidence about impacts becomes a major focus. This emphasis in the Strategy's structure on climate impacts in terms financial loss has the effects of both diverting attention from other kinds of loss and avoiding the inclusion of evidence about impacts and interventions as factors that could, alongside climate risk, have informed the Strategy's prioritisations. The example of the place of windstorms in the Strategy will illustrate this point. It is noted in Chapter 1 that severe windstorms appear to have become more frequent in the past few decades and that a tornado affected North London in 2006. Nevertheless, it is stated that due to the uncertainty of windstorm projections in UKCP09 and the fact that southeast England has the highest building standards for wind resistance in England, the Strategy will not consider windstorm impact in depth but keep it under review for inclusion in future revisions. However, although actual buildings in London may be relatively wind-resistant, the city's combination of concentrated populations, private vehicles, increasing numbers of trees and vulnerable high structures such as advertising boards, satellite and phone masts, suggest the relevance of presenting evidence on the human and structural impacts of such events, prior to deciding upon climate risk priorities.

The question also arises as to whether the availability of evidence (and practical experience) has influenced the distribution of Actions between the different climate risks. Birkmann *et al.* (2010) in their review of nine plans and studies regarding city adaptation found that plans provide more advanced structural and non-structural measures for hazards of which the city has past experience. This is partly borne out by the London Strategy. As noted in the introduction to this paper, London has experience with all three aspects; however, it also has considerable recent history with windstorms which are not included in this strategy (as discussed above). London's experience with overheating is more recent than that with flooding, and droughts have been manageable, preventing the need for water companies to implement a non-essential uses ban. Accordingly, drought accounts for five 'Actions' compared to nine for flooding and 13 for overheating. The small number of measures on drought can also be explained as due to the limited number of measures available to mitigate and adapt to drought (see Section 6.1), as well as related to the way that some of the cross-cutting Actions refer to more than one climate risk. Conversely, it is possible that there is a regulatory origin to the number of actions on flooding. While there was a recently revised Planning Policy Statement (PPS 25 – DCLG 2010) on Development and Flood Risk at the time of the Strategy, no equivalent PPS addressed drought and overheating.

Additionally, the more general points to be made about the evidence base for climate change also apply: the uncertainties of climate change (RCEP, 2010, Table 2.1) make both strong, clear climate projections and the applications of cost-benefit analysis approaches problematic (RCEP, 2010, points 4.38-4.42). This may also present an issue for public engagement which is harder to conduct in the absence of clear predictions and direction (Susskind, 2010, p223-224). There are also areas on which there is not sufficient research on which to base conclusions and actions, for example, the

downstream effects of climate events, such as the impact on ecosystem services (RCEP, 2010, point 2.102).

4.4 Partnership working in the Strategy

As noted earlier, the draft Climate Change Adaptation Strategy for London refers to some 30 types of partners. Embedded in this figure are a number of partnerships and fora which themselves consist of multiple partner organisations, with a high degree of overlaps in their membership composition. The multiplicity of these organisations and the complexity of their relationships is a manifestation of the interconnections between different climate challenges and the interdependencies between policies and actions that are designed to address them. It also shows the richness of the existing institutional networks that can be mobilised to respond to these challenges (see Table 3 below).

Table 3: GLA's partners in adaptation actions

Adaptation actions related to:	Partners
Flooding (9 actions)	<ul style="list-style-type: none"> • Environment Agency (3) • Boroughs (3) • The Drain London Forum (4) • The Association of London Borough Planning Officers (1) • The Local Resilience Forums (1) • London Climate Change Partnership (1) • London Resilience Partnership (1) • Transport for London (1) • Thames Water (1)
Drought (5 actions)	<ul style="list-style-type: none"> • London Water Group (1) • OfWat (1) • London Resilience Partnership (1) • Boroughs (1)
Overheating (13 actions)	<ul style="list-style-type: none"> • Scorchio and Lucid Projects (1) • Chartered Institution of Building Services Engineers (1) • London Development Agency (1) • London Climate Change Partnership (1) • London Resilience Partnership (1) • Boroughs (1) • Un-identified partners (6)
Cross-cutting issues (7 actions) <i>Health (2)</i> <i>Environment (1)</i> <i>Economy (2)</i> <i>Infrastructure (2) (transport, energy, waste)</i>	<ul style="list-style-type: none"> • London Climate Change Partnership (1) • London Regional Public Health Group (1) • NHS London (1) • London Primary Care Trusts (1) • Environment Agency (1) • Business organisations (1) • Insurance sector (1) • Transport for London (1) • Distribution Network Operator (1) • Energy retailers and suppliers (1)

Multiple and complex partnership working contributes positives for both instrumental and communicative learning' both of which are required for effective adaptation (RCEP, 2010, points 4.100-4.118). It may in some cases support co-ordination of actions and motivation and in fact, many of the partnerships mentioned above have been established partly to address the challenge of coordination. But conversely, according to a range of sources, it can also provide tensions emerging from duplication and overlaps between networks, and 'collaborative inertia'. In comparison with a single unitary administrative system concerned with implementation, complex partnerships have

been associated with communication and co-ordination difficulties (Hogwood and Gunn, 1984; RCEP, 2010, points 4.86-4.87). A brief outline of the composition, roles and activities of some of the main partnerships in London adaptation is provided in Section 3 above and details of their actions on specific climate risks are provided in sections 5-7 below. Here, it is important to note that the growing number of these overlapping partnerships raise other issues such as a lack of clarity of roles and responsibilities and lines of accountability and legitimacy.

The Strategy goes some way to addressing such issues, for example by naming a lead actor for each of the 34 Actions and through its proposals to set up web pages and portals for information-sharing. However, it does not explicitly acknowledge some of the deficits of partnership working and how it will overcome these. Since the Strategy was issued, it has also emerged that some of the partners and Lead Partners in Actions have been dissolved or have an uncertain future. It is not clear what mechanism will be used to reallocate their responsibilities and whether this may result in gaps in delivery.

Some structural issues raised by interviewees are also not addressed in the Strategy: what leverage does the GLA hold over London boroughs; what likewise is the leverage of the 'Adapting to Climate Change' (ACC) committee over adaptation processes and institutions? These questions are even less likely to find simple answers in the current context of a restructuring process which embraces dimensions that include levels of governance, planning guidance and local authority monitoring, as described elsewhere in this paper.

Interviewees in the ARCADIA study also expressed doubts about engaging the private sector on grounds of both the internal economic justification needed for businesses to take part and their demand for tightly focused process. Another issue raised was the importance of transparency and challenge in a new policy area such as climate change adaptation, which contrasts with the observation of opacity in critical plans such as those of TfL regarding floods and emergencies (outlined in more detail in Section 5, on Flood, below). Issues of leverage, of the different requirements by public and private sector organisations engaging in partnerships and on the transparency and amenability to challenge of the plans of all collaborating parties might benefit from explicit discussion in the strategy.

There are several more general points to be made about partnership working as follows: there is a lack of parity between organisations regarding whether they are required to produce climate plans and report progress towards adaptation, or whether this remains voluntary (RCEP, 2010, points 3.20-3.28). Furthermore, different organisations and regulatory regimes may impose different planning periods that range from 5 to 100 years. Also, in contrast with mitigation there is 'no pre-defined endpoint, blueprint or programme for adaptation' (RCEP, 2010, point 5.7). Finally, the funding for partnerships (e.g. DEFRA funding for Regional Climate Change Partnerships) is frequently time-

limited. As sustained commitment in an era of budgetary cuts is not guaranteed, this is likely to affect continuity of partnership work.

4.5 Civic engagement in the Strategy

Birkmann *et al.* (2010), in their review of nine adaptation plans and studies from major cities around the world, noted that a good deal of emphasis was placed on interdepartmental and inter-agency input to the strategies, but less information was provided regarding the involvement of “civil society, non-governmental organisations and/or the private business sector” (p190). In line with this observation, while there was description of cross-departmental and interagency working, civic engagement was not highlighted in London Strategy. This may fit with the UK’s Climate Change and Adaptation Plans generally, which have not emphasised consultation, although a recent circular letter to council chief executives suggests a degree of local consultation on climate change risk assessment will in future be embedded (Mortimer, 2010, p2).

Yet public engagement for adaptation is important on a number of dimensions. To begin with, ‘A decision-making process which those affected perceive to be open and fair can go a long way to enhancing tolerance and even acceptance of outcomes’ (RCEP, 2010, points 4.79-4.85). Public engagement can also improve the expert understanding of local flood situations and generally enhance the planners’ knowledge of climate impacts at the scale of small local areas (Susskind, 2010, p224). Experiences from London and the Thames Estuary areas have shown that the integration of stakeholders’ views and development of informal stakeholder networks on flood risk management can help develop an efficient and adaptive strategy (McFadden *et al.*, 2009). There is also an ethical dimension: the example of the Lower Thames catchment shows how real life strategies that appear to be technically and economically effective may not be fair for vulnerable localities from equality perspectives, without a fair involvement of the respective stakeholders (Johnson *et al.*, 2007a).

