

CLIMATE GREENING

LONDON • ROTTERDAM • TORONTO

A comparative analysis of the governance capacity of
adaptation to climate change in urban areas.



A Master's Thesis by Heleen Mees

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Climate Greening London, Rotterdam and Toronto

A comparative analysis of the governance capacity of adaptation to climate change in urban areas.

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Abstract

This research addresses the question what the governance conditions are of the spatial planning policy field to “climate green cities”, that is to adapt cities to climate change by means of green space. The use of green space is a no-regret adaptation strategy, since it not only absorbs rainfall and moderates temperature, but it simultaneously contributes to the sustainable development of urban areas through its many co-benefits. However, green space competes with other short-term socio-economic interests that require space. As a cross-divisional policy field spatial planning can mediate among these competing demands for land use and as such offers potential for the governance of adaptation. Through their effect on land use and spatial configurations in cities, spatial planning policies can affect resilience to the impacts of climate change. Nevertheless, climate change considerations have not yet had much impact on urban planning. Through an in-depth comparative case study of three frontrunner cities in adaptation planning, Rotterdam, London and Toronto, the governance capacity is analysed for each city. A framework of analysis was developed to analyse the governance capacity, broken down into five sub-capacities: legal, managerial, political, resource and learning capacity. The content analysis of key policy and strategy documents of each city has provided a top-down perspective, while in-depth semi-structured interviews with key actors and stakeholders in each city have provided the bottom-up perspective. This was complemented with a horizontal perspective by comparing the cities in order to distinguish universal patterns. The overall conclusion is that the legal capacity of spatial planning appears to be most important for climate greening cities, while the managerial capacity is seriously hampered by the complexity of urban governance structures, leading to compartmentalisation and institutional fragmentation as the two key barriers to the governance capacity for climate greening cities. The political capacity is also well developed but not necessarily as a result of spatial planning, while the resource and learning capacity represent most potential for growth. The biggest opportunities for climate greening cities are the establishment of strong links between adaptation and other important societal governance themes, the most obvious one being climate change mitigation, as well as the integration of adaptation considerations into spatial planning processes and standards for sustainable building.

Keywords: adaptation to climate change, spatial planning, governance capacity.

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1. Introduction, background and methodology

1.1. Introduction

The impacts of climate change are increasingly evident all over the world, and even more so in urban areas, which house more than half of the world's population and represent enormous amounts of human, cultural, economic and financial capital. Cities will need to adapt to the impacts of climate change in order to remediate their most prominent problems of heat stress and flood risk. A popular measure to do this is by means of green space. The governance of adaptation to climate change in urban areas by means of green space is the topic of this research. In order to shed light on this topic, this first chapter will discuss adaptation to climate change as a public policy issue, the issue of its governance, the specific issues in the urban environment and the spatial dimension of this issue. These discussions lead to the research questions and scope, after which the research methodology will be explained. The final aim of this research is to gain insight into the governance conditions needed for the spatial planning policy field to adapt cities to climate change through green space.

1.2. Adaptation as a public policy issue

Despite all the mitigation efforts to reduce greenhouse gas emissions, unavoidable climate change will happen in the next decades as a result of past emissions. Global average mean temperatures are increasing, and there will be an increasing occurrence of extreme weather events. Depending on the region we will experience more heat waves, more heavy precipitation events, more areas affected by drought, more intense tropical cyclone activity and an accelerated sea level rise. These climate changes will have considerable socio-economic, ecological and health impacts, from increased flood risk and coastal zone erosion, to water shortages, potential reductions of agricultural yields, biodiversity loss and an increase in heat-related deaths, to mention a few (EC, 2009a; EEA, 2008; IPCC, 2007)). Various studies have indicated that the costs of taking action now to address the impacts of climate change are much lower than the cost of inaction in the medium or long term (EC, 2009a). While mitigation measures address the causes of climate change, adaptation measures deal with avoiding or reducing its inevitable impacts for current and future generations. While many definitions of adaptation to climate change are in circulation, one of the most commonly used definitions is from the Intergovernmental Panel on Climate Change (IPCC), which defines adaptation as *"the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."* (IPCC, 2007, p.6). For the purpose of this research with adaptation is meant the public policies, programmes and actions as deliberate interventions which aim to moderate the impacts of climate change and/or to exploit their opportunities. This is also often referred to as 'planned adaptation' as opposed to 'autonomous adaptation', which happens spontaneously and independently (Rayner and Jordan, 2009; Füssel, 2007). Along similar lines I have defined 'adaptation planning' as the intended planning of public policies, programmes and actions for the purpose of decreasing the vulnerability to the impacts of climate change, and taking advantage of its opportunities. This vulnerability depends not only on the severity of the impact, but also on the ability to cope with it (Wall and Marzall, 2006). Vulnerability to climate change can be decreased, not only by coping with the impacts but by creating more sustainable patterns of development (Pielke et al., 2007).

Since the beginning of the 2000s adaptation has gradually been recognised as a policy objective. Until that time adaptation was considered a taboo subject because it was widely believed to frustrate mitigation objectives (Rayner and Jordan, 2009; Pielke et al., 2007). IPCC has a separate working group on adaptation; consequently it has become a serious part of the IPCC third and fourth assessment reports of 2001 and 2007, under the name of 'Impacts, Adaptation and Vulnerability' (IPCC, 2010). In turn this has sparked off a realisation among various levels of government of the need for adaptation planning, in particular in Europe where a new albeit still hardly full-fledged area of policy is emerging (Rayner and Jordan, 2009; Swart et al., 2009).

1.3. The governance of climate change adaptation

Adaptation to climate change is seen as a “wicked problem”¹, that requires difficult, non-evident and often contradictory solutions in the face of uncertainty, as well as large scale environmental and social change, involving many actors in society from different institutions and with different value systems (van Nieuwaal et al., 2009, p.18; Swart et al., 2009, p.48; Lorenzini et al., 2007, p.68). Therefore it is argued that adaptation to climate change needs a governance approach (van Nieuwaal et al., 2009, Lorenzini et al., 2007). Governance is often described as the horizontal way of steering society, making public issues the responsibility of all three spheres of State, Market and Civil Society, in particular in dealing with highly complex problems that appear to be beyond the capacity of states alone to solve (Meadowcroft 2007). Moreover, adaptation touches all levels of governance; it requires actions from the local to the global (Mickwitz et al., 2009; Swart et al., 2009). Many believe that adaptation needs management on the local scale since the effects of climate change can vary significantly per region and should be dealt with by those who are directly affected by them (Biesbroek et al., 2009; Saavreda and Budd 2009; Lindley et al., 2007). Others state that the national and regional level should provide guidance to the local levels in the form of adequate legal and financial frameworks (Mickwitz et al., 2009; Swart et al., 2009). Yet others plea for a global governance system, dealing with issues such as climate-induced migration and decreased food security (Biermann et al., 2008).

In the last decade the governance of adaptation to climate change is getting increased attention and political support on the global, regional and local scale (Mickwitz et al., 2009; Rayner and Jordan, 2009; Biermann et al., 2008). On the global scale the UNFCCC articles 4.1 and 4.8 deal with climate change adaptation and the 1997 Bali Action Plan has acknowledged the need for enhanced action on adaptation by Parties to the Convention. The Copenhagen Accord of the 15th Conference of the Parties in December 2009, contains a commitment from developed countries to invest \$30 billion in the next three years to support developing countries which are particularly vulnerable to the adverse effects of climate change and another \$100 billion per year in the longer term (America.gov, 2010). The United Nations Development Programme has developed an ‘Adaptation Policy Framework’ which helps countries to formulate and implement adaptation strategies, policies and measures (UNDP, 2010). At the regional level most activities so far have focussed on scientific assessments of regional climate change impacts. In Europe the European Commission (EC) has actually taken the step of formulating broad policy guidelines on adaptation for its member states. The EC issued a White Paper (COM2009/147) in April 2009, called “Adapting to climate change: Towards a European Framework for action”. At the national level several European countries have developed National Adaptation Strategies. Like the European White Paper these National Adaptation Strategies are still only of an advisory nature and leave much room for interpretation at the sub-national level. In the meantime many local authorities have developed climate change adaptation strategies and programmes, predominantly in cities (Swart et al., 2009).

1.4. Cities and the governance of climate change adaptation

Nowadays roughly 50 percent of the world’s population live in cities (UNFPA, 2010). They account for around 80 percent of greenhouse gas emissions and are therefore to a large extent responsible for the anthropogenic factor of global climate change (C40 cities, 2009). Cities are also on average more affected by climate change. First of all, because they are often located in delta regions and/or in close vicinity of the sea. This makes them more vulnerable to flood risk as a result of increased frequency and intensity of precipitation and storm events, as well as sea level rise.

¹ The term “wicked problem” originates from Rittel and Webber (1973, p.160) with which they characterized planning problems in the complex world of modern times. They described wicked problems as problems that are unique in their own kind, cannot be true or false, have no stopping rule, have an enumerable set of solutions, have no ultimate solution, and their solution is consequential. In this thesis the meaning is similar to the term “unstructured problem” in environmental science, which means there is low consensus on knowledge (poor understanding of the problem) and low consensus on values (agreement on what the problem is and how it is to be solved) (Hisschemöller and Hoppe, 1995).

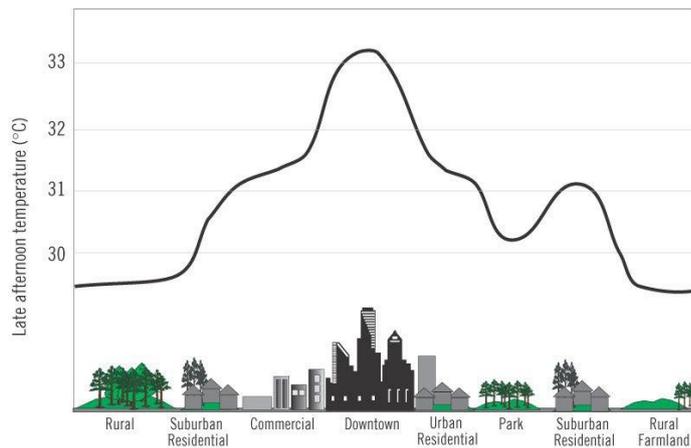


Figure 1.1.: visualisation of the Urban Heat Island
(Urbanheatislands.com, 2010)

Secondly, because cities are faced with the so-called urban heat island (UHI) effect² due to their intense urbanisation (see figure 1.1.). Urban areas can be exposed to an average of 4°C warmer temperatures than rural areas, and global rising temperatures are going to exacerbate this UHI effect (Rahola et al., 2009). Thirdly, because the urban environment is less healthy than rural areas and the effects of climate change will worsen this situation (Lindley et al., 2007). Some of the climate change impacts cities are confronted with, are increased demand for cooling and energy shortages, declining air quality, ground

and surface water quality problems, pressure on infrastructure, property loss, increased risk of heat related mortality and many more (McCarney, 2009). In sum, in cities the linkages and feedbacks between climate drivers and their impacts, and socio-economic drivers form a formidable challenge for policy makers (Lindley et al., 2007). Moderation of excessive rainfall, heat and drought form the key challenges cities face in their governance of adaptation to climate change.

Local governments of cities increasingly demand a role in the global climate policy agenda. In line with the global trend towards multi-level and network governance, several transnational municipal city networks have been established around climate protection as a form of self-governance (Kern and Bulkeley, 2009). On the global scale the Clinton Climate Initiative has led to the creation of the 'C40 cities climate leadership group'. At the regional level several networks have emerged, such as the 'Climate Alliance' and 'ICLEI's Cities for Climate Protection' (Kern and Bulkeley, 2009). However, most of these networks still focus on CO₂ reduction and energy efficiency (mitigation), rather than on adaptation to climate change. Individual activity on climate change by cities is also still centred around mitigation in most cases. Nevertheless, there is a growing number of pioneer cities that have started to embrace adaptation issues, goals and measures. The case studies of this research, Rotterdam, London and Toronto, have been selected for their front runner status in adaptation planning.