While the Strategy includes contact addresses and website URLs and promotes the availability of versions for people with a different first language or a disability, the degree of public consultation on the Strategy appears limited to a small paragraph that concludes the Introduction. This takes the form of a solicitation of public suggestions on four dimensions of the Strategy: its evidence base, the framework, the actions and the key indicators. The Strategy neither invites comment on the civic engagement aspects, nor makes a commitment to a systematic presentation or analysis of responses, but only to use ‘best’ ideas in the final version. The dedicated GLA website for the consultation notes 7,000 responses but only a few dozen are made available for each ‘risk’ theme and beginning the top-rated string are a dozen or so denying the existence or human origin of climate change (Mayor of London, 2010b). It is not as yet clear whether there will be any more responsive integration. As noted in the RCEP’s ‘Adapting Institutions to Climate Change’ cited above, there may be considerable differences in the effectiveness of public engagement, depending upon whether it is conceived in terms of a one-off event, or what they described, based on a previous

study, as the preferable and more sound option of ‘continual social intelligence gathering’ (RCEP, 2010, point 5.78). There appears to be considerable room for improvement in this aspect of the Strategy.

Exemplary with regard to civic engagement is a 2009 study for Kimberley, British Columbia, which uses a ‘learn, share, plan’ framework that places civic engagement at the heart of its approach:

Learn – Gathering available scientific data on projected climate impacts to Kimberley and connecting this with local observations and concerns.

Share – Bringing the results of the data collection to the community, and providing opportunities to learn how the predicted impacts could affect Kimberley.

Plan –Synthesizing all the input that was received in the learning and sharing stages, and creating an action plan setting out both short-term and long-term adaptation measures. (Liepa, 2009, p xiii).

Given that, as we identify further below, the London Strategy appears to be weak on civic engagement aspects, some of the approaches presented in this report could be of interest in strengthening the quality of London’s adaptation planning.

4.6 Implementation and monitoring in the Strategy

The Strategy’s implementation plans are presented as Chapter 10, which consists of a single table with Lead Agency, Partners and ‘Delivered by’ dates for each of the 34 Actions. This ‘skeletal’ presentation leaves many questions unanswered but has the virtue of an apparently ‘light touch’ for organisations that have accrued a number of complex monitoring and reporting responsibilities. Also on the positive side, the identification of a Lead Agency implies accountability, which could otherwise be diffused across the multiplicity of partnerships involved. Furthermore, the majority of the ‘Delivered by’ dates are within one or two years of the date of this Strategy, with only the major structural measures given more distant delivery dates (energy and water efficiency of homes; increasing tree cover; river restoration). On the negative side, it is not clear what the consequences of failure to deliver will be and how much power the various Lead Agencies have in effecting their allotted tasks. In terms of central government monitoring, the regime since the time of the draft strategy has become more relaxed. The above-mentioned letter to council chief executives on Adapting to Climate Change (Mortimer, 2010, p1), proposes that, in lieu of monitoring through the National Indicator system, in particular NI 188, a ladder process from building capacity to taking concrete measures is adopted by authorities. Yet the interviews for this study suggest that a greater urgency than would be implied by such a gradualist approach is felt by some of the key actors in the adaptation process. Whether the convictions of some key actors and their network pressures are

sufficient to drive the implementation and monitoring process without more stringent regulation remains unclear. Table 4 below summarises the findings of this evaluative section.

Table 4 Overarching Gaps in the Strategy

London Strategy	Gap
P2R2 approach	The place of an action in the linear order of the Prevent --Prepare – Respond-Recover series may be conflated with issue of its urgency.
	'Emergency' focus may lead to overlooking incremental, step-wise, adjustments to an altering climate. May also lead to underuse of the communicative and place-making advantages of climate change opportunities
Evidence base	Reliance on predictability of events rather than their impacts and outcomes prioritises climate risks for which evidence of likelihood is more clear, while sidelining climate risks for which likelihood is uncertain but which may have equal or greater negative impacts on people and places.
	The uncertainties of climate change make both strong, clear climate projections and the application of cost-benefit analysis approaches problematic.
Partnership working	Characterised by many partnerships that are positive for learning, co-ordination and motivation, but can also have coordination disbenefits and contribute tensions and delays.
	Lack of transparency concerning leverage of GLA over London boroughs and some partner organisations' adaptation plans which are not publicly accessible.
	Unclear how 'Lead Partner' status reallocated when organisations are dissolved or reconfigured.
Civic engagement	Lack of clear commitment to engage public systematically.
	Lack of clear commitment systematically and transparently to report and integrate public feedback on the consultation.
Implementation and monitoring	Danger of losing leverage through weakened implementation and monitoring framework, in particular loss of NI 188.
	Greater transparency and clarity needed about leverage of Lead Actors for each action and consequences of failure to deliver.

5 Flood Risk in London

5.1 Flood risk

The Association of British Insurers (ABI) has estimated that the claims for storm and flood damage in the UK doubled to over £6bn over the period 1998-2003, with the prospect of a further tripling by 2050 (ABI, 2004). The impact of flood risk in the UK is exemplified in incidents such as the 2007 summer floods when 13 people lost their lives and about 48,000 homes and 7,000 businesses were flooded (Cabinet Office, 2008). These extreme events have had major impact on the natural environment, households, businesses, infrastructure and health of particularly vulnerable sections of society, such as low-income households and the elderly.

Strategic spatial planning is considered a key approach to flood risk management in the long term (Hutter, 2007). One of the major instruments for managing flood risks is to develop long-term scenarios looking at the impacts on the economy, society and the environment (Hall *et al.*, 2003). In the initial stages of the process, sustainability appraisals and strategic environmental assessments provide important planning tools in managing flood risks (Carter *et al.*, 2009). Besides policy, planning and legislative action, an integrated role for the public and private sectors is also of key importance.

There are six common sources of flooding for urban areas in the UK:

- **River (or fluvial) flooding** causing watercourses to swell. This also contributes a more common threat to urban areas (Fleming, 2002).
- **Coastal (or tidal) flooding** resulting from a combination of tidal surge and low atmospheric pressure (e.g. storms).
- **Surface water flooding** due to torrential downpours causing flash floods that affect the capacity of drainage systems.
- **Sewer flooding**, when sewers become clogged or overwhelmed by heavy rain.
- **Groundwater flooding** from a rising water table, especially in areas with (semi)permeable rocks (aquifers).
- **Reservoir flooding** from the failure of a dam that holds volumes of water above ground level.

This variety of possible types of flooding suggests the risks associated with densely populated urban areas, which are located closer to flood sources. Another reason for the vulnerability of urban areas is that they usually stretch local ecological systems, and the addition of further environmental pressure has the potential to produce drastic results (Berry, 2004). With the growing impacts of climate change, the potential for flood damage has significantly increased over the last two decades (Johnson *et al.*, 2007b). Flooding incidents, furthermore, are projected to become more common in

a warmer future climate (Kundzewicz *et al.*, in press). In this situation, many of the traditional solutions to managing flood risk in urban environments may be considered either less effective or too costly. There is recognition of a greater need to identify and implement alternative solutions that are more adaptable at local levels.

5.2 Flood risk in the London Strategy

London is prone to all the flood risks listed above, with the exception of reservoir flooding. The draft Strategy acknowledges that the city is particularly vulnerable to three types of flood. In reverse order of priority, there is currently a low risk of tidal flooding from the North Sea, a medium risk of fluvial flooding from the Thames and its tributaries; and a high probability of flooding from surface water run-off. However, the Strategy emphasises that the risk factor in all such cases may increase in the longer term with projected sea level rise and more frequent winter precipitation. With 15% of London built on the floodplains, an estimated 1.25 million people and 481,180 properties are at risk in the event of a major flood. In this respect three priorities are outlined: improving the understanding of flood risks in London in order to adopt more effective flood management techniques (the knowledge has been developed to some extent from various previous and ongoing research projects through simulations and forecasts); identifying and protecting critical assets and vulnerable communities (knowledge remains less developed due to lack of coordination between various agencies and limited government support); and increasing public awareness and enhancing resilience both for individuals and communities (which can only be done by understanding the public perception of potential risks and threats).