1.5. The role of green infrastructure in urban climate change adaptation

There are various means to address key urban adaptation issues. From a technical and economic point of view, both more traditional approaches such as grey infrastructural measures and more modern approaches such as green infrastructural measures can help regulate water quantity and moderate temperature. While *grey* infrastructure makes use of engineering services to make buildings and infrastructure more resilient to climate change (for example by applying physical interventions such as dikes and levees or installing air conditioning in buildings), *green* infrastructure³ makes use of ecosystems services by utilising nature's capacity to absorb or control the impacts of climate change (EC, 2009a, p.5). For this specific use of green infrastructure the term 'climate greening' has been created, with which is meant adaptation to climate change by means of green infrastructure, or in other words making society more climate resilient through green space.

² UHI is defined as the rise in temperature of any man-made area, resulting in a well-defined, distinct "warm island" among the "cool sea" represented by the lower temperature of the area's nearby natural landscape. It is well-known that the progressive replacement of natural surfaces by built surfaces, through urbanization, constitutes the main cause of UHI formation. (urbanheatislands.com, 2010)

³ An interconnected network of green spaces that conserves natural ecosystems values and functions and provides associated benefits to human populations (Benedict and McMahon 2002, p.12)

According to the Impact Assessment of the EU White Paper (EC, 2009b) there is evidence that this approach is more efficient, sometimes more feasible than the grey infrastructural alternatives and considered a no-regret action because of its societal co-benefits. A study by Gill et al. (2007) in the Manchester conurbation area has shown that urban green space and green roofs have significant potential to moderate temperature and decrease surface run-off of rainwater. Their modelling work suggests that increasing the green space cover by 10 percent in high-density residential areas and town centres could keep surface temperatures at or below the baseline 1961-1990 level for most of the century. However, removing 10 percent green cover from these areas, increased maximum surface temperatures by 7 to 8.2°C by the 2080s, assuming the highest emissions scenario. Greening roofs in town centres, according to their models, decreases temperatures by 6.6 to 7.6°C by the 2080s with the highest emissions scenario (Gill et al., 2007). Moreover, the use of green infrastructure may help reduce flood risk, retain surface water, reduce greenhouse gas emissions and energy demand for the cooling and heating of buildings (Gill et al., 2007; CABE Space, 2004). In addition to providing climate adaptation and mitigation benefits, green infrastructure offers a range of other functions in urban areas, such as health benefits, increase of amenity values, attraction of investments, increase in property values and reduction of noise and air pollution. The combination of these functions makes the use of green infrastructure an attractive climate adaptation strategy, since it simultaneously contributes to a sustainable development of urban areas (Baycan-Levent and Nijkamp, 2009; James et al., 2009; Gill et al., 2007). From a normative viewpoint green infrastructure could also be a preferred choice, since it does not increase energy demand (and thus frustrates mitigation efforts), it tends to be beneficial for vulnerable groups in society and improves social well-being for all citizens.

1.6. The spatial dimension of the governance of climate change adaptation

Many adaptation measures have spatial consequences at the local level, through grey infrastructural measures such as for instance dams, dikes and levees, or through green infrastructural measures such as for instance the dedication of land in former flood plains as conservation parks for water retention purposes, or the planting of trees for the provision of shade and cool areas. One of the first examples of a new and adaptive form of flood risk management is the Dutch 'Room for the River' programme, which has inspired many other countries to utilise (green) space for flood risk alleviation. These kind of space consuming adaptation measures can clash with other forms of land use, in particular in urban areas faced with an ever increasing development pressure. Therefore integrated responses at the local level are required and this is typically where spatial planning can play an important role in mediating competing demands for land use (Mickwitz et al., 2009; Lindley et al., 2007; Espace, 2007). While there are many definitions of spatial planning, in this research spatial planning is seen as a way of addressing the spatial or territorial dimension of sectoral policies and strategies (Wilson and Piper, 2008, p.136; Nadin, 2007, p.53). There is a common recognition of the role of the spatial planning policy field in adaptation to climate change. Through their effect on land use and spatial configurations in cities, spatial planning policies can affect resilience to the impacts of climate change (Davoudi et al., 2009; Bulkeley, 2006). Many national governments have acknowledged the role of spatial planning in the governance of adaptation. Based on the study of seven European National Adaptation Strategies, Mickwitz et al. (2009) conclude that most strategies recommend to integrate adaptation concerns into spatial planning policies and processes. This is endorsed by the EU white paper on adaptation, which calls for a mainstreaming of adaptation into other EU policy sectors, including spatial planning (EC, 2009, p.8).

There are significant differences in spatial planning systems across the world, since they are "deeply embedded in their socio-economic, political and culture context" (Nadin and Stead, 2008, p.35). Nevertheless, worldwide the spatial planning policy field has faced similar processes of change. A general trend towards decentralisation and a governance approach can be observed; for example through increased involvement of urban communities and through increased cooperation between public and private actors, leading to the creation of public-private partnerships (Friedman, 2005;

Bourne, 2005; Keller et al., 1996). Moreover many spatial planning systems across the world are moving towards a more “comprehensive integrated approach” of horizontal and vertical integration of spatial policies across sectors and jurisdictions (Nadin and Stead, 2008; Wolfe, 2005). A spatial principle which has gained momentum throughout the (developed) world is that of urban containment in order to combat urban sprawl and spare the country side. In Europe one refers to the ‘compact city’ as the “city of short distances” (EC, 1999, p.21), endorsed by the European Spatial Planning Perspective. In North America a similar guiding principle has been introduced in the form of ‘smart growth’ policies (Amborski, 2005). Supported by ‘Greenbelt’ policies, this smart growth/compact city principle has led to a growing emphasis on the need for more intensive development within urban areas to safeguard green space in the surroundings of cities. However, it has also led to a considerable loss of green space within cities. This critical dilemma has been expressed by Jim (in Baycan-Levent and Nijkamp 2009, p.2) as follows: “a compact city becomes the antithesis of a green city”. This gradual loss of urban green space reduces nature’s capacity to absorb or control the impacts of climate change, as a result of which the vulnerability of cities to these impacts increases. On the other hand, the vulnerability can be decreased through spatial planning by protecting and enhancing urban green space.

1.7. Knowledge gaps in the governance of adaptation

Given the critical role that spatial planning could play in the governance of adaptation, it is unfortunate that its capacity to actually do so has not yet fully developed; in all European countries studied by Mickwitz et al. (2009) and Swart et al. (2009) the integration of adaptation considerations into spatial planning is limited to the general level of policy formulation and still lacks concrete instruments and measures for actual implementation. The ESPACE program has claimed the lack of institutional frameworks to support adaptation to be a major barrier to the governance of adaptation by spatial planning (Espace, 2007). Moreover, in many countries climate change adaptation has been treated primarily as a water management or flooding issue, leaving out other important aspects of adaptation and therefore leading to partial solutions (Mickwitz et al., 2009; Nieuwaal et al., 2008; Wilson, 2006). Based on an extensive literature study into publications that address urban climate change issues, Nieuwaal et al. (2008) conclude that climate change has so far not had much impact on urban planning, although a sense of urgency is shared by most publications. Despite the recommendations of policy makers on how the role of spatial planning should be shaped (see for example the ESPACE decision support guidance with 14 recommendations to incorporate adaptation within spatial planning mechanisms at local, regional, national and European levels), the knowledge on how capable this policy field is to actually fulfil this role appears to be lacking and no research on this topic has yet been performed. In other words, knowledge as to the governance capacity of the spatial planning policy field to climate green cities and the governance conditions needed to fulfil this role is lacking. The hypothesis is that the governance capacity of spatial planning is a necessary precondition for the successful governance of adaptation to climate change; hence the bigger the capacity, the more successful the governance of adaptation will be, which in turn influences the effectiveness of green infrastructural measures. For the purpose of this research governance capacity is defined as the degree to which a public-private network of actors is able to resolve societal issues by applying principles of good governance (further elaboration will be given in chapter two).

In sum, according to scientists and policy makers spatial planning offers potential for the governance of adaptation, and green infrastructural adaptation measures offer a no-regret solution. On the other hand, the example of the compact city shows that such a dominant normative spatial concept could be in the way of these governance processes. Given the very young development of adaptation policy in general and the use of green infrastructure as an adaptation measure in particular, it would be relevant to gain insights into the governance capacity of the spatial planning policy field to climate green cities and identify its main opportunities and barriers. This would provide valuable insights for local governments in urban areas into the governance conditions needed for successful governance processes in adaptation to climate change.

1.8. Research design

1.8.1. Research objective, scope and questions

The aim of this research is to gain insight into the governance conditions of the spatial planning policy field for climate greening cities, by analysing and comparing its governance capacity and its key barriers and opportunities for climate greening London, Rotterdam and Toronto.

Considering the early development stage of adaptation policy, it is still too premature to study the actual governance capacity, based on the outcome and impact of these policies. These cities, frontrunners in adaptation planning, have just started to formulate their adaptation strategies and programmes, and most of these strategies have not yet been (fully) implemented, let alone that their results can be analysed. Therefore this research has focused on the potential capacity, taking into account recent governance developments and policy intentions as far as known at the time of research. If described in terms of the Underdal (2002) model of assessment objects in terms of output, outcome and impact, this research has studied the output level, by analysing the planned programmes, activities and measures of these cities. This has the advantage of providing insight into the more practical side of the governance of adaptation, rather than strictly doing a theoretical exercise. Furthermore, this research is delimited to 'planned adaptation', which means that those policy initiatives and actions are analysed which are anticipated and deliberately planned by the local government, as opposed to those that happen autonomously, for example by citizens who use air conditioning to combat heat stress (Füssel, 2007; IPCC, 2007). Since (local) governments so far have been the primary actors in planned adaptation, this research focuses on their role specifically, although the importance of private actors in spatial planning processes is recognised and taken into consideration, in particular with respect to public-private partnerships. Finally, this research focuses on green infrastructure as an adaptation measure with spatial dimensions. It is realised that this is a normative choice, and that there may be other adaptation measures which effectively deal with mitigating the impacts of climate change. Green infrastructure consists of green space from small to large scale: at the level of buildings in the form of trees, green roofs and green walls, at the level of neighbourhoods in the form of small parks, playing fields, allotments and other green open spaces, at the city level in the form of large metropolitan parks and an interconnected network of green open spaces throughout the city. The following central research question has been formulated:

Which conditions contribute to the governance capacity of the spatial planning policy field for climate greening cities?

The sub-questions, which build up to this central question, are as follows:

- *What are the critical aspects of the governance capacity of the spatial planning policy field for climate greening cities?*
- *Based on these critical aspects, what is the extent of governance capacity of the spatial planning policy field in London, Rotterdam and Toronto for climate greening their cities, and what are the main barriers and opportunities to this governance capacity?*
- *What are the main similarities and differences in the governance capacities and their barriers and opportunities among these cities?*
- *What can be learnt from this comparison and which critical aspects can be relatively easily improved to enhance the governance capacity?*

1.8.2. Scientific and societal relevance

Adaptation to climate change is a relatively new policy field, which has operated in the shadows of mitigation policies, focusing on reduction of greenhouse gases and energy efficiency. Scientific research on climate change adaptation is still in its early stages of development and so far has been dominated by natural science, mainly through climate modelling and scenario building regarding the extent of climate change and its potential impacts on water resources, flood risk, human health, biodiversity etc. This is an ongoing research agenda, in an attempt to fill the immense knowledge gap and reduce the uncertainty with respect to the ecological dynamics of climate change. Recently this one-sided scientific focus is shifting towards a sustainable development perspective, in which socio-economic aspects are included (Biesbroek et al., 2009). Social scientists have started to get an interest in climate change adaptation policy, its policy instruments and its governance arrangements. However, so far there has been little research regarding the institutional dimensions of the governance of adaptation (Gupta et al., 2008). Moreover, a recent literature study on climate change adaptation and governance has shown that publications in the field of urban planning and its dealings with adaptation strategies are still quite limited (Nieuwaal et al., 2009). Nieuwaal et al. (2009, p.26) conclude that extensive knowledge of practical experiences needs to be built, for example by comparing case studies, so that lessons can be learnt and good and bad practices can be shared. This research is meant to contribute to building such knowledge regarding the governance capacity of the spatial planning sector for adaptation to climate change in urban areas. It is hoped that the knowledge generated by this research will not only help in building social scientific knowledge in the field of the governance of climate change adaptation, but will also generate practical knowledge and lessons for policy makers in cities, dealing with climate change and green infrastructure as a means to mitigate its impacts.

1.8.3. Research perspective

This research is based on the hypothesis that the governance capacity of spatial planning is an important precondition for the successful governance of adaptation to climate change and ultimately for the effectiveness of green infrastructure as an adaptation measure. In order to analyse and compare the governance capacity of the three cities, a framework of analysis has been developed. The theoretical basis for this framework stems from governance literature, and is supplemented with literature on the governance of adaptation to climate change, as well as on urban green planning. More in particular, the conceptual model of governance capacity from Nelissen et al. (2000) and of adaptive capacity of Gupta et al. (2008) are used as a starting point, to which specific critical aspects for climate change adaptation and green policy in urban areas haven been added, derived from the literature mentioned above. Together this leads to a framework of analysis as depicted in figure 1.2., in which the governance capacity is broken down into five sub-capacities. Chapter two provides the theoretical background of this framework, as well as the detailed description of the framework and the underlying indicators, which have been used to “measure” the governance capacity of the three cities.

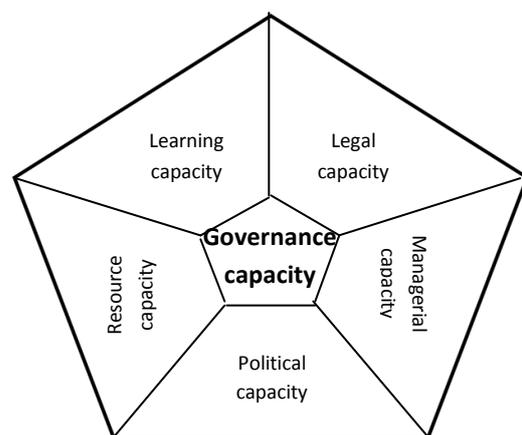


Figure 1.2.: framework of analysis for governance capacity inspired by Nelissen et al. (2000) and Gupta et al. (2008)

1.9. Research methodology

The research strategy chosen, is qualitative by means of a cross-national comparative case study approach. Case studies deliver concrete context dependent knowledge suitable for social scientific research, which deals with the analysis of complex contradictory social situations where the boundaries between the object of study and the context are blurred, as is the case for this research (Flyvberg, 2006; van der Zouwen, 2006; Campbell, 2003). A comparative case study approach is a commonly used strategy to increase the validity of a research, since additional cases can provide greater weight to the conclusions (van der Zouwen, 2006; Campbell, 2003). Comparative research is very common in spatial planning literature, for instance to examine a transnational spatial planning policy in different national contexts with different spatial planning traditions in order to take account of context dependency, to advance planning theory or to improve planning practice in the form of lessons drawing (Sykes, 2008; Dühr, 2008). *Cross-national* comparative research allows the exploration of differences in underlying planning systems and governance arrangements (Dühr, 2008). Along these lines, this research aims to learn lessons from experiences in cities with a common agenda, but with different contexts. In order to achieve this, an in-depth study is conducted of the governance capacity of each city in their respective governance and spatial planning context, after which they are compared and contrasted for similarities and differences. This type of research delivers a *horizontal comparative* perspective. Next to this a *top-down* perspective is provided through desk-research, by analysing the content of key policy and strategy documents relevant for each city in the field of adaptation planning, water management and green infrastructural planning from the national to the local administration levels. In total 95 official documents were analysed. A document list can be found in appendix 1. A *bottom-up* perspective was generated through field research in the form of 33 in-depth and semi-structured interviews: 11 interviews of an hour or longer with 13-14 stakeholders in each city. Respondents were officers of various government divisions at the local and regional level, complemented with some representatives from market parties or civil society. Most respondents were identified with the snowball method. Appendix 2 gives an overview of the respondents and their functions, appendix 3 contains the semi-structured interview guide, to give an idea of the set of questions which were used to steer the conversations. Figure 1.3. visualises the research set-up with the three complementary perspectives, which together should lead to a robust analysis of the governance capacity based on a common framework of analysis.

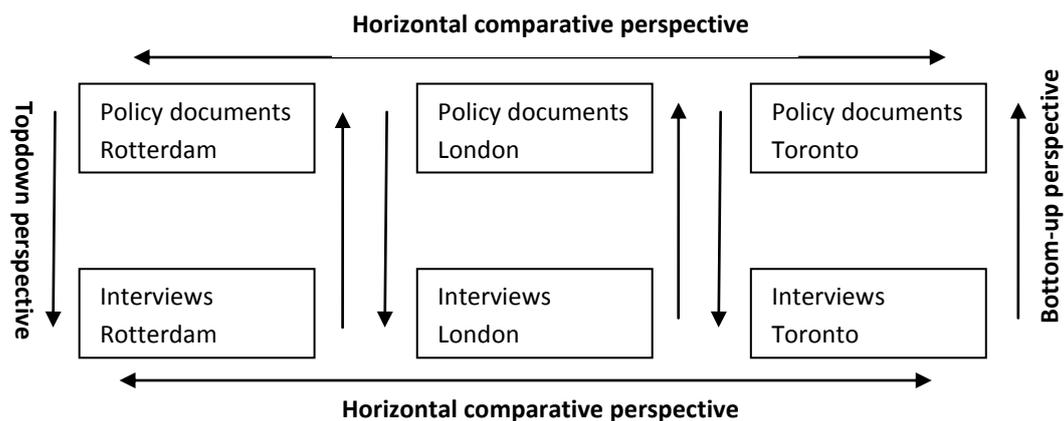


Figure 1.3.: research set-up based on three perspectives

At the end of each interview respondents were asked to give their perceived key opportunities and barriers to the governance capacity, based on the five sub-capacities. While no definitions were given in advance of these abstract terms, an opportunity was generally interpreted as a chance for increasing the capacity and a barrier as the opposite: something that decreases or obstructs the capacity. This also means that the same thing can be an opportunity for one and a barrier for another

respondent, although this kind of ambiguity rarely occurred in practice. Based on the chosen analytical framework, opportunities and barriers could be both material (money, staff, technology) and immaterial factors, such as institutional and contextual factors.

In addition to stakeholder interviews, expert interviews were conducted to get a helicopter view prior to the fieldwork in the three cities. Four interviews were held with spatial planning experts and practitioners in the field. This was to get an idea of some of the key themes and issues in spatial planning related to climate change, which helped to prepare the interview guide and to steer the interviews, based on these important themes. Two additional expert interviews were held with scientists in the field of urban governance from local universities, in order to become more acquainted with the governance arrangements for London in England, the United Kingdom and for Toronto in Ontario, Canada.

In sum, the research can be divided into the following chronological phases:

1. Design of the analytical framework, based on the literature review and expert interviews
2. Fieldwork in the cities: content analyses of official documents and stakeholder interviews
3. Comparative analysis and conclusions.

In total, the following information sources were used for this research:

- Literature on the governance of adaptation, adaptive capacity and green planning, which served as the theoretical basis for the development of the framework of analysis.
- Literature on spatial planning, with a focus on the planning systems of The Netherlands, United Kingdom and Ontario, Canada, which provided the contextual information for the case studies.
- Officially approved policy and strategy documents, such as spatial plans and acts, adaptation strategies, water management plans and urban greening plans at all levels of government (from national to local), in order to provide the top-down perspective.
- Stakeholders involved in spatial, adaptation and green planning, and water management, in order to generate a bottom-up perspective.
- Experts of spatial planning theory and practice, and of urban governance, in order to gain a helicopter view on the one hand, and specific contextual information on the other hand.
- Grey literature such as staff reports, internal memos etc. from local governments, as well as research reports and advice notes from specialised government agencies, spatial planning institutions, NGOs, expert networks etc., to supplement the material for the top-down perspective and give further contextual information.
- Other media, such as internet sites, brochures, conference documents, special interest magazines.

Although the choice for a qualitative research design means that in principle generalisations cannot be made, the external validity of the research has increased as a result of the strategic sampling of cases (see next section) and the use of one common framework of analysis for these cases. The triangulation of research methods and sources has increased the internal validity of this research in terms of the trustworthiness of conclusions. Moreover, the case study descriptions of each city (chapters 3, 4 and 5) have been sent to ten respondents per city for factual verification. In total 17 respondents have provided valuable feedback on these case studies.

It is hoped that this research may identify patterns in the governance processes for adaptation and its barriers and opportunities, It is certainly not the intention to assess the cities against each other and do any distinctive statements on the cities, but to provide valuable lessons for other cities which are still in the scoping and designing stage of the governance of climate change adaptation.

1.10. Case study selection

Cities were chosen as items of analysis. The tensions created by the fact that the impacts of climate change are stronger in urban areas, that they represent the bulk of human and financial capital for their national economies, and that their green infrastructure is under continuous development pressure, make them very interesting cases to study. London, Rotterdam and Toronto were strategically selected as 'similar cases' from a top 15 list of candidates for a number of commonalities, in order to reduce the number of uncontrolled variables, so that patterns and universal relations might be found (Campbell, 2003; Pickvance, 2001). They are Western democratic cities, exposed to the processes of globalisation, neo-liberalisation and post-Fordism; an ever increasing concern for sustainable development; and similar shifts from government to governance (Allahwala et al., forthcoming). They face similar impacts from climate change as a result of global warming and changing precipitation patterns (drier summers and wetter winters). All three are considered frontrunners in the governance of adaptation; they have formulated a separate cross-divisional, city-wide adaptation strategy, and they made a start with the implementation of green infrastructural adaptation measures, in particular relating to green roofs. Furthermore all three cities are green in terms of their relative amount of green space. The growth of all three cities is contained by smart growth/compact city and green belt policies imposed on them by higher levels of government (Carter-Whitney, 2008), giving them similarly very high pressures towards further densification. Finally, all three belong to the 'C40 cities climate leadership' transnational network, of which Toronto is the chair and London the deputy chair. Nevertheless each city has its own specific governance and spatial planning context, leading to some differences in governance arrangements and spatial planning systems, as will become clear from the separate chapters on these cities. Their similar characteristics and yet different contexts make them interesting cases to compare in terms of their governance capacity and its barriers and opportunities. Ultimately this might provide insights into which conditions are necessary as a minimum for the successful governance of adaptation to climate change in urban areas.

1.11. Organisation of thesis

The thesis is structured along the following lines (see figure 1.4.). Chapter two provides the theoretical background and gives further explanation of the framework of analysis for governance capacity. Chapters three to five provide detailed case study descriptions of the governance capacity of each city. This is because an accurate descriptive analysis of each case study is necessary before the comparison can begin (Pickvance, 2001). Chapter six provides the horizontal perspective in the form of a comparative analysis of the governance capacity of the three cities, so that patterns might be discerned. Chapter seven answers the central research question, discusses the basic assumptions underlying this research, and provides a discussion around the limitation of the conclusions and recommendations for further research. For the convenience of the reader the references are inserted after each chapter; this is especially relevant for chapters three to five, since a lot of case specific literature has been used.