Strategy Prevent, Prepare, Response, Recover framework

To identify the spectrum of emergency planning and disaster management for climate change adaptation in London, the P2R2 framework helps to highlight the distribution of responsibilities between strategic actors and identify the gaps within the policy and action chain. The framework for flood risk management in London is as follows.

Prevent: the strategy proposes a three-pronged preventative approach to reducing the impact of flooding. The first prong is the use of the spatial planning system in restricting development in areas at risk of flood, which is deemed the responsibility of the GLA and the London boroughs. The second prong is managing flood defences and drainage systems, which are largely the responsibility of the Environment Agency and Thames Water respectively, while some responsibilities for drainage and maintenance also fall to London boroughs, TfL and private landowners. The third prong of the approach is the use, and increase, of Flood Storage areas (e.g. parklands and sports fields), which can be deliberately flooded to divert the flow and reduce water levels in cases of emergency.

Prepare: in terms of preparatory action, the Strategy indicates that considerable effort has been put into understanding and preparing for floods and their associated risks. Under the Flood and Water Management Act 2010, local authorities are required to work alongside the Environment Agency to

manage flood risk through spatial and emergency plans. Under the Climate Change Act 2008, all utility companies are required to submit their emergency plans regarding climate risks to the government. The GLA's Regional Flood Risk Appraisal has identified regionally important assets and recommended actions for developing flood risk resilience. The Environment Agency has also produced Catchment Flood Management Plans for fluvial flood risks from London's rivers, while the Thames Estuary 2100 project focuses on tidal flood risks. Similarly, all the London boroughs have produced Strategic Flood Risk Assessments (which will in the future be more integrated between boroughs). Under the Flood and Water Management Act 2010, all local authorities are required to produce Surface Water Management Plans (SWMPs). The GLA has been providing support through the Drain London Forum for London boroughs producing SWMPs, which are scheduled to be completed for all London boroughs by February 2011. Within such a context, it is recognised that such assessments as have been made need to be shared and integrated with other stakeholders and there is a need to interpret the available information and analyses at a local level. There is also a need to raise awareness and preparations at household and community level. Among the various actions initiated by the Environment Agency, 'Floodline Warning Direct' provides online and real-time information to its subscribers. The Strategy stresses the importance of vulnerable individuals and communities signing up to the Floodline service, keeping valuables secure, having a flood plan in case of emergency and insuring appropriate possessions.

Respond: the Strategy mentions the Regional Risk Register drawn up by the London Resilience Partnership (LRP), which identifies tidal and fluvial flooding as major risks to London. The LRP is also said to be in the process of revising the London Strategic Flood Response Framework for managing a significant flooding event at regional level (latest version at the time of this paper was January 2010). All London boroughs have either a generic or specific flood emergency plan and are also producing Multi-Agency Flood Plans in association with neighbouring boroughs, emergency services and strategic partners. In addition, a mutual aid agreement is being developed between London boroughs to provide assistance for any kind of emergency.

Recover: a London Recovery Management Protocol in place at GLA assigns specific roles and responsibilities to all relevant agencies, in order to facilitate fast recovery in case of a regional emergency. While some boroughs have based their recovery plans upon this Protocol, the Strategy observes that local recovery plans should in any case give attention to the following at a local level: humanitarian assistance, displaced residents, insurance claims, businesses recovery and social support, coordination with voluntary agencies and clearing flood debris. For communities and individuals, the Strategy suggests flood protection measures to facilitate quick recovery in the flood aftermath, such as repairs that are flood resilient.

5.3 Key Actors for Flood Risk in the London Strategy

DEFRA

According to the specific Actions proposed by the Strategy, DEFRA is funding the Drain London Forum to undertake strategic analysis of surface water flood risk in London, prioritise areas of high risk of flood and develop a framework for collaboration (Actions 2, 3, 4 and 9 respectively). Besides this, DEFRA is also involved with the GLA in Action 31 on engaging with business enterprises and other key stakeholders for flood risk management in London. Some of the most critical responsibilities of DEFRA in relation to adaptation to climate change are executed through the Environment Agency, which is an Executive Non-departmental Public Body. Its main objective is to protect and improve the environment and promote sustainable development. The Agency works in partnership on adaptation measures particularly in relation to flood and coastal erosion and the management of water resources (Environment Agency, 2010a).

Environment Agency

The Environment Agency has provided an online (tidal and fluvial) flood risk map of Greater London alongside the Floodline service to help areas in greater danger of flooding. However, only 19% of Londoners living in flood-prone areas have signed up for the emergency warning service. Furthermore the map does not integrate information on surface flooding. The Agency has also helped devise Catchment Flood Management Plans for all London rivers. A flagship aspect of the Agency's activities is the maintenance of Thames Barrier to protect London from tidal flooding. In 2002, the Agency initiated the Thames Estuary 2100 (TE2100) project to establish long-term prospects for tidal flood risks. The project anticipates the Thames Barrier to be effective against projected tidal threats until 2070. It proposes greater cooperation between the GLA and London boroughs for maintaining existing defences. It also highlights the role of spatial and emergency planning in avoiding the consequences of flooding. The Flood Forecasting Centre, established in April 2009 by the Agency in association with the Met office, provides an extreme weather and flood risk warning service to the boroughs and emergency services in London. In 2009, the Environment Agency developed the Thames River Basin Management Plan in accordance with the EU Water Framework Directive (WFD) which was approved by DEFRA in December 2009 (Environment Agency, 2009). It is the first of a series of six-year planning cycles. Although the plan is not explicitly mentioned in the Strategy, this may be a timing issue (the Strategy being dated February 2010). Within the Strategy, the EA's Catchment Flood Management Plans are discussed under the 'Prepare' heading of the flooding section. In terms of specific Actions identified by the Strategy, the Environment Agency has been indicated as a lead partner in three Actions (listed in Table 5). Actions 1 and 6, which respectively concern mapping out the communities and assets at risk, and identifying critical assets and vulnerable communities, both involve coordination with the GLA, London boroughs, LRP and LCCP. Action 8 on public awareness and capacity building involves working with

the GLA and London boroughs. Additionally, the Agency is also involved in cooperation with the GLA and other partners to reclaim and restore 15 km (more than 9 miles) of Thames tributaries by 2015, through the London Rivers Action Plan (Action 30).

Transport for London

TfL is a public organisation that serves Greater London with underground, surface and rail transport. As a functional body of the GLA and a major service provider, it is also responsible for implementing a transport strategy for London. In its 2009 'Environment Report' TfL acknowledges the threat that flooding presents to London's transportation system and vows to take necessary measures by adapting its services and infrastructure with regard to such impacts. TfL's 'Climate change fact sheet' (TfL, 2009) notes the climatic forecasts for increased incidence of storms and floods in London. It also states the existence of operational processes to help identify the risks occasioned by severe weather events. Accordingly, there are flood management plans in place across all modes of transport, and emergency strategies are regularly tested. However, no further details are available to the public on the nature and effect of these plans and strategies.

The London Climate Change Adaptation Strategy identifies three major transport risks from flooding: Within the underground system, stations, tracks, trains, depots and supporting infrastructure would be affected, causing delays and suspension of services. For surface transport, flooding of highways and greenway networks, including underpasses, subways and tunnels could cause diversions and delays. Regarding river transport, waterborne freight and the Woolwich ferry may be at risk due to closure of the Thames Barrier.

Thames Water

As a private utility company, Thames Water Utilities Limited is responsible for water supply and drainage for Greater London and surrounding areas. The company acknowledges the effects of climate change on the River Thames, which by 2080, could rise by up to two meters with water from sea level rise combined with storms (Thames Water, 2010a). The Corporate Responsibility Report 2008-09 states the inclusion of climate change adaptation in the company's five-year plan. The plan gives consideration to climate change in water resource planning, improving the capacity of drains to cope with extreme incidents, and the protection of key assets from flooding (Thames Water, 2010b). The Report also mentions 'Sewer flooding' issues that result from the inability of the system to cope with high volumes of water resulting from heavy or prolonged rainfall. In 2008-09 there were 856 reports of such events in comparison with 3,166 in 2007/08. Of the total, 96 are reported to have been caused by severe weather in 2008/09, as against 2,140 incidents in 2007/08. The Report also states that in 2008/09, flooding to 874 homes and external areas was alleviated, bringing the total since April 2005 to 4,385. In 2009, the company submitted a Business Plan to OfWat proposing protection for another 1,176 properties by April 2010.

The Strategy cites experience of studies from the London Borough of Camden which observed many of the drains operating at less than 40% capacity due to poor maintenance. As reflected in the 'Prevention' measures discussed above, there seems insufficient maintenance of drainage networks, and consequently the standard of services available is often well below the original design standards. Although Thames Water is responsible for much of London's water network, TfL and the London boroughs, along with private landowners, remain liable for the drains. Thames Water is among the key partners for Action 7 above to review drain and gully maintenance programmes, in coordination with TfL, GLA and the London boroughs, especially focusing on critical drainage areas.

Drain London Forum

Drain London Forum has received funding from DEFRA to analyse and prioritise flood risk areas and develop a collaborative framework of action (see Table 5, Actions 2, 3, 4 and 9). The Forum is a key partner for Action 5 on integrated flood risk management, and Action 20 on green roofs. It is also exploring further possibilities for a sustainable urban drainage system to avoid the risk of flash flooding. The Forum is a key partner of the GLA, along with boroughs, homeowners and developers, in providing support for 100,000m² of green roofs through helping to prepare a prospectus on its benefits (Action 20).

London Councils/London Boroughs

In terms of flood risk and water management, London Councils acknowledges London's exposure to surface water flooding and vulnerability of the drainage network especially in flood risk areas. It estimates that a 1 in 50 year rainfall (or 2% annual chance) event today would flood 1 in 7 buildings in London. All London boroughs are required to produce Flood Recovery Plans and some have based this on the London Recovery Management Protocol, which includes details for membership agencies' roles and responsibilities and areas of activity for a multi-agency recovery group. The Strategy urges boroughs to consider the following issues: community recovery including housing displaced people and supporting individuals and businesses suffering flood consequences; clean up costs; loss of revenue.

London Resilience Partnership

The Partnership acknowledges that London is more exposed to flood risk than any other urban area in the UK. Despite being the economic backbone, a large area lying within the floodplain of the River Thames and its tributaries means that any form of flooding could affect the built environment and the transport network. The Partnership identifies London's vulnerability to three types of flooding: fluvial, tidal and surface water. It counts on the role played by the Environment Agency and emergency services in dealing with any flood-related incident.

The LRP has produced a London Flood Response Strategic Plan in partnership with the Government Office for London. The plan provides regional and sub-regional frameworks for multi-agency coordination and lays out step by step guidance in case of a flood emergency (London Resilience,

2010b). The LRP appears among the key actors in Actions 1 and 6 with regard, respectively, to mapping out communities and assets at risk and identifying critical assets and vulnerable communities, alongside the Environment Agency, the GLA, London boroughs and LCCP.

London Climate Change Partnership

LCCP supports Drain London Forum in developing a community flood plan for London, and initiating a pilot project for adaptive road or pavement surface treatments that reduce flooding (LCCP, undated a). LCCP is a key partner in Actions 1 and 6 on, respectively, mapping out communities and assets at risk and identifying critical assets and vulnerable communities, in association with the Environment Agency, the GLA, the London boroughs and the LRP.

Insurance sector

As the representative trade body of more than 400 British insurance companies, the Association of British Insurers (ABI) regularly warns the government to invest in flood defence, flood prevention and adaptation measures. It cites the examples of the 2009 floods in Cumbria that resulted in insurance companies paying out £200 million (ABI, 2010). At the international level, *ClimateWise* provides a platform for the insurance sector to respond to the demands of climate change. Launched in 2007, the lobbying group is today comprised of more than 40 international insurers from around the world.

While discussing insurance issues in relation to flooding events, the Strategy places a special focus on vulnerable communities. It observes that flood risk insurance is generally provided within standard insurance cover, but that the uptake of buildings and contents insurance tends to be lower than average in low-income communities. For example, fewer than 1 in 5 households living in social housing actually make use of the Housing Associations' 'insurance with rent' schemes. The Strategy notes that ClimateWise is a key partner in cross-cutting Action 32 calling the government to amend building regulations to make the built environment more climate resilient. Meanwhile, as discussed earlier, the Strategy observes that at present, insurance companies themselves do not incentivise homeowners and landlords particularly with regard to flood resilience and flood protection measures. It also suggests that London boroughs should include advice on insurance claims in their flood recovery protocols.

5.4 Proposed Actions for flood risk in the London Strategy

In order to understand and manage the impacts from flooding in London, the Strategy proposes a vision of robust emergency plans. This vision is to be achieved by: improving understanding of and ability to manage flood risk; reducing flood risk to vulnerable communities and strategic assets; and raising public awareness and individual and community capacity to recover, besides improving overall resilience. In general, the Strategy recognises that there is currently a good understanding of, and arrangements to cope with, tidal and fluvial flood risks; but less preparedness for surface water

flood risks. A range of specific Actions are offered to fill these knowledge and implementation gaps. Table 5 below lists the Actions relevant for flood risk management out of a total of 34 proposed Actions for climate change adaptation. The table also includes the six cross-cutting actions that apply to all three risk areas.

Table 5 List of Relevant Actions and Actors in Flood Risk Management

Actions	Lead Actors (delivery deadlines)	Key Partners
1. Map out who and what is at flood risk. Forecast future flood scenarios	Environment Agency (Winter 2010)	GLA, London boroughs, LRP, LCCP
2. Develop Surface Water Management Plan (SWMP) to identify priority areas	Drain London Forum (Spring 2011)	DEFRA
3. Develop Spatial Data Infrastructure Portal (web-based info sharing of surface water flood risks, GIS)	Drain London Forum (Spring 2011)	DEFRA
4. Develop an online flood incident reporting system	Drain London Forum (Autumn 2010)	DEFRA
5. Integrated flood risk management both across and within boroughs	GLA (Spring 2011)	Association of London Borough Planning Officers, Local Resilience Forums, Drain London Forum
6. Identify critical assets and vulnerable communities in flood risk areas	Environment Agency (Autumn 2010)	GLA, London boroughs, LRP, LCCP
7. Review drain and gully maintenance programme	TfL (Spring 2011)	GLA, London boroughs, Thames Water
8. Public awareness and capacity building to prepare and respond	Environment Agency (Spring 2011)	GLA, London boroughs
9. Develop community flood plans (piloted for two selected communities)	Drain London Forum (Spring 2011)	DEFRA, GLA, London boroughs
10. Publish a water strategy for London that includes both drinking and floodwater management.	GLA (Spring 2011)	Environment Agency, Thames Water
17-20. Urban greening	GLA (mostly by Summer 2012)	London boroughs and other partners (inc. Drain London Forum, TfL)
<i>Cross-cutting issues</i>		
28 Undertaken an assessment of impacts of climate change on health sector in London	LCCP (Summer 2010)	Regional Public Health Group, NHS London
29 Ensure climate risks are addressed in hospital refurbishment programme and commissioning of health services	GLA(Summer 2010)	Regional Public Health Group, NHS London
30. Restore 15km of London's rivers	River Restoration Centre (2015)	GLA, Environment Agency, London boroughs
31. Engaging with business enterprises and key stakeholders	LDA (ongoing)	GLA, London boroughs, London Councils, Environment Agency, DEFRA, business-to-business organisations

Actions	Lead Actors (delivery deadlines)	Key Partners
32. Call the government to amend building regulations to make them climate resilient	ClimateWise (Summer 2010)	GLA
33. Climate risk assessment of TfL's assets and operations to develop action plans	TfL (Summer 2010)	GLA
34. Work with the energy distributors and retailers to ensure resilience of the distribution infrastructure	Distribution Network Operator, EDF (Summer 2011)	GLA

Source: Adapted from London Climate Change Adaptation Strategy (2010)

Actions 1-5 and 10 above are directly concerned with flood risk management, Actions 6-7 refer to vulnerable assets and communities, whereas Actions 8-9 relate to public awareness and capacity building. Additionally, the Strategy relates flood management strategies to Actions 17-20 (to be discussed below in the section on Overheating) on urban greening; and crosscutting Actions 30 on restoring London's rivers, 31 on business engagement and 32 on the growing role of the insurance sector.

5.5 Gaps in the flood risk strategy for London

The table below summarises gaps identified in the flood risk strategy for London, both by the Strategy itself and by the authors. Rather than organising it according to the P2R2 Framework, it is organised according to theme, so that for example, issues concerning insurance or plan-making can be grouped together.