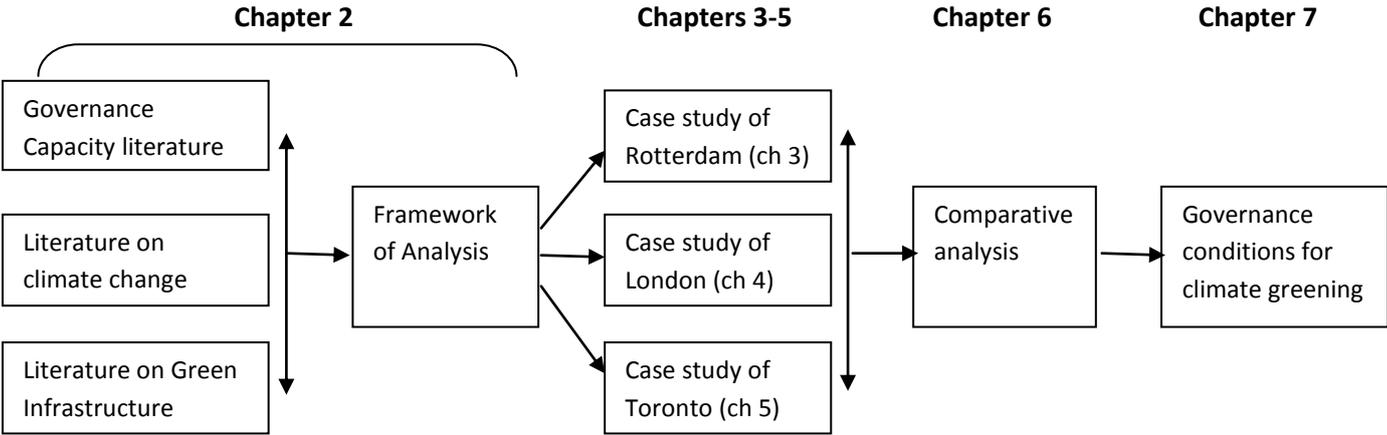


Figure 1.4.: structure of the thesis

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2. Governance capacity in theory

2.1. Introduction

Adaptation to climate change is a complex societal issue, characterised by a high degree of scientific uncertainty and ambiguity because of the lack of a sound and indisputable knowledge base, and by a high level of societal debate because of the different values of societal actors underlying both the problem definition as well as the potential solutions. Therefore it has been argued in the first chapter that adaptation can be defined as a wicked problem, which consequently can only be steered through a governance approach (van Nieuwaal et al., 2008; Lorenzini et al., 2007). In the past decades the concept of 'governance' has gone through a noteworthy revival which made it become a buzzword (Jessop, 1998, p. 30). There are many definitions of the term governance, ranging from narrow ("Governance is about managing networks", Rhodes, 1997, p. 217) to wide ("Managing rules by which public policy is formulated and implemented", also referred to as "meta-governance", Jessop, 1998, p. 29). Regardless of these varying definitions, there is a baseline agreement that governance refers to the development of governing styles in which the boundaries between and within public and private sectors have become blurred (Stoker, 1998, p. 17). Governance is also described as a new *process* of governing; the difference with government lies in the processes meant to achieve conditions for ordered rule and collective action (Stoker, 1998, p.17). The key difference in the processes is that governance uses governing mechanisms which do not rest on recourse to the authority and sanctions of government (Stoker, 1998, p.17). Instead, governance relies on network management where actors of various constellations from state, market and civil society interact with each other on the basis of interdependency and where responsibilities for the public domain are shared. Various types of arrangements of cooperation among the three spheres have emerged, such as co-management, interactive planning, partnerships amongst others (Glasbergen and Driessen, 2005). They have in common that a plurality of actors participate in dialogue, negotiate, try to reach consensus and create a win-win situation. Nevertheless, government actors still play a major role in governance processes, since they are the only institution mandated for the common good via democratic representation. Oftentimes unilateral action by the government in the form of regulations or market incentives is still needed to overcome dominant interests (Meadowcroft, 2007). Thus the state still plays a key role in governance processes, through managing the rules and patterns of coordination and organising the complex structures of hierarchies, network and markets (Kjær, 2004). The central role of the state in *environmental* governance is widely endorsed by scholars (Karkkainen, 2004); or as Blowers (1998, p.245) put it, the state should do 'environmental planning' in order to provide a guiding strategic framework for society. As was described in chapter 1, the state has so far dominated in the governance of adaptation, at least in the early stages of policy formulation that most governance processes for adaptation are currently in. Hence, while this research looks at adaptation planning from a governance perspective, in which adaptation planning is achieved by a network of actors from state, market and civil society, in this research the focus will be on the state as the primary actor which has acknowledged the collective interest of adaptation planning and has so far initiated most adaptation strategies, policies and measures.

Building on the first chapter, this chapter aims to provide further explanation and clarification of the analytical framework. This framework is based on the concept of governance capacity. Firstly an exploration will be given of how this concept is defined and described in literature. On the basis of this literature review, a new definition has been made for governance capacity suiting the purpose of this research. Consequently, the analytical framework will be applied to the governance issue of adaptation planning in urban areas. It will be explained which critical aspects are the focus of this research, and how these critical aspects are 'operationalised'. This will be done in the next sections.

2.2. Governance of adaptation, adaptive governance and adaptive capacity

In the literature on the governance of adaptation which has emerged in the last decade, several concepts have been used, such as ‘adaptive governance’ and ‘adaptive capacity’, in an effort to deal with the “inherent complexity and unpredictability of ecosystem dynamics” (Nieuwaal et al., 2008, p.15). ‘Adaptive governance’ is often used in literature regarding the adaptive management of ecosystems, which tries to include the social dimension to address the broader social context of ecosystem management, leading to “the adaptive governance of social-ecological systems” (Folke et al., 2005, p.444). Nieuwaal et al. (2008, p. 16) describe adaptive governance as “the governance context that enables, or at least legitimises, adaptive management strategies”. Lynch and Brunner (2008, p.2) stress the importance of using the experiences of local communities in dealing with extreme events and describe adaptive governance as a counterforce against the top-down scientific management of natural resources, by proceeding from the bottom-up with local communities integrating their knowledge into policies for the common good. They argue that climate policy still relies heavily on scientific management, while adaptive governance can help to reduce the vulnerability to the impacts of climate change.

Another term that has been related to adaptation to climate change is the term ‘adaptive capacity’. In its broader sense it centres around the ability of a system (institutions, organisations, communities etc.) to adapt to and/or cope with change (Pahl-Wostl, 2009; Wall and Marzall, 2006; Adger et al., 2005) or as defined by Gupta et al. (2008, p.7) “the ability of the community and the ecosystem to prepare for or cope with ... a natural or manmade disaster”. Another definition for adaptive capacity which focuses even more on the change aspect of social-ecological systems is from Pahl-Wostl (2009, p.355): “the ability of a resource governance system to first alter processes and if required convert structural elements as response to experienced or expected changes in the societal or natural environment”. IPCC (2001, p.6) has defined it more narrowly as “the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences”. Several scientists have attempted to develop an analytical framework for adaptive capacity. Some focus more on political and institutional capacity (see for example Mehrotra et al., 2009 and Gupta et al., 2008), others more on local community capacity (see for example Wall and Marzall, 2006 and Ivey et al., 2004).

This research builds on the concept of the ‘governance of adaptation’ and consequently presents a framework for analysing the ‘governance capacity’ to adapt to climate change. Based on the definition of ‘planned adaptation’ given in chapter one, I have defined ‘governance of adaptation’ as:

“the governance process that guides the planning of collective programmes and actions which aim to moderate the impacts of climate change”.

As such the governance of adaptation can be seen as a governance process for adaptation planning, while adaptive governance is more widely about the governance process of adapting to an ever changing social-ecological system which could be a climate system, but is not necessarily limited to that. Similarly adaptive capacity enables systems to adapt to changes in social-ecological systems. Therefore adaptive governance and adaptive capacity appear to put more emphasis on the change aspect and how a system can cope with change by means of important notions such as social learning processes (Pahl-Wostl, 2009; Hulme et al., 2007). Governance of adaptation and governance capacity as used in this research however, will look more holistically at governance processes, based on the principles of good governance. As such it is more in line with literature on good governance in relation to climate change with references to equity, legitimacy, accountability, effectiveness and efficiency for instance (Tanner et al., 2009; Adger et al., 2005). Good governance deals with concepts such as democracy, rule of law, decentralisation, discretion, equity and efficiency (Botchway, 2000, p.184). A number of good governance models have been developed (see for example UNESCAP, 2010 and Graham et al., 2003). These are multi-criteria models which aim to assess the performance of governance processes. The UNESCAP model of good governance has eight characteristics: it is

participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law (UNESCAP, 2010). The analytical framework for this research builds on the concept of good governance. A few relevant elements from existing frameworks of adaptive capacity have been added to complement the framework, since climate change is by definition also a form of change in a social-ecological system. This is covered in the next section.

2.3. Governance capacity as an analytical framework

In order to increase the internal validity and the reliability of this research a common framework of analysis has been developed that has been used for the descriptive analysis of each of the three cities. The hypothesis underlying this research is that the governance capacity of the spatial planning policy field is an important precondition for the successful governance of adaptation in urban areas and the effectiveness of green space as an adaptation measure, due to the fact that its effect on spatial configurations can affect the resilience of cities to climate change.

This raises the question what can be understood by 'governance capacity'. There is no common agreement on the concept of governance capacity; scholars have given various interpretations depending on their field of work, of which a few examples are given below. In general governance capacity can simply be described as the capacity of an organisation, institution, community or other entity for good governance (Graham et al., 2003). When good governance became a leading concept in public administration, many organisations such as the World Bank, the IMF and various UN bodies made interpretations of this concept, suiting their own purposes. The World Bank for instance has defined governance capacity as "the ability to coordinate the aggregation of diverging interests and thus promote policy that can credibly be taken to represent the public interest" (Frischtak, 1994, p.vii), putting much emphasis on democratic values in light of the situation in developing countries. In international relations theory, starting from a state centric point of view Knill and Lehmkuhl (2002, p.43) define governance capacity as "the formal and factual capability of public or private actors to define the content of public goods and to shape the social, economic, and political processes by which these goods are provided", in the understanding that both public and private actors contribute to the provision of public goods. Based on public administration theory Nelissen et al. (2000, p.22) describe governance capacity as the degree to which a (new) mode of governance is successful in combating or resolving societal problems. Taking elements of the definitions mentioned above into account, for the purpose of this research governance capacity is described as:

"the degree to which a public-private network of actors is able to resolve societal issues by applying principles of good governance".

With public-private network is meant a group of inter-connected actors, state and non-state (from the market or civil society) who together take the responsibility for governing a societal problem.

While the concept of governance capacity itself is subject to interpretation, its analysis and assessment poses yet another challenge. Like adaptive capacity it is a concept that is difficult to demarcate, to measure and for which to define robust criteria, since these are dependent on the problem that is being addressed and the theoretical approach taken by the evaluator. Based on their extensive work in the field of collaborative planning Innes and Booher (2002, p.17) regard collaborative processes as essential for building the capacity of a governance system so that it "can learn, experiment and adapt creatively to threats and opportunities", and consequently give criteria such as encouragement of diverse voices and interests, well-networked relationships, a distributed intelligence system, and a well-developed civil society. Bulkeley et al. (2009) analyse the capacity for urban climate change adaptation of cities in the South by reviewing climate knowledge, governance capacity (which includes good governance practices and financial and human resources), multi-level governance, networks and partnerships, and engaging communities. Their findings suggest that good governance is seen as a crucial determining factor of adaptation (Bulkeley et al., 2009, p.35). Nelissen

et al. (2000) have developed a more general conceptual model with three value systems, i.e. the legal, managerial and political system. According to them a governance mode needs to be both just, effective and democratic, even though these values can sometimes be contradictory. Therefore their hypothesis is that the governance challenge lies in balancing these three values (Nelissen et al., 2000). The *legal* value system represents the law and general principles of good governance; its values are justice, legality and the rule of law. The *managerial* value system involves the effective implementation and use of business management tools for public policy, with values such as effectiveness, efficiency and simplicity. The *political* value system concerns democratic arrangements and involves values such as societal support, political representation, accountability and transparency (Nelissen et al., 2000). This model, which incorporates important principles of good governance, is used as a starting point for the creation of an analytical framework for analysing and comparing the three cities. For this research legal capacity is interpreted as the formal regulations and policy principles spatial planning has at its disposal to steer adaptation planning by means of green space, as well as the environmental equity aspects of adaptation. With respect to the managerial capacity this research looks at the extent of integration of adaptation into spatial policy, of collaboration with other policy sectors and the use of integrative management tools as means to be effective and efficient in the governance of adaptation. The political capacity consists of accountability and political will. For the purpose of this research it is complemented with leadership, which is an important aspect of the capacity of institutions to adapt to climate change (Mehrotra et al., 2009), and in particular as agent of change, according to Gupta et al. (2008). While these three capacities are very relevant for good governance in general terms, the framework of analysis is complemented with two additional capacities that appear to be critical to the governance of adaptation to climate change and the governance of urban green space. Firstly, resource capacity is added, based on the fact that this appears to be a critical factor, both in literature on adaptive capacity (Gupta et al., 2008; Wall and Marzall, 2006) and on green planning in urban areas (Baycan-Levent and Nijkamp, 2009; Carmona et al. nd). It contains critical aspects such as economic, human and knowledge resources. Secondly, learning capacity in the form of social learning, continuous learning processes and the building on existing experiences appears to be quite crucial in literature on adaptive capacity (Pahl-Wostl, 2009; Gupta et al., 2008). For this research its two critical aspects are formulated as 'dealing with uncertainty' and the presence of 'continuous learning processes'. The above selection of sub-capacities and their critical aspects leads to the framework of analysis as depicted in figure 2.1. The inner circle represents the more general theoretical framework for the governance capacity of adaptation. The outer circle represents the more specific application of the framework to the governance of adaptation in urban areas by means of green space. As explained in the first chapter, the object that is analysed is the spatial planning policy field in the wider sense. It is not limited to the spatial planning actors and institutions *persé*. In congruence with the definition of spatial planning given in the first chapter, it can involve all actors or institutions that address the spatial or territorial dimension of their own policies and strategies. Since the spatial planning policy field is a rather abstract notion, this will mean that in the application of the framework this notion will be translated into the public and private actors involved in addressing the spatial dimension of policies and programmes that are meant to make the urban area more climate resilient.