Table 6 Current gaps in adapting to flood risk

Gaps	Relevant Action in Table 5	Source of gap
Borough-level Strategic Flood Risk Assessments (SFRAs) should be better integrated across boroughs	5	Strategy
A lack of integration between borough spatial planners and emergency planners on flood risk management measures	5	Strategy
Utility managers have not completed flood risk assessments of infrastructure	6	Strategy
The Environment Agency's Thames River Basin Management Plan (Environment Agency, 2009) is not mentioned in the Strategy. Prepared in accordance with EU Water Framework Directive (WFD), it should be able to help manage fluvial floods.		Authors
Lack of community flood plans in high risk areas	9	Strategy
Action 33 identifies TfL as being engaged in climate risk assessment. From the flood risk point of view, it should also coordinate with the Highways Agency, Thames Water, and the London boroughs for a systematic exchange of data on past flooding experiences.		Authors

Gaps	Relevant Action in Table 5	Source of gap
At least up to the time of the Strategy, the demands on the planning system have intensified as local authorities are required to produce increasing numbers of plans		Authors
It is not clear whether the GLA and boroughs in using spatial planning to avoid development in areas of flood risk have factored in risk from surface water as well as fluvial and tidal flooding. Although surface water flooding is frequently noted as difficult to predict in the Strategy, this is an area where local knowledge and consultation can be particularly helpful (Susskind, 2010).		Authors
The removal of the obligation to monitor and report local actions towards realising the Thames Catchment Flood Risk Management Plan (formerly carried out through National Indicator 189) may hinder both pressure to act and knowledge of progress on this dimension.		Authors.
Various reporting obligations for proactive flood risk planning and management are proving too complicated for the boroughs.		Authors
The loss of a single development agency, in the form of the LDA, and its replacement by a plurality of Local Enterprise Partnerships, could impede delivery of cross-cutting Action 31, for which LDA is nominated as Lead Actor.		Authors
Like-for-like insurance replacement fails to improve the resilience of property at risk from flooding	32	Strategy
Although there are certain government grants that assist homeowners and landlords in taking flood resilience measures, insurance companies do not generally provide attractive premiums for people in flood-prone areas (Crichton, 2008).		Authors
The National Flood Insurance Program in the US has created opportunities for all residents to obtain common terms and costs of insurance, irrespective of their location in flood risk areas. The NFIP's Preferred Risk Policy is available for just over \$100 per year (New York City Office of Emergency Management, 2010). (However, it should be noted in this regard that where insurance is easily accessible residents and landlords may decide not to proceed with more effective flood adaptation and mitigation measures – Lamond <i>et al.</i> , 2009)		Authors
Many Londoners are either uninsured or under-insured for flood emergencies.		Strategy
Poor sign-up to Floodline Warnings Direct and lack of individual preparedness for flooding	8	Strategy

Gaps	Relevant Action in Table 5	Source of gap
Action 8 suggests gaps in public awareness. These should be perceived in terms of <i>public participation</i> . Experiences in the UK indicate that it is not so much a question of people’s general awareness as of the fact that local risk assessments tend to be based on experiences that underestimate the impacts of rare events such as floods (Burningham <i>et al.</i> 2008), Therefore, it is important to engage with local perspectives on risks and to involve local population in the flood risk management processes. It is also worth understanding that the modern day ‘local community’ is complex and globalised, and comprises a mix of overlapping networks and interests which may result in both cooperation and conflicts (Coates, 2009).		Authors
The standard of the drainage system and its maintenance often remains poor and below average.		Strategy
TfL is the leading actor in the Strategy for Action 7 (Review of drain and gully maintenance programme) but the TfL website gives no public information on this. In view of the concern shown by the Strategy with regard to the capacity of London’s drainage system to cope with a flooding event, it is critical that TfL’s actions are made more transparent.	7	Authors
The utility regulators (OfWat and OfGem) have not allowed utility companies to invest in flood resilience.		Authors

6. Drought risk in London

6.1 Risk of drought

Drought is a natural phenomenon that can occur in any climate and in any part of the world. The fact that the perception of ‘drought’ may vary from place to place underlies its complex nature. Generally, drought is defined as a deficiency in rainfall occurring over a prolonged period of time. The length of the prolongation period would depend upon the nature of the geographical setting and of the weather patterns that ultimately affect the water cycle. It has been divided into the categories of single-season drought, which can endure for up to 9 months; and multi-season drought, which extends beyond this, to cover subsequent summers and winters. It is difficult to predict natural droughts more than one month in advance, as the process involves a variety of parameters and variables that may be active in various distant geographical regions (National Drought Mitigation Centre, 2006). Although among the most common of the natural hazards, there is nevertheless a relatively limited range of options for planning to mitigate droughts. Similarly, adaptive measures are largely focused on minimising its impacts through managing water resources and consumption patterns. In terms of costs, although the economic impacts of droughts are relatively easy to measure, its social and environmental costs are difficult to estimate. The 1988-92 (Wilby, 1995) and 2004-06 droughts in the UK exposed the inadequacy of groundwater sources, river

flows and reservoirs in the wake of a prolonged dearth of precipitation (Wilby and Perry, 2006). The 2004-06 drought is particularly notable, as it occurred within a combination of an exceptionally warm two-year sequence and low winter/spring rainfalls (Water Watch, undated). Water scarcity, shortage or stress is an inadequate supply of water for human use that can have an economic and/or physical cause depending upon whether the lack of water is due to lack of investment in a equitable infrastructure or lack of physical resources, in some cases due to prioritising agricultural uses.

A strategic approach to spatial planning and decision-making allows the consideration of resilience issues for society and landscape in terms of biodiversity, demographic change, social behaviour, patterns of water consumption and retention, technological innovations, public awareness and government policies. One such key tool is known as Integrated Water Resource Management, which provides a planning and decision-making framework from provision to utilisation (Kidd and Shaw, 2007). Adaptive measures for drought plans in this respect primarily involve identifying vulnerable communities and promoting partnership actions between the various stakeholders concerned, ranging from government agencies to civic bodies and from water associations to climate scientists.

6.2 Drought risk in the London Strategy

With its increasing population and economic activity, London is particularly prone to the discrepancy between water supply and demand. The Strategy makes mention of the dry hot summer of 2003 that was followed by dry winters from 2004-06, which particularly affected Southeast England. This situation highlights the need for efficient management of water resources, especially when 80% of London's water comes from two London rivers, the Thames and Lee, and is then stored in various reservoirs. The other 20% is abstracted from aquifers. Both these sources (rivers and aquifers) are highly dependent upon winter rainfall for consumption over the summer months. Of the average 690mm per annum in the Thames catchment, only 13% is used for water provision to London, while the remainder either evaporates ($2/3^{\text{rds}}$) or feeds into plants, rivers and wetlands and so forth. The probability of drought in various London boroughs depends upon their location with regard to the water resource zones, which have been allocated on the basis of water supply companies and connectivity. In all, Greater London is served by four water companies (Thames, Veolia, Essex and Suffolk, and Sutton and East Surrey), of which Thames Water covers the majority of the population (about 79.5%). Thames Water is also the only company engaged in both water supply and sewerage, whereas the remaining three companies are involved in water supply only. On the demand side, each person in London consumes 161 litres per day, which is above the national average of 150 litres. Fixed rates on water consumption, based on the type of property, are paid by 80% of London's population. Hence the Mayor's draft Water Strategy is particularly focused upon increasing the number of households with water meters installed (Mayor of London, 2009b). A supply network more than a century old implies an ageing distribution system, along with issues of corrosion and sedimentation inside and around the pipes, resulting in leakages and other factors which could exacerbate the consequences of a drought. Adaptive measures in London particularly need to

address the cumulative effects of climate change, river flow patterns, groundwater availability, evaporation and increasing demand. To balance the supply and demand functions, the Strategy proposes the following framework.

Strategy Prevent, Prepare, Respond, Recover framework

The framework for drought management in London is as follows.

Prevent: the strategy asserts that it is not possible to prevent drought. However, there are a number of ways in which the impacts emerging from drought can be minimised. This includes reducing water consumption and exploiting water resources.

Prepare: the Strategy identifies three major actors in preparing for drought. First of all, water companies have been encouraged to prepare their strategic Water Resource Management Plans (WRMP). These plans are obligatory and should cover a period of 25 years, with a provision for review every five years. WRMPs are supposed to provide details on how water companies plan to meet future demands by managing water resources and reducing environmental impacts. Additionally, there should be parallel business plans to ensure regular funding for future strategies. The second key actor is the Environment Agency which provides an advisory framework to support companies in the preparation of WRMPs. The Strategy here particularly criticises OfWat's stance through its price review (PR09) because it does not allow water companies to adopt their infrastructure in accordance with UK Climate Projections forecasts (OfWat, undated). Communities and individuals are identified as the third key actor for preparatory drought measures. As the key stakeholders, communities and individuals can help minimise water consumption and develop new sustainable habits.