A set of indicators has been developed in an effort to "measure" each critical aspect per sub-capacity in a qualitative assessment process. The next section will give a detailed outline of each sub-capacity, its critical aspects and their indicators based on the literature review and the feedback from the expert interviews.

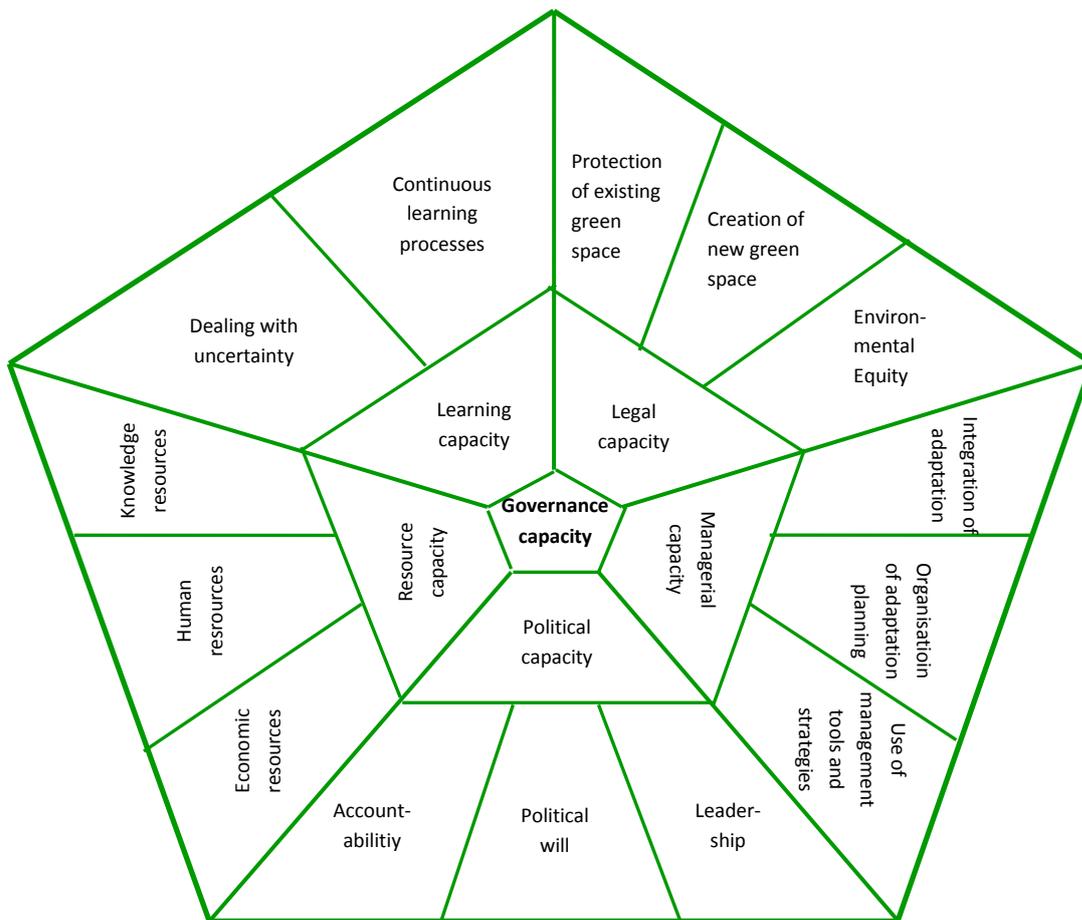


Figure 2.1. Framework of analysis for governance capacity with the critical aspects per sub-capacity.

Inspired by Nelissen et al. (2000) and Gupta et al. (2008)

The inner ring is the general framework for governance capacity, the outer ring is a further specification of governance capacity, geared towards the issue of adaption in the urban environment by means of green space.

2.4. Operationalising the governance capacity framework

2.4.1. Legal capacity

According to Nelissen et al. (2000) the *legal* value system represents the law and general principles of good governance with values such as justice, legality and the rule of law. For the purpose of this research these values have been redefined into the following critical aspects:

- 1) regulative institutions to protect existing green space,
- 2) regulative institutions to create new green space, and
- 3) environmental equity.

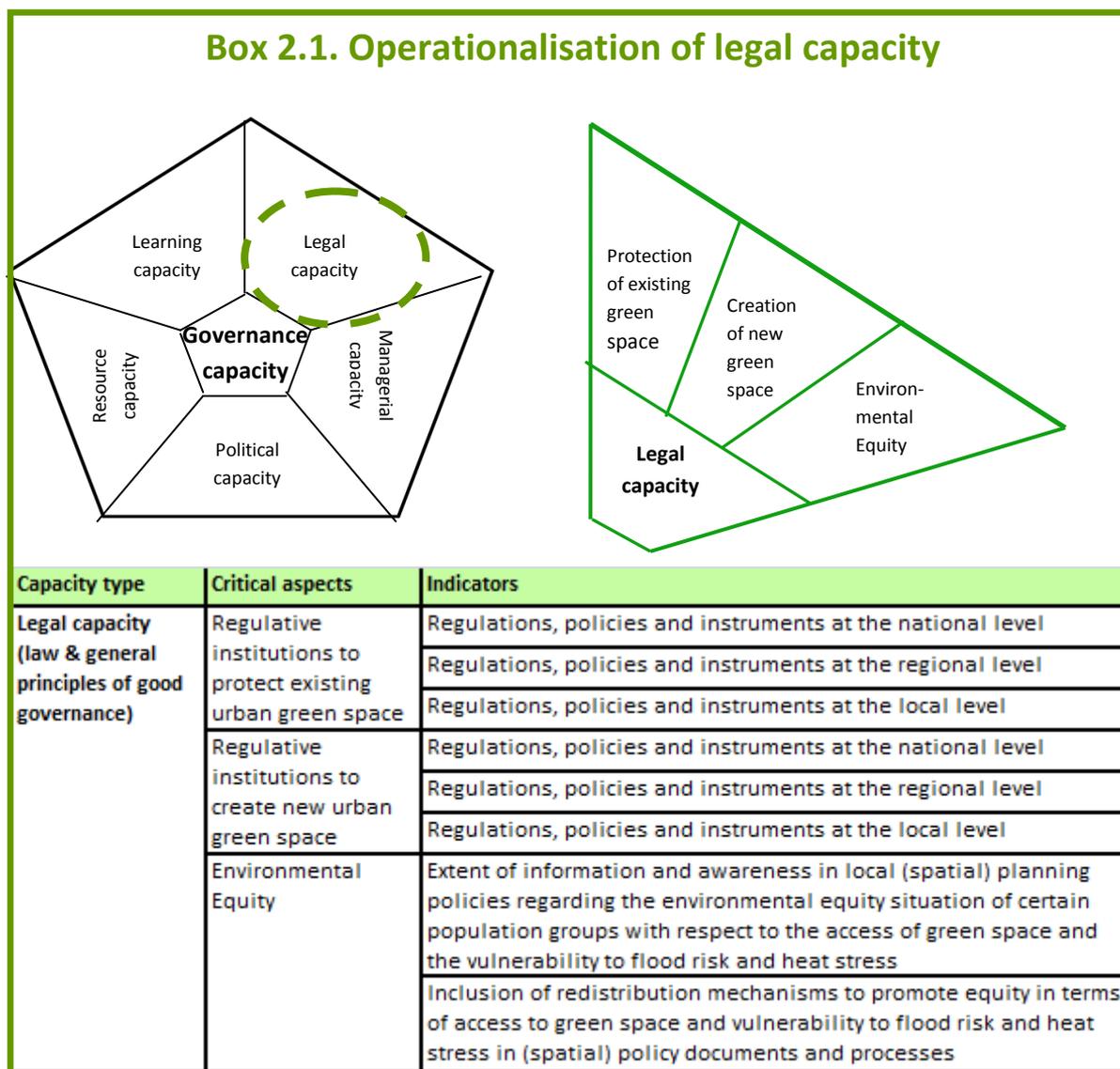
Regarding the first critical aspect, it is essential that there are legal and spatial planning instruments as rules of behaviour in order to protect *existing* green space. In the context of this research regulative institutions should be interpreted as the formal (legal structures, regulatory frameworks) and informal rules (principles and norms) that govern the behaviour of actors (Gupta et al., 2008). Spatial instruments, which regulate land use for example through zoning plans or (by-)laws, are seen as a special form of legal control. While they are primarily effective in case of development, they can also have a signalling function for further sustainable policy making (Glasbergen, 1992). These formal and informal rules to protect existing green space are critical because they can prevent cities from becoming more concrete and impervious, thus preventing cities from becoming even more vulnerable to extreme surface water run-off and flooding in times of excessive rainfall, as well as to extreme heat stress in times of high temperatures. The indicators used to measure the strength of these regulative institutions are: 1) existence of regulations, policies and instruments at the national level, 2) existence of regulations, policies and instruments at the regional level, and 3) existence of regulations, policies and instruments at the local/municipal level. This multi-level governance perspective takes account of the complex, multi-layered policy making process that ultimately influences policy making at the local governance level; it also enables to check the extent of consistency of regulations among these governance levels.

Regarding the second critical aspect, it is essentially the same line of reasoning as the first one. The key difference here is that it involves legal and spatial planning instruments that can create *new* green space. This can be done either by designating land for the creation of playgrounds, allotments, parks etc.; or by multi-functional use of existing land, for example by adding green to roofs and walls, or by planting trees. This is also seen as a critical aspect because it can actually reduce the vulnerability of cities to the impacts of climate change by making the city less concrete and impervious. The indicators used to measure this critical aspect are similar to the previous aspect. The hypothesis underlying this critical aspect is also similar: the more and stronger these regulative institutions are, the higher the potential capacity is to climate green the city. The hypothesis is that the existence of regulative institutions to protect existing green space and create new green space is a necessary minimum condition for the governance of adaptation by means of green space. Without these institutions the climate greening of cities cannot be done.

The third aspect, environmental equity, is also seen as critical in the context of this research, in particular with respect to health issues related to climate change. In her dissertation work on the environmental equity situation in The Netherlands, Kruize (2007, p. 16) defines environmental equity in the material sense of the word as “the distribution of environmental burdens and benefits among socio-economic groups”. She prefers this term over the commonly used term of environmental justice because of the political sensitivity and normative stance of the word justice. This research follows the same line of thought, in the sense that the access of citizens to green space is seen as a material environmental benefit, while the exposure of citizens to flood risk from excessive rainfall and to heat stress from high temperatures is seen as a material environmental burden. Vulnerability to flood risk and heat stress is however, not only determined by socio-economic factors, but also by age: children and elderly are for example more sensitive to heat exposure. Thus multiple factors of deprivation (social class, minority status) in combination with age can lead to an inequitable situation in case of both access to green space (benefit) and exposure to flood risk and heat stress (burden). It

is common knowledge that green space contributes to social justice and health (Baycan-Levent and Nijkamp; Tzoulas et al., 2007; Brown and Grant, 2005), while access to green space is often correlated with social class: the more wealthy a citizen, the more likely the citizen is to live in a low density area, and the more likely the access to green space is for this citizen, at least according to the literature (and thus research) from the USA (Jones et al., 2009; Sister et al., 2008; Patz et al., 2007; Frumkin 2005); consequently this citizen is potentially also less vulnerable to heat stress and flood risk. Nevertheless, also Kruize (2007) found a correlation between high income groups and access to green space in her Dutch research. The two indicators used to analyse environmental equity are 1) the extent of information and awareness in planning policies and processes regarding the environmental equity situation of certain population groups with respect to the availability of green space and exposure to flood risk and heat stress, and 2) the inclusion of redistribution mechanisms to promote equity in terms of access to green space and exposure to flood risk and heat stress in (spatial) policy documents and processes. The hypothesis is that the existence of information regarding the vulnerability of population groups will increase the chance of the creation of policies to resolve this inequitable situation, which in turn will increase the capacity to be just and fair in climate greening the city.

The complete overview of the operationalisation of legal capacity is summarised in box 2.1.



2.4.2. Managerial capacity

According to Nelissen et al. (2000) the *managerial* value system involves the running of a public administration like a business in order to be effective, including the use of business management tools for public policy. For the purpose of this research the following critical aspects have been defined as essential for effective adaptation planning:

- 1) Integration of adaptation and green planning into spatial planning,
- 2) Organisation of spatial, green and adaptation planning, and
- 3) Use of management tools and strategies.

With respect to the first critical aspect there appears to be consensus in both the literature on adaptation (see for example Füssel, 2007 and Adger et al., 2005) as well as policy documents from national governments and the European Union (see for example the studies of Mickwitz et al., 2009 and Swart et al., 2009 on national adaptation strategies in Europe, and the EU White Paper on Adaptation) that adaptation should not be dealt with as a stand-alone issue, but requires an integrated approach; ie. it should be integrated into other sectoral policies. The integration of adaptation into the policies, programmes and processes of other policy fields is also referred to as the “mainstreaming of adaptation” (Füssel, 2007, p. 272). Even more specifically many policy makers, spatial planning experts and scientists have pled for the integration of adaptation into the spatial planning policy field. In fact, the European Interreg programme ‘Espace’ (European Spatial Planning Adapting to Climate Events) was created for the sole purpose of putting adaptation at the heart of spatial planning (Espace, 2007). The same appears to be relevant for urban green planning. In their study of urban green planning in 23 European cities Baycan-Levent and Nijkamp (2009) conclude that urban green spaces are very undervalued in urban planning and that urban green planning needs a more integrated approach. Therefore the hypothesis is that the degree of integration of adaptation and green planning into spatial planning policies and processes determines the managerial capacity of spatial planning; so the more it is integrated, the better spatial planning is able to climate proof the city. The three indicators used to measure the degree of integration of adaptation and green planning into spatial planning are: 1) the extent of integration of adaptation issues, goals and measures in spatial policy documents from national to local, 2) the extent to which the urban planning process contains provisions to climate proof the city, and 3) the extent to which green infrastructure planning is a mature and integrated part of overall city planning and used as an instrument for adaptation.

The second critical aspect concerns the organisation of spatial, green and adaptation planning. All three require an integrated approach, since they touch many sectors and policy fields in society. Therefore they cannot be effectively undertaken in silos with actors that protect their turf, but require coordination and coherence across sectors. Adaptation being a wicked problem, interaction is necessary between different governance levels and among different actors, stakeholders and sectors in society. This coordination and coherence of adaptation and green planning becomes even more important in the face of institutional fragmentation, which refers to the fact that many different institutions are involved resulting in the fragmentation of responsibilities and funding. This is a pertaining issue in literature on both adaptation and green planning (McCarney, 2009; Heinrichs et al., 2009; Trohanis et al., 2009; Biesbroek et al., 2009; Penney and Wieditz, 2007; Baycan-Levent and Nijkamp, 2009; Carmona et al., nd). For instance, the study of Baycan-Levent and Nijkamp (2009) has shown that the number of departments involved in urban green planning determines very strongly the success level: if only one department is in charge of urban green planning the success level is much higher than when tasks, responsibilities and funding are fragmented across many departments. Consequently it is hypothesised that the level of coordination across policy sectors, governance levels and geographical areas determines the effectiveness of spatial, green and adaptation planning and thus the managerial capacity; the more coordination, the better. Likewise, the extent of fragmentation of these policy fields determines the effectiveness; the more fragmented, the more cooperation and coordination is needed. The indicators which measure the level of organisation of spatial, adaptation and green planning are: 1) the extent of fragmentation of

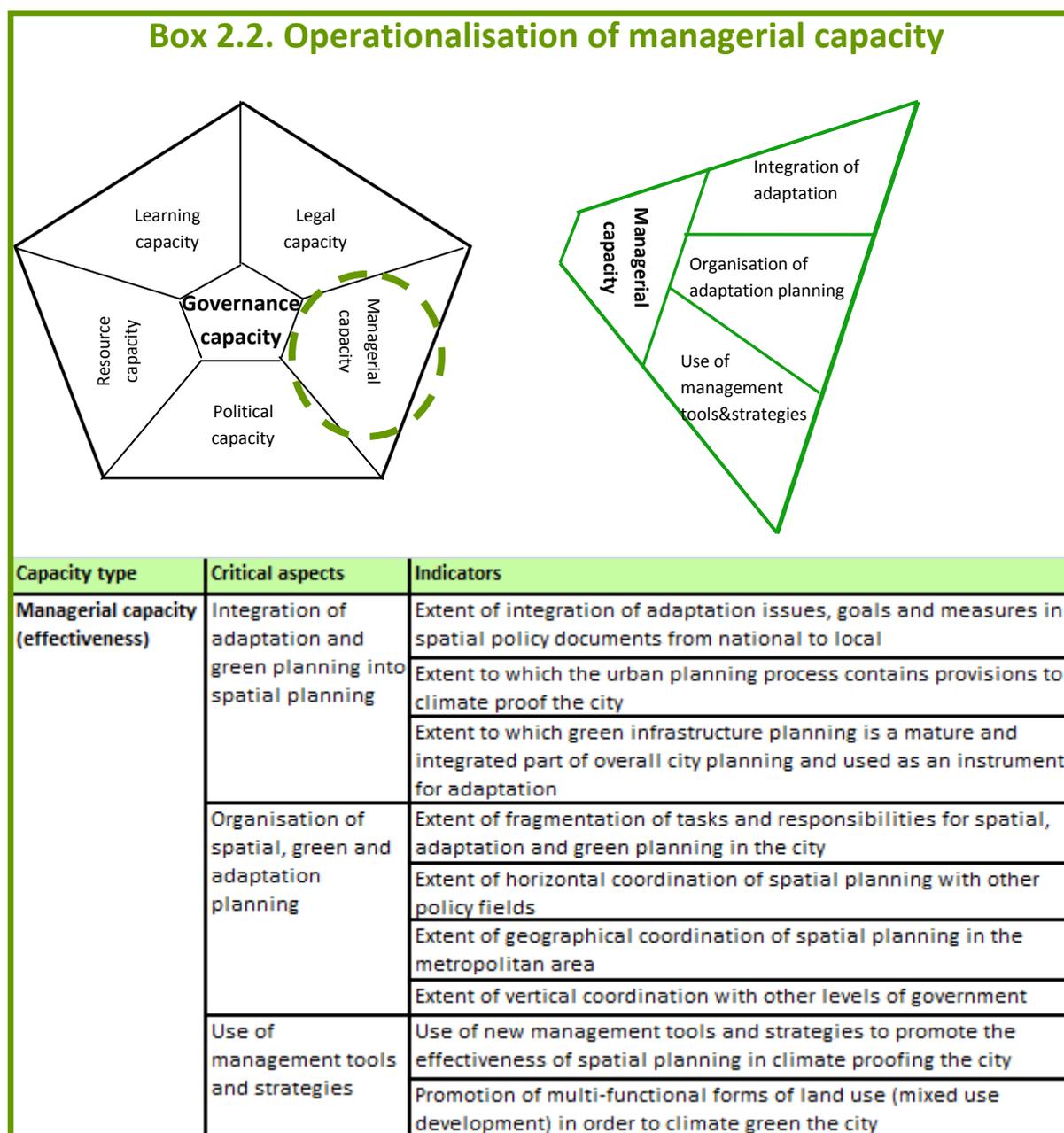
tasks, responsibilities and funding of spatial, adaptation and green planning, 2) the level of horizontal coordination across policy fields, 3) the level of vertical coordination across governance levels, and 4) the level of geographical coordination across the jurisdictional area. This last point is highly applicable to the London situation. The Greater London area is divided into 33 local authorities (see chapter 4) which have jurisdiction over their own borough. Also Rotterdam (Rotterdam Region) and Toronto (Greater Toronto Area) are part of a greater region as a result of which they have to cooperate with surrounding municipalities in order to achieve a coordinated and integrated approach for the region (see chapters 3 and 5).

The third critical aspect concerns the use of management tools and strategies. The idea behind this is that the public sector can learn from the business sector in how to effectively and efficiently govern a public issue (Nelissen et al., 2000). Silothinking and fragmentation are phenomena which are not exclusive to public administration, but arise in any (larger) organisation. Organisations consist of people managing other people in hierarchical relationships (Mintzberg and Van der Heyden 2000, p.2). Larger organisations apply the concept of specialisation in order to organise and manage the complexities of functions, products, processes etc., and to improve productivity and efficiency (Stoner, 1982; Webber, 1981). However, a hierarchical, top-down way of steering supported by (standardised) rules, processes and procedures as coordination tools does not suffice in the complex world of wicked problems. More flexibility is needed and a common way to do this in a business environment is via matrix structures, which cut across the vertical chain of command and are meant to promote interdisciplinary cooperation, to unite knowledge and authority and to define rules for managing differences. Common forms of internal structures are dynamic and organic project teams and programme units, in which functional specialists are united in specially appointed teams for as long as a particular need exists (Stoner, 1982; Webber, 1981). Other strategies to stimulate lateral coordination is via committees and task forces, or the creation of special functions which have an integrating role, such as project managers. Some forms of coordination go beyond the organisation itself and seek liaisons with external experts, firms, groups etc. in the form of partnerships. This idea has entered the field of public policy making together with the rise of governance and networks as mechanisms in complex and uncertain issue areas and has for instance been a key policy instrument for territorial and social cohesion in the EU (Bache, 2010). Partnerships between state and private actors have come to be known as Public-private partnerships (PPPs). PPPs came into existence in the 1980s in the context of New Public Management concepts in the public sector, which led to debureaucratisation and the promotion of privatisation in public services as examples of the implementation of economic sector management principles in the public sector (McQuaid and Scherrer, 2010; Dunn-Cavelty and Suter, 2009). Nowadays there are many forms of partnerships. Weihe (2008) has identified four approaches to PPPs: the urban regeneration approach, the policy approach, the infrastructure approach, and the development approach, the latter promoted by various UN organisations. The urban regeneration approach which focuses on specific projects and programmes in the area of urban development, and the policy approach which is more generally about public-private relations in different policy settings, are most applicable to this research. Thus the first indicator for this critical aspect is the use of management strategies and tools to climate proof the city. The underlying hypothesis is that the use of management strategies and tools such as project teams, committees, task forces and partnerships will increase the coordination and cooperation among the relevant actors and stakeholders and thus increase the managerial capacity; the more these strategies and tools are applied, the more coordination.

The second indicator is the promotion of multi-functional forms of land use. This is because multi-functional land use is, according to the experts interviewed, *the* solution to merging both the compact and the green city. Multifunctional land use (MLU) is a form of mixed or compact land use development and can be defined as "*the combination of different socio-economic functions in the same area*" (Vreeker et al., 2004, p. 289). It was introduced as a spatial planning concept to intensify the use of space and create synergies between the combined land use functions. Planning for a more open green urban area as a means to climate green the city, should not lead to increased emissions

of greenhouse gases and other air pollutants as a result of a less efficient infrastructure and longer (car) travel distances. Thus, in the competition for space in the densely built urban environment, multi-functional forms of land use which include green space are the only viable solution to both a climate proof and a sustainable city, as well as to avoiding or reducing greenfield development at the urban fringes. The hypothesis is that the active promotion of multi-functional forms of land use to climate green the city increases the effectiveness and efficiency of land use and thus the managerial capacity. A new and popular form of multifunctional land use that moderates excessive rainfall and heat stress, is the provision of green roofs on top of buildings. Therefore the analysis will pay special attention to this form of multi-functional land use.

Box 2.2. provides the complete overview of the managerial capacity and how it is operationalised.



2.4.3. Political capacity

In the model of Nelissen et al. (2000) the political value system concerns democratic arrangements; it involves values such as societal support, political representation, accountability and transparency (Nelissen et al., 2000). For the analytical framework of this research the following critical aspects have been selected:

- 1) Accountability,
- 2) Political will, and
- 3) Leadership.