Respond: the Strategy acknowledges water companies' drought plans for multi-staged processes of implementing water restrictions in order to save water supplies for vital needs. These plans proved successful in controlling demand in 2005-06. However, their effectiveness in the longer term remains to be seen. Communities and individuals as major consumers are entrusted to understand the need for water rationing¹ in the case of a drought. Another key response is the use of desalination plants to provide additional sources of water supply and the Strategy announces that one is planned to be completed at Beckton in East London by 2010. However, being energy-intensive, the process is regarded as of limited value. The Strategy also refers to recommendations from the Mayor's draft Water Strategy to make attempts to: reduce water leakages from supply networks, improve efficiency in consumption, reclaim water for non-potable uses, and develop water resources with minimal environmental impacts (Mayor of London, 2009b). Such new resources, according to the Strategy, may include: desalinating sea water, reusing effluent,

¹ Neither the Strategy nor the water companies actually use the word 'rationing'. Instead the terms such as 'reducing the demand' and 'controlling the demand' are used.

increasing the capacity of existing reservoirs, and recharging groundwater into aquifers for underground storage.

Recover: drought, being a purely natural climate phenomenon, is usually relieved through rainfall. Hence, the Strategy does not identify any specific measure for any private or public actor to produce recovery plans.

6.3 Key Actors for Risk of Drought in the London Strategy

Environment Agency

The Environment Agency provides consultation to water companies for their Water Resources Management Plans (WRMPs). It also issues licenses to water companies for water abstraction. For this purpose, it produces Catchment Abstraction Management Plans. It also produces a London-wide Catchment Abstraction Management Strategy, a six yearly planning document for management of water sources available to London that include the Thames and its tributaries (Environment Agency, 2006). It raises concerns relating to both the lack of potential for available resources to meet future demand, as well as the environmental damage that is resulting from ongoing over-abstraction of water. The Agency produces the Thames River Basin Management Plan, mentioned in connection with flood in the last section. This emphasises the stress faced by the water environment in Thames river basin district, and the actions that can help address these pressures. The Agency has also produced a Drought plan for the Thames Region that looks at wider aspects, ranging from geological impacts to drought management and monitoring, and from actions and triggers to adaptive actions and communication strategies (Environment Agency, 2010b).

The Environment Agency features strongly in two key Actions for drought management (10 and 11). First, the publication of a London-wide Water Strategy that is already underway (in partnership with GLA and Thames Water). Second, defining 'water neutrality' in London and identifying strategic efficiency measures to increase drought resilience in the water resources. This Action involves working with the four companies supplying water to London along with GLA and London Councils.

Thames Water

Although four water companies supply London with water, almost 80% of water supply is by Thames Water. Thames Water is a key partner in Actions 10 and 11, which respectively, regard publishing London's Water Strategy; and studying water neutrality in London. The company, along with other water suppliers, is required under the Water Act 2003 to prepare drought management plans. The company's drought management plan elaborates measures for potential drought (Thames Water, undated). It highlights the sources of water supply and compares these with the consumption patterns of Londoners using both demand-side and supply-side measures. The company regularly monitors rainfall patterns, groundwater levels, river flows, reservoir levels and soil moisture deficits

to predict drought. It also uses forecasting models and tools to anticipate drought possibilities and environmental impacts. In case of drought, the company is supposed to contact the Environment Agency and DEFRA for Drought Permits to abstract additional quantities of water and implement limited supply measures. The plan also incorporates a strand of local media campaigning to raise awareness of drought management measures, in the event of drought.

OfWat

OfWat is the water services regulation authority for England and Wales. They work in partnership with organisations such as the Environment Agency and the Consumer Council for Water. They are charged with making sure that customers receive a good quality service and value for money. As part of this service, they monitor and approve each companies charge for water and sewerage services every year and aim to keep prices as low as possible. However, another part of their remit is to secure a reasonable return for water companies. There is also a duty to exercise powers in conformity with sustainable development aims. However, there appear to be tensions between prioritising current and longer term investment objectives, which will be given consideration by the organisation before its 2015-20 price review (RCEP, 2010, point 4.55).

London Councils

For drought management, London Councils is part of the London Water Group in collaboration with GLA, working on Action 11 undertaking study to define and achieve water neutrality in London. London Councils also plays a proactive role in keeping regular contact with water supply companies for awareness raising and resilience in partnership with boroughs and regional stakeholders.

Besides the forum of London Councils, London boroughs, either collectively or individually, feature in a number of Actions as proposed by the Strategy for flood risk, drought and overheating management.

London Resilience Partnership

The Strategy puts the LRP in the lead position with regard to Action 14, which consists of reviewing London's resilience and preparing a drought plan (London Resilience, 2010c). The LRP has based its plans on the government's water strategy, which anticipates frequent occurrence of drought in the South East of England (HM Government, 2008). The LRP argues that given London's average temperature is about 9°C higher than the surrounding rural areas, it is particularly vulnerable to periods of drought. In order for local populations to develop adaptation to incidents of drought, it asserts the need to reduce leakages from London's water supply lines and suggests a change in local populations' consumption habits.

6.4 Proposed Actions for Risk of Drought in the London Strategy

The Strategy considers the probability of drought in London to be relatively low. However, it notes concerns that the risks, though low at present, are increasing due to continue change to the climate and London’s increasing population. To adapt to such a situation and to develop resilience, the Strategy sets a vision for achieving a sustainable balance between water supply and demand by 2030 and for making London more resistant to drought. This vision is to be achieved by taking a strategic view of the water resources available to London, reducing water demand in the city and improving its responsiveness to drought. Subsequent to this, five key Actions have been established with lead actors and their key partners, in order to understand and prepare for the challenges posed by a potential drought, as presented in the table below.

Table 7 List of Relevant Actions and Actors in the case of Drought

Actions	Lead Actors (delivery deadlines)	Key Partners
10. Publish a water strategy for London that includes both drinking and floodwater management.	GLA (Spring 2011)	Environment Agency, Thames Water
11. Undertake a study to define water neutrality in London and how it can be achieved.	GLA (Autumn 2011)	London Water Group (London Councils, GOL, GLA, Water companies [Thames, Veolia, Essex and Suffolk, and Sutton and East Surrey], Environment Agency)
12. Encourage OfWat to help the water companies deliver water efficiency savings and investment in the water infrastructure.	GLA	-
13. Improve the energy and water efficiency of up to 1.2 million homes by 2015; and with business and GLA estate managers to improve the energy and water efficiency of public and commercial buildings.	GLA (Trial of 10,000 homes in 2010. Improve 189,000 homes by 2012)	London Boroughs, GLA Estate Managers, Businesses
14. London Resilience will review the need for a London-specific Drought Plan.	LRP (Ongoing)	-

Source: Adapted from London Climate Change Adaptation Strategy (2010)

Actions 10-12 above refer to the strategic view of London’s water resources. The London Water Strategy is currently in a draft form (with a final version programmed for the end of 2010). The London agglomeration is considered to have sufficient supplies to meet present demands. However, future growth in areas with limited potential for extending their water resources brings new challenges to the water companies. Therefore, Action 13 aims to improve London’s water efficiency and resilience to drought. Finally, Action 14 raises the issue of preparing effective action London-wide through the London Resilience Partnership.

6.5 Gaps in the drought risk strategy for London

Table 8 below summarises gaps identified in the flood risk strategy for London, both those suggested by the Strategy itself and additional gaps contributed by the authors. As in the Table for Flood situations, it is organised according to theme.

Table 8 Current gaps in adapting to drought situations

Gaps	Relevant Action in Table 7	Source of gap
London-wide need to reduce the demand for water	11 and 13	Strategy
Changing attitudes and cultures towards water consumption needs to take place not only at the level of the community and individual but also within small, medium and large enterprises and their various service, production and consumption activities.		Authors
Need for wider collaboration in terms of awareness-raising, through public stakeholders being involved in the preparatory Actions.		Authors
OfWat should support water companies' investment in long-term drought resilience	12	Strategy
London Resilience to review the need for a London-specific drought plan	14	Strategy
Partner plans and strategies for drought should also be made available to the public		Authors
Investigate powering desalination, effluent recycling and aquifer recharge using renewable energy sources		Authors
Clearer evidence on the impact of drought permits allowing increased abstraction on wetlands and rivers – with regard to both to loss of biodiversity and of important 'ecosystem services' - needs to be assembled to inform policy on issue of drought permits.		Authors
Weather modification techniques such as cloud seeding (practiced in many arid regions) may help replenish rainwater supplies to the specific areas.		Authors
The costs and mechanisms of water import from regions with supplies excess to needs, (as occurred in Spain in 2008 – Nash, 2008) could also be considered.		Authors

Source: London Climate Change Adaptation Strategy, 2010: 33

7. Overheating risk in London

7.1 Risk of overheating

Overheating or heatwave is an extreme weather event defined by unusually hot periods in summer that may endure from a few days up to a few weeks. Overheating is usually defined anthropocentrically and may include a dimension of excess humidity. This overheating affects people (illnesses and deaths), the economy (losses and damage to properties and goods) and the

environment (droughts and fires etc.) (Kuchcik, 2006). It particularly affects densely populated urban areas. As heatwaves occur more frequently, the phenomenon has come to be interpreted as one of the indications of global warming and the impacts of a changing climate. Vulnerable social groups and ageing populations are most at risk from overheating, raising concerns for environmental justice between different communities (White-Newsome *et al.*, 2009). In Europe, the first recorded occurrence of a heatwave in recent history was in the UK, when the hot dry summer of 1976 preceded a severe drought (Kuchcik, 2006). The Strategy uses the term 'overheating' to describe a rise in summer temperatures to the extent that they affect people's comfort and health and cause damage to the infrastructure. Exposure to extreme heat both within and outside urban dwellings causes severe health problems within the population (Jakšić and Jakšić, 2006).

The adaptation challenge for spatial planning is to anticipate the impacts of extreme temperatures on the built environment. Preventative and remedial measures should deploy appropriate technologies (energy-efficient air-conditioning, passive cooling) to reduce temperatures, (Hacker and Holmes, 2007) and buildings and the urban environment should be effectively designed for comfortable ventilation (Jenkins *et al.*, 2009). Besides calls for health measures and active responses from the concerned agencies, it is also important to support individual and collective initiatives for adaptation and to enhance resilience. In this respect, Wolf *et al.* (2010) have given the example of how social capital can be a source of reducing vulnerability to heatwaves, based on a case study of UK cities, and elaborating a complex relationship between social capital, health and adaptation to climate change. The PPS1 Supplement asserts the need for measures to moderate the high summer temperatures by means of urban open space and tree shading to reduce the urban heat island effect that develops within a sea of cooler rural air, especially at night time (DCLG, 2007). The Greater London area, as the UK's largest and most densely populated conurbation, is subject to both the causes and the effects of overheating. During the August 2003 heatwave, more than 600 lives were lost in London. A recent pilot study of housing in London reveals that during a period of high temperatures, more than 40% of bedrooms monitored failed the recommended overheating criteria in the overnight period. The study proposes tools to help address issues faced by people living in vulnerable building types and areas (Mavrogianni *et al.*, 2010).

7.2 Risk of Overheating in the London Strategy

The London Climate Change Adaptation Strategy notes the probability of this occurrence is high, as London has experienced two heatwaves in the last decade. It maintains that recent summers in London have shown the impacts of higher temperatures on urban living. London is sensitive to any rise in temperature above 24°C.

Prevent, Prepare, Response, Recover framework

The framework for the management of risks of overheating in London is as follows.

Prevent: the strategy maintains that just like drought, heatwave as a weather phenomenon cannot be prevented. The best option is to reduce the impact of hot weather. The adaptation Actions in this respect include: retrofitting buildings to stay cool in summer and designing green spaces and breeze pathways for urban cooling. As this is a relatively recent source of concern, the existing building and urban design and refurbishment codes do not fully incorporate regulations to prevent internal and external overheating with structural causes, which includes inefficient air conditioning. The strategy claims to be one of the first to tackle this issue on a strategic scale.

Prepare: on the planning side, minimising solar gain and increasing urban greening are among the common issues to be addressed to prepare for and reduce the urban heat island effect. The Strategy also stresses public health issues in preparation for heatwaves. It discusses the importance of a national Heatwave Plan as devised by the Health Protection Agency (HPA, 2010). The current Heatwave Plan provides guidelines for GPs and local social services in locating vulnerable individuals and ensuring their wellbeing. The Strategy however criticizes this approach and considers it a major gap, as the vulnerability of an individual to heat may vary from day to day, and also because people with vulnerabilities may not necessarily consider themselves to be 'vulnerable'. Furthermore, London's social services are already stretched so this approach may not be appropriate for London's situation.

Respond: an efficient response can best be achieved if communities and individuals take the necessary measures to avoid overheating without using the type of air-conditioning which is energy intensive and productive of waste heat. Hospitals and care homes are required to devise their heatwave plans to ensure a maximum level of service and comfort and maintain room temperatures up to 26°C.

Recover: as in the case of drought, the Strategy identifies little need for inputs to recovery once the heatwave is over. Presently, there are no obligations to any government agency or private body to produce heatwave recovery plans. Hence the generic London Recovery Management Protocol would be brought into action. However, the Strategy points to the need for an assessment of the Heatwave Plan devised by the Health Protection Agency in order to evaluate its effectiveness (GLA, 2010a, p83).

7.3 Key Actors for risk of overheating in the London Strategy

London Climate Change Partnership

In the event of overheating, LCCP has been nominated for Action 24, which refers to retrofitting a social housing development to reduce risks to residents from heatwave. This is to be done through an economic incentives scheme, in collaboration with private companies and government agencies, by retrofitting with green roofs (LCCP, undated c).

LRP

For climate change events, the Partnership has developed scenarios for up to 2080 as the capital is expected to be consuming higher amounts of energy in summers causing heat island effect as well as burden of energy sources. LRP strongly favours an awareness raising campaign for citizens for energy saving measures and adapting the lifestyles and behaviours to the changing climate.

CIBSE

The Chartered Institute of Building Services Engineers is a professional association which sets standards and publishes guidance and codes and also engages in an educational and information remit. The fourth of their six core objectives includes: 'promoting competence and knowledge, through engagement in issues including the safety of people in and around buildings, sustainability, climate change, use of natural resources and globalisation of the engineering industry' (CIBSE, 2010a). They are currently working with the Met Office to provide daily mean outdoor temperature and comfort temperatures by postcode which will be available through a link on their website. Their Guide on Environmental Design has a chapter dedicated to comfort criteria and guidance on overheating criteria and they recently produce a practical guide to improving summertime comfort in buildings (CIBSE, 2010 b).

Transport for London

Transport for London is preparing strategies addressing the climate resilience of the London transport network under a range of climate risks. With regard to London Underground, the current programme for upgrading lines and increasing capacity has prompted interventions to counteract temperature increases that will also address overheating due to climate change. These interventions include increasing air-conditioned carriages and chiller units on stations, as well as improving ventilation and raising passenger awareness. Air conditioning on mainline trains, currently at about 50% will also increase as stock is replaced. New buses are built to better heat-resilient standards while the existing fleet is being retrofitted with cooling systems. However, most of London's transport is dependent upon electricity or diesel and the Strategy urges TfL to consider the resilience of its energy supply under extreme climate conditions.

Thames Water

The Strategy does not relate Thames Water to any of the issues around heatwaves. However, this does not exclude the fact that even for short durations, extreme heat may result in heavier water usage. Thus, it might be worthwhile for Thames Water and other water suppliers to prepare anticipatory plans.

7.4 Proposed Actions for risk of overheating in the London Strategy

The Strategy considers there to be a high probability of risk from overheating in London. For such a situation, it sets a vision to make London a comfortable city to live, work and play in, ensuring a robust emergency plan for heatwaves. To this end, the policy strives to improve the understanding of risks associated with overheating by identifying who and what is at risk, managing potential temperature rise by increasing vegetation cover in London, reducing the uses of mechanical cooling and working to develop an effective heatwave plan. Subsequently, 13 key Actions in association with various actors have been discussed, as follows:

Table 9 List of Relevant Actions and Actors in the case of overheating

Actions	Lead Actors (delivery deadlines)	Key Partners
15. Undertake a feasibility study into a network of weather stations	Met Office (Winter 2010)	Mayor of London, London Climate Change Partnership, OPAL network, London Grid for Learning
16. Improve understanding of climate change effects on summer temperatures in future and identify priority areas of overheating and risk management.	GLA (Winter 2010)	LUCID project SCORCHIO project
17. Enhance 1,000 ha of greenspace by: - Implementing the Green Grid - Preparing Supplementary Planning Guidance for a London-wide Green Grid - Supporting boroughs and other partners in creating similar projects	LDA (Summer 2012) GLA (2011) LDA (ongoing)	East London Green Grid Partnership LDA Londonwide Green Grid Partnership
18. Increase green cover in the Central Activities Zone	GLA (5% by 2030, further 5% by 2050)	London Boroughs of Lambeth, Southwark, Tower Hamlets, Hackney, Islington, Camden, Westminster, Wandsworth and City Corporation of London.
19. Increase tree cover by 5% by 2025 - Planting 10,000 street trees - Identifying planting opportunities and funding	GLA (Summer 2012) London Tree and Woodland Implementation Group (ongoing)	Boroughs, voluntary sector, TfL and developers

Actions	Lead Actors (delivery deadlines)	Key Partners
20. Enable the delivery of 100,000m ² of new green roofs (through preparing a prospectus on the green roofs benefits)	GLA (Summer 2012)	Drain London Forum, boroughs, homeowners and developers
21. Publish bespoke design guidance for developers to reduce overheating risk	CIBSE (Spring 2010)	GLA
22. Implement a new 'cooling hierarchy' policy in the replacement London Plan	GLA (Winter 2010)	-
23. Map opportunities for decentralised cooling	LDA (Summer 2010)	London Boroughs
24. Retrofit a social housing development to reduce overheating risk	Social housing provider (Spring 2012)	LCCP
25. Assess and promote 'Cool Roof' technologies	Cool Roofs Consortium (Autumn 2011)	GLA, Brunel University
26. Assess the benefits of heatwave refuges	LRP (Summer 2011)	-
27. Determine how best to encourage and enable a community-level response to heatwaves	GLA (Autumn 2011)	Boroughs, Regional Public Health Group

Source: Adapted from London Climate Change Adaptation Strategy (2010)

Actions 15-16 above aim to improve the understanding of risks and priority areas related to overheating; while the remaining Actions 17-27 attempt to manage higher temperatures by means of urban greening activities. The Green Grid as discussed in Action 17 above is an experimental network of multi-purpose open spaces in East London. Its success is being used to replicate such regeneration approaches in other areas of London.