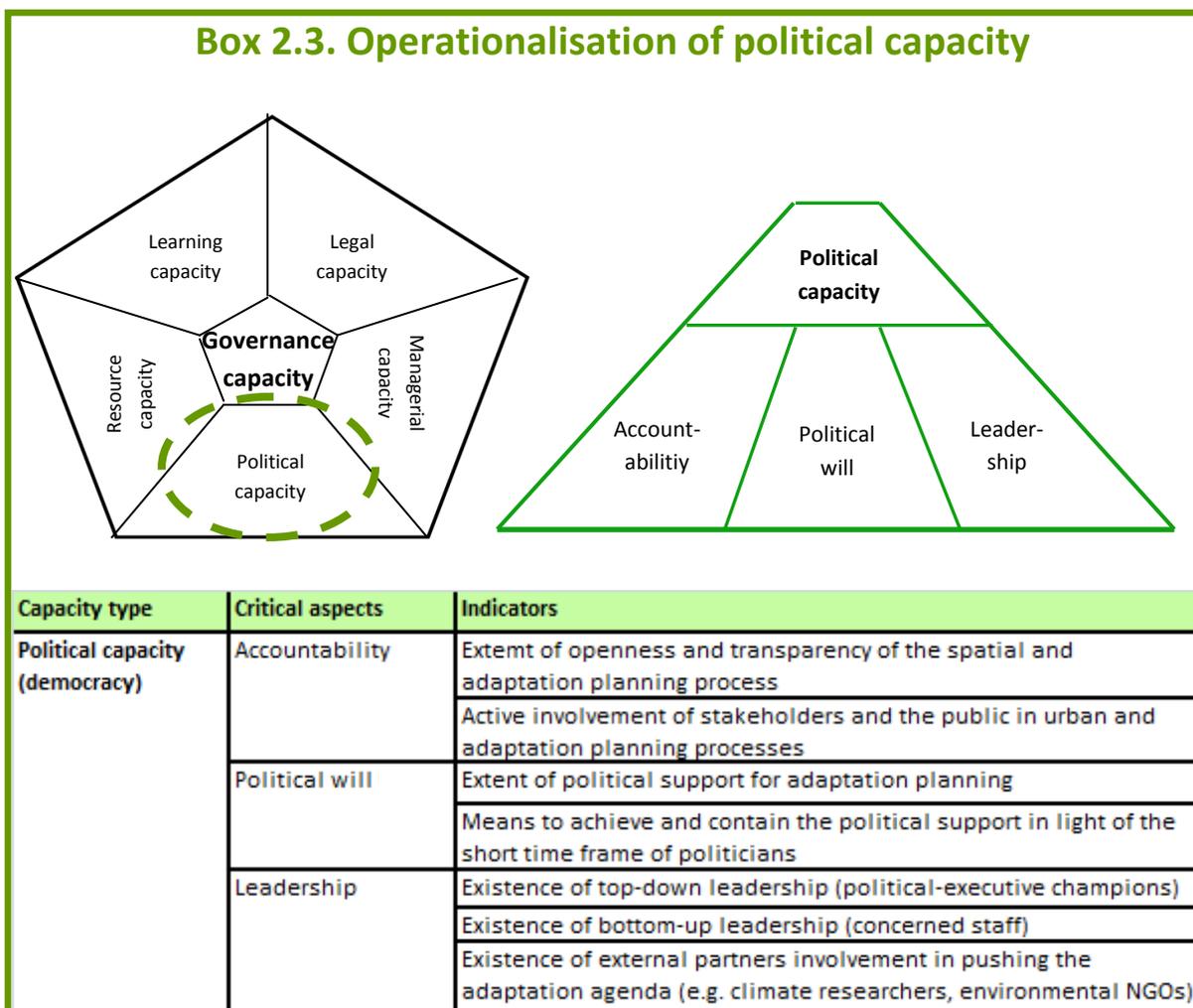
Any (good) governance model will contain accountability as one of its key characteristics; it will be a fixed item on the shopping list of ingredients for good governance (Botchway, 2000, p.161). In general it concerns the fact that policy makers of the state, private sector and civil society should be accountable to their stakeholders and the public at large; to those that will be affected by the policy (UNESCAP, 2010; Tanner et al., 2009; Graham et al., 2003; EU, nd). Accountability, transparency and participation are often grouped together. This is because accountability cannot do without transparency, in the sense that one should have access to all relevant information regarding both the content and the process of policy making, so that stakeholders and the general public can indeed hold policy makers accountable. This means that information is not only available, but also easily accessible. Accountability is equally dependent on a well represented participation of stakeholders and the public in policy making processes, either via direct representation or via legitimate institutions or organisations that represent their interests. These general principles of good governance have been made specific for this research, by zooming in on the processes of urban and adaptation planning. In Western democratic societies public participation and access to information in public policy processes are regulated by law (for instance through freedom of information acts and spatial planning acts). Considering the “wicked” nature of adaptation, a plurality of values and interests of diverse actors can be expected. Therefore adaptation planning processes should also involve a wide set of stakeholders (McCarney, 2009; Hulme et al., 2007). The indicators used for analysing the accountability in the context of this research are: 1) the extent of openness and transparency of the planning process, and 2) the active involvement of stakeholders and the public in spatial and adaptation planning processes. The hypothesis is that the more accountable spatial and adaptation planning processes are in these two respects, the higher the political capacity is.

Political will is another critical aspect of political capacity. Political support and policy guidance, is necessary for the development and implementation of spatial planning strategies that take adaptation into account (Wilson, 2006). Political commitment is seen as a precondition for effective environmental policy integration (Mickwitz et al., 2009; OECD, 2002). Since the integration of adaptation is a critical aspect of the managerial capacity, as was stated in the previous section, it therefore becomes important to have the political will to actually support this integration process. Political support is also necessary for the prioritisation of adaptation considerations versus other policy aims in the allocation of scarce resources (see next section). This appears to be rather critical in urban green planning (Baycan-Levent and Nijkamp, 2009; Carmona et al., nd), and is a phenomenon which tends to affect long-term collective interests such as adaptation in the face of short-term political electoral cycles (Biesbroek et al., 2009; Penney and Wieditz, 2007). The indicators for analysing the political will are: 1) the extent of political support for adaptation planning, and 2) the means to achieve and contain this political support. The latter is added in particular to address the short-termism of politics; it is not only critical to achieve political support (for instance as a result of an extreme event), but it is equally important how this support can be kept in times of change of political direction, so that it can be sustained over a longer time period. It is hypothesised that the higher and longer the political support is maintained, the higher the political capacity is.

Leadership is the third critical aspect of political capacity. It is often an important variable in frameworks for adaptive capacity (Mehrotra et al., 2009; Gupta et al., 2008; Ivey et al., 2004). Furthermore, if not explicitly cited as an indicator for adaptive capacity, it is regularly mentioned as an important challenge for the governance of adaptation (Heinrichs et al., 2009; Trohanis et al., 2009;

McCarney, 2009; Penney and Wieditz, 2007). The reason why leadership has received much attention in the limited but growing body of literature on adaptation is that it is seen as important for raising visibility and awareness of adaptation issues, for motivating others, for showing direction, for driving processes of change, for building consensus and for coordinating across government levels and sectors, in particular in light of the institutional fragmentation (see previous section). For the purpose of this research the following three indicators have been selected to measure leadership: 1) the extent of top-down leadership (political-executive champions), 2) the extent of bottom-up leadership (concerned staff), and 3) the extent of external partners involvement in pushing the adaptation agenda (e.g. climate researchers, environmental NGOs). The hypothesis is that leadership for adaptation can only be strong enough, if it manifests itself simultaneously at different and complementary levels; at the top in the form of one or a few highly visible political or executive champions (for instance a Mayor or alderman) as ambassadors; at the bottom in the form of dedicated and passionate city officers who do all the action on the ground and can be the glue among different city departments or divisions in the coordination of adaptation planning; from outside renowned scientists or other credible experts can often be crucial in providing legitimacy to adaptation action.

Box 2.3. gives an overview of the political capacity and its operationalisation.



2.4.4. Resource capacity

In addition to the three more general sub-capacities relating to good governance (legal, managerial and political capacity), two capacities have been added, so as to take account of the more specific conditions which appear to be crucial for the governance of adaptation and green planning.

Resource capacity, and in particular the lack thereof, is a recurrent theme in the literature on adaptive capacity (Gupta et al., 2008; Wall and Marzall, 2006), governance of adaptation (Bulkeley et al., 2009; McCarney, 2009; Füßel, 2007) and urban green planning (Baycan-Levent and Nijkamp, 2009; Carmona et al., nd). Wall and Marzall (2006, p. 378) go as far as to say that the availability of resources is the “sine qua non of adaptive capacity”. Defining the local community as the object of analysis, they take resources in the widest sense as the point of departure and then subdivide those into social, human, institutional, natural and economic. Gupta et al. (2008), who define institutions as the object of analysis, take a more narrow approach by subdividing resource capacity into authority, human resources and economic resources. While authority is very relevant from the perspective of institutions, in this research authority is regarded more holistically and is partly covered through the legal capacity, which provides power to policy makers in the form of rules and planning instruments. Instead, this research will focus more on the availability of knowledge resources as a critical aspect of adaptation planning, which will be justified below. Therefore the critical aspects of resource capacity are as follows:

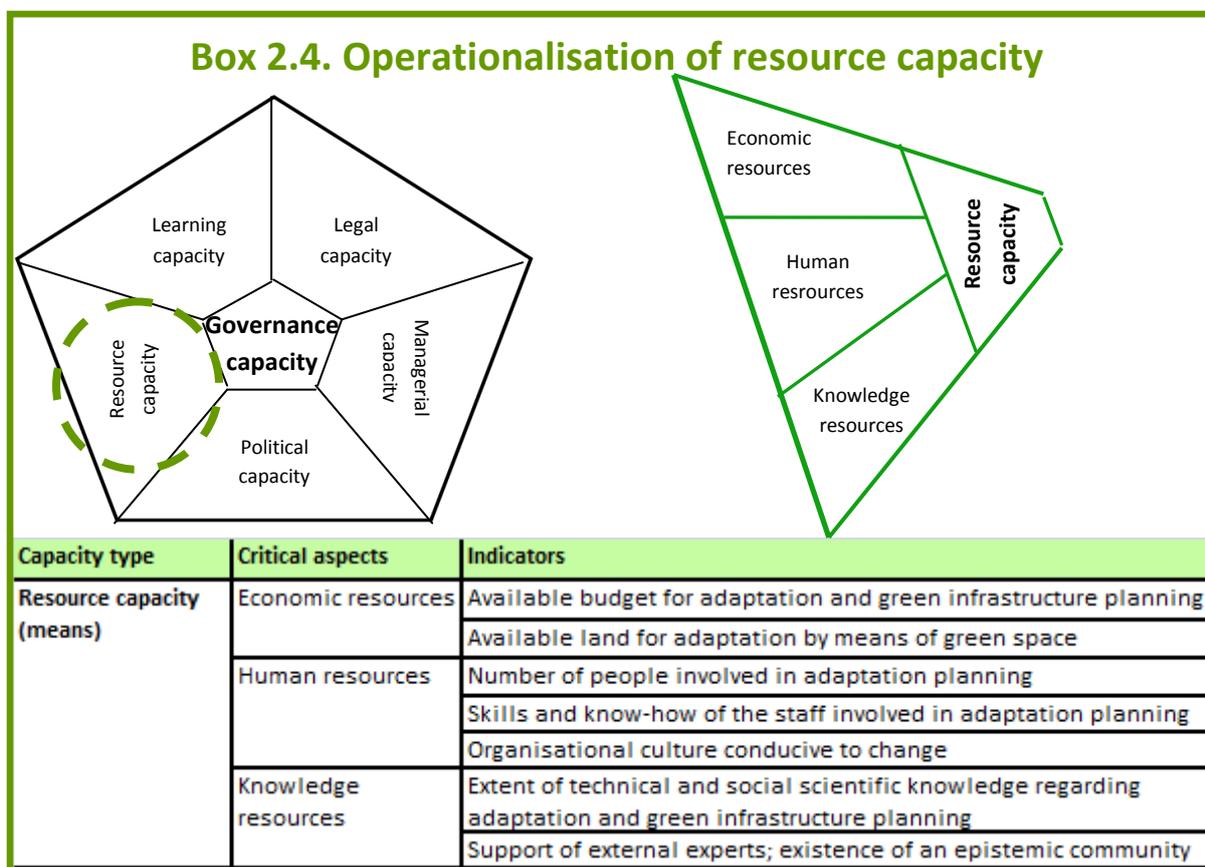
- 1) economic resources,
- 2) human resources, and
- 3) knowledge resources.