7.5 Gaps in the Overheating Risk Strategy for London

The following gaps have been identified in adapting London to overheating situations:

Table 10 Current gaps in adapting to overheating in London

Gaps	Relevant Action	Source of Gap
The loss of a single development agency, in the form of the LDA, and its replacement by a plurality of Local Enterprise Partnerships, could impede delivery of Actions 17 and 23, for which LDA is nominated as Lead Actor.		Authors
There is a need to publish and promote design guidance on reducing overheating in buildings	21	Strategy
There is a need for building regulations to incorporate steps for retrofitting old buildings so that they can be adjusted to be habitable in extreme temperatures. In particular, CLG needs to incorporate this into its policies.		Authors
The Heatwave Plan recommends that GPs and social services should identify heat vulnerable individuals, but there is no mechanism for this	27	Strategy
It is more important to promote programmes of public education regarding measures to take in the case that high temperatures are experienced.		Authors
Heatwave preparedness should also be defined through collaboration between institutions, government and the community, to help mitigate public health effects. ²		Authors
In light of the above, there is a growing need for the civic infrastructure and its allied agencies to put immediate or alternative recovery measures in place, beyond the London Recovery Management Protocol mentioned in the Strategy.		Authors

Source: London Climate Change Adaptation Strategy, 2010: 34

² White-Newsome *et al.* (2009)

8 Risk by Risk gap analysis overview

Table 11 below brings all the gaps identified in the last three sections together. From this summary table, the characteristics of the kinds of risks that are identified within London’s adaptation planning and those that are contributed from other sources can be identified. Overall it can be seen that the Strategy itself emphasises assessment, plan-making and creation of guidance. The authors’ contributions emphasises greater sensitivity to organisational pressures and the notion of greater public involvement through education and awareness-raising. Some suggestions also promote wider consideration of technological solutions.

Table 11 Risk by Risk Gap Analysis of the London Strategy

Gaps	Action	Source
Flood		
Borough-level Strategic Flood Risk Assessments (SFRAs) should be better integrated across boroughs	5	Strategy
A lack of integration between borough spatial planners and emergency planners on flood risk management measures	5	Strategy
Utility managers have not completed flood risk assessments of infrastructure	6	Strategy
The Environment Agency’s Thames River Basin Management Plan is not mentioned in the Strategy. Prepared in accordance with EU Water Framework Directive (WFD), it should be able to help manage fluvial floods.		Authors
Lack of community flood plans in high risk areas	9	Strategy
Action 33 identifies TfL as being engaged in climate risk assessment. From the flood risk point of view, it should also coordinate with the Highways Agency, Thames Water, and the London boroughs for a systematic exchange of data on past flooding experiences.		Authors
At least up to the time of the Strategy, the demands on the planning system have intensified as local authorities are required to produce increasing numbers of plans		Authors
It is not clear whether the GLA and boroughs in using spatial planning to avoid development in areas of flood risk have factored in risk from surface water as well as fluvial and tidal flooding. Although surface water flooding is frequently noted as difficult to predict in the Strategy, this is an area where local knowledge and consultation can be particularly helpful.		Authors
The removal of the obligation to monitor and report local actions towards realising the Thames Catchment Flood Risk Management Plan (formerly carried out through National Indicator 189) may hinder both pressure to act and knowledge of progress on this dimension.		Authors.
Various reporting obligations for proactive flood risk planning and management are proving too complicated for the boroughs.		Authors

Gaps	Action	Source
The loss of a single development agency, in the form of the LDA, and its replacement by a plurality of Local Enterprise Partnerships, could impede delivery of cross-cutting Action 31, for which LDA is nominated as Lead Actor.		Authors
Like-for-like insurance replacement fails to improve the resilience of property at risk from flooding	32	Strategy
Although there are certain government grants that assist homeowners and landlords in taking flood resilience measures, insurance companies do not generally provide attractive premiums for people in flood-prone areas.		Authors
The National Flood Insurance Program in the US has created opportunities for all residents to obtain common terms and costs of insurance, irrespective of their location in flood risk areas. The NFIP's Preferred Risk Policy is available for just over \$100 per year. (However, it should be noted in this regard that where insurance is easily accessible residents and landlords may decide not to proceed with more effective flood adaptation and mitigation measures.)		Authors
Many Londoners are either uninsured or under-insured for flood emergencies.		Strategy
Poor sign-up to Floodline Warnings Direct and lack of individual preparedness for flooding	8	Strategy
Action 8 suggests gaps in public awareness. These should be perceived in terms of <i>public participation</i> . Experiences and in the UK indicate that it is not so much a question of people's general awareness as of the fact that local risk assessments tend to be based on experiences that underestimate the impacts of rare events such as floods. Therefore, it is important to engage with local perspectives on risks and to involve local population in the flood risk management processes. It is also worth understanding that the modern day 'local community' is complex and globalised, and comprises a mix of overlapping networks and interests which may result in both cooperation and conflicts.		Authors
The standard of the drainage system and its maintenance often remains poor and below average.		Strategy
TfL is the leading actor in the Strategy for Action 7 (Review of drain and gully maintenance programme) but the TfL website gives no public information on this. In view of the concern shown by the Strategy with regard to the capacity of London's drainage system to cope with a flooding event, it is critical that TfL's actions are made more transparent.	7	Authors
The utility regulators (OfWat and OfGem) have not allowed utility companies to invest in flood resilience.		Authors
Drought		
London-wide need to reduce the demand for water	11 and 13	Strategy
Changing attitudes and cultures towards water consumption needs to take place not only at the level of the community and individual but also within small, medium and large enterprises and their various service, production and consumption activities.		Authors

Gaps	Action	Source
Need for wider collaboration in terms of awareness-raising, through public stakeholders being involved in the preparatory Actions.		Authors
OfWat should support water companies' investment in long-term drought resilience	12	Strategy
London Resilience to review the need for a London-specific drought plan	14	Strategy
Partner plans and strategies for drought should also be made available to the public		Authors
Investigate powering desalination, effluent recycling and aquifer recharge using renewable energy sources		Authors
Clearer evidence on the impact of drought permits allowing increased abstraction on wetlands and rivers – with regard to both to loss of biodiversity and of important 'ecosystem services' - needs to be assembled to inform policy on issue of drought permits.		Authors
Weather modification techniques such as cloud seeding (practiced in many arid regions) may help replenish rainwater supplies to the specific areas.		Authors
The costs and mechanisms of water import from regions with supplies excess to needs, (as occurred in Spain in 2008) could also be considered.		Authors
Overheating		
The loss of a single development agency, in the form of the LDA, and its replacement by a plurality of Local Enterprise Partnerships, could impede delivery of Actions 17 and 23, for which LDA is nominated as Lead Actor.		Authors
There is a need to publish and promote design guidance on reducing overheating in buildings	21	Strategy
There is a need for building regulations to incorporate steps for retrofitting old buildings so that they can be adjusted to be habitable in extreme temperatures. In particular, CLG needs to incorporate this into its policies.		Authors
The Heatwave Plan recommends that GPs and social services should identify heat vulnerable individuals, but there is no mechanism for this	27	Strategy
It is more important to promote programmes of public education regarding measures to take in the case that high temperatures are experienced.		Authors
Heatwave preparedness should also be defined through collaboration between institutions, government and the community, to help mitigate public health effects.		Authors
In light of the above, there is a growing need for the civic infrastructure and its allied agencies to put immediate or alternative recovery measures in place, beyond the London Recovery Management Protocol mentioned in the Strategy.		Authors

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