The first critical aspect, economic resources, speaks for itself. Without sufficient financial resources costly adaptation measures cannot be taken. Without sufficient financial resources urban green space cannot be properly maintained or enhanced, and new green space cannot be acquired. Limited and declining resources have been a major cause of the widespread decline and neglect of urban green space throughout the world (Baycan-Levent and Nijkamp, 2009; Carmona et al., nd). Without available land for green space, adaptation by means of green space is seriously hampered. Availability of land is even more critical in the urban environment, because of the high pressure on land. Therefore the indicators analysed for economic resources are: 1) the availability of financial budget for adaptation and green infrastructure planning and 2) the availability of land for green infrastructural adaptation measures. The hypothesis is that the more economic resources are available, the higher the resource capacity is.

The second critical aspect, human resources, is important in terms of both quantity and quality. Quantity has to do with the sheer number of people involved in adaptation planning. Or in other words it deals with the sufficiency of staff, dedicated to adaptation planning, as well as the part-time involvement of staff through project teams, committees, partnerships and other forms of collaborative organisation. Quality has to do with the skills, knowledge and experience of staff with respect to adaptation planning. Since many actors are new to the field of adaptation they are not used to consider climate change in their decision making (Füßel, 2007). The indicators used to analyse the human resources therefore are 1) the number of people involved in adaptation planning, 2) the skills and know-how of staff involved in adaptation planning, and 3) the existence of an organisational culture conducive to change. This last point has been specifically added based on the feedback in the expert interviews. Several experts indicated that this point might be particularly critical in the administrative bureaucracy of the civil service apparatus. This apparatus is organised through formal and hierarchical rules, procedures and reporting lines, which might seriously be in the way of adapting to new circumstances. Furthermore, this rather rigid vertical steering in the civil service might seriously hamper more lateral forces, which are needed for the coordination and integration of adaptation planning. Also here the hypothesis is straightforward. The more staff is available and knowledgeable regarding adaptation, and the more the civil service can adjust to changing circumstances, the higher the resource capacity.

The third critical aspect concerns knowledge resources. Lack of climate science and knowledge is often cited as problematic in literature on adaptation as well as by policy makers themselves. It is a major cause of the considerable uncertainty around climate change (see also next section). In fact, according to Adger et al. (2009, p.350) lack of knowledge is often used as an excuse for delaying adaptation action, thus making it a limit in itself. This lack of natural scientific knowledge also features in literature on the role of spatial planning in adaptation to climate change, especially regarding the precise local impacts of climate change (Espace, 2007; Wilson, 2006). Furthermore, Mickwitz et al. (2009) based on several case studies in six EU countries, found that research programmes which aim to increase adaptation knowledge are most often directed towards natural science-based knowledge regarding impacts on different policy sectors. The production of social scientific knowledge appears to be still in its infancy. External experts, scientists and consultants can help in building both natural and social scientific knowledge regarding adaptation planning. The more so, if it concerns a network of experts in the form of like minded scientists, also referred to as an “epistemic community” (Haas, 1992). According to Haas (1992) such a community exists when the experts have shared values, beliefs and views on appropriate policies, although they may have different backgrounds. In case of complex problems they can help with international policy coordination, and they can also support national governments through participation in think tanks, research bodies etc. (Haas, 1992). Thus, it is hypothesised that the support of external experts, or even the existence of an epistemic community around adaptation science, can further increase the knowledge resources and might even assist in the integration of adaptation policies. The indicators for the analysis of knowledge resources are: 1) the extent of technical and social-scientific knowledge regarding adaptation (and green) planning, and 2) the support of external experts in the preparation of adaptation strategies, or even better the existence of an epistemic community to support policy making for adaptation. The overall assumption is that the more knowledge, the higher the resource capacity is.

Box 2.4. summarises the operationalisation of resource capacity.



2.4.5. Learning capacity

The second additional capacity that is incorporated into the framework, is learning capacity. Learning capacity is often directly associated with adaptive capacity (Pahl-Wostl, 2009; Gupta et al., 2008, Hulme et al., 2007; Folke et al. 2005). Pahl-Wostl (2009) is very elaborate on the learning capacity of social-ecological systems being essential to their ability to cope with change and adjust accordingly. Learning is regarded “an exploratory, stepwise search process where actors experiment with innovation until they meet constraints and new boundaries” (Pahl-Wostl, 2009, p.358). Hence learning processes are regarded as the key elements for analysing adaptive capacity according to Pahl-Wostl (2009). Although less strongly pronounced, Gupta et al. (2008, pp. 11-18) see learning capacity as one of three basic qualities integral to adaptive capacity. Considering the importance these scholars have given to learning capacity, this capacity has been added as a fifth and final sub-capacity for analysing the governance capacity of adaptation, with the following two critical aspects:

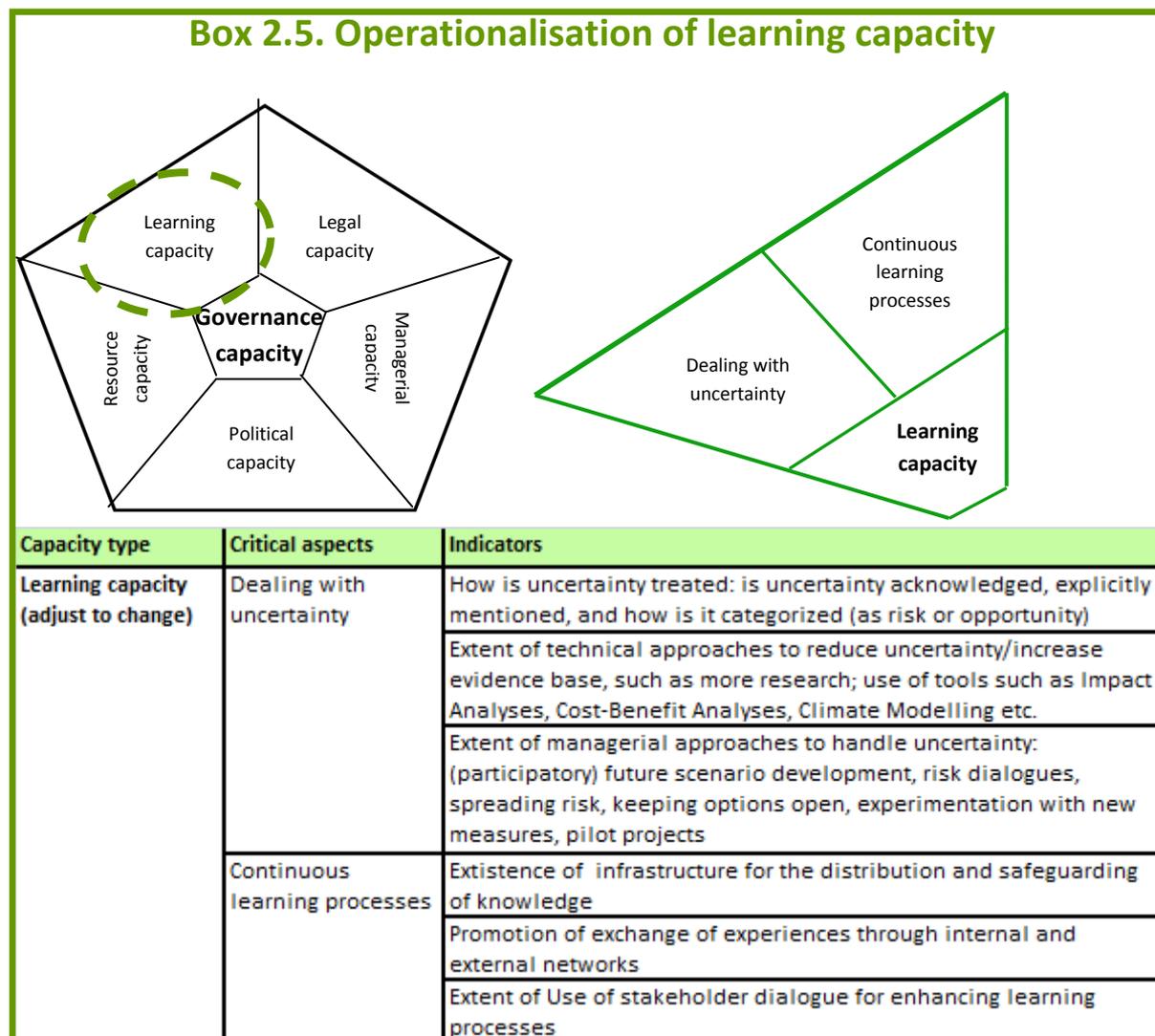
- 1) dealing with uncertainty, and
- 2) the presence of continuous learning processes.

Dealing with uncertainty is critical to learning in adaptation planning. In the uncertain context of climate change and its impacts on society one has to learn to live with this uncertainty. Uncertainty regarding future local impacts is another key constraint to adaptation found in literature (Adger et al., 2009; Nieuwaal et al., 2009; Füssel, 2007; Espace, 2007; Penney and Wieditz, 2007; Wilson, 2006). In her analytical framework for adaptive capacity, Pahl-Wostl (2009, p. 359) includes uncertainty as a separate category, due to the importance of dealing with uncertainty for adaptive governance. Füssel (2007, p.273) claims that adaptation planning shares many common features with risk management, especially because of this uncertainty. Therefore it is worthwhile, according to Füssel (2007), to compare adaptation with practices of established (disaster) risk management. Ultimately adaptation is about reducing the risks of climate change (as well as using the opportunities it provides) (IPCC, 2001). The indicators selected for analysing how uncertainty is dealt with are: 1) the treatment of uncertainty, 2) the extent of technical approaches to reduce uncertainty by increasing the evidence base, and 3) the extent of managerial approaches to handle uncertainty. The first indicator has to do with the basic attitude whether and how uncertainties are explicitly acknowledged and communicated (preferably with probability scenarios attached to them). Furthermore, it deals with questions such as: Are uncertainties viewed as an opportunity or a threat? Are uncertainties used as a reason for doing nothing or as a reason for increasing efforts as a result of the precautionary principle? According to Kinzig et al. (2003) it happens all too often that scientists are bad communicators when it comes to uncertainty, while politicians are not brave enough to make decisions under uncertainty. Therefore they propose to create special science-policy forums to deal with uncertainty (Kinzig et al., 2003). Indicators two and three are about how uncertainty is being dealt with. The second indicator concerns efforts that try to repress uncertainty by conducting more (natural-scientific) research, and by using assessment tools such as Impact Assessments, Cost-Benefit Analyses, Climate Modelling etc (Nieuwaal et al., 2009). The third indicator looks at efforts that rather take uncertainty as a given, embrace this uncertainty and try to manage this uncertainty to acceptable levels of risk. Examples of new approaches to manage uncertainty are (participatory) future scenario development, risk dialogues with stakeholders, spreading risk, keeping options open, experimentation with new measures, pilot projects etc. (Gupta et al., 2008). The hypothesis is that the more uncertainty is explicitly acknowledged and dealt with (either by reducing the uncertainty or by managing it), the higher the learning capacity is.

The second critical aspect concerns continuous learning processes. Multi-level learning processes are seen as critical for adaptive capacity by Pahl-Wostl (2009). Pahl-Wostl (2009, p. 359) assumes that social learning goes through consecutive phases of single, double and triple loop learning. Single loop learning is related to the traditional policy cycle of planning, monitoring and managing in the sense that strategies are improved step-by-step without questioning the underlying assumptions, while double loop learning does the latter explicitly by reframing the problem and the goal. Triple loop learning concerns a real transformation with structural changes to regulatory frameworks, value

structures, practices etc. She concludes that most attempts at the governance of adaptation to climate change are still dominated by single-loop learning (Pahl-Wostl, 2009, p. 363). Continuous learning processes are also recognised as important by Gupta et al. (2008, p. 18) in their framework for adaptive capacity of institutions, in the sense that these should encourage actors to learn through organised processes such as learning networks, infrastructural provisions such as internet, media, workshops etc, structures for monitoring, evaluation and feedback. Again the hypothesis is quite straightforward: the more continuous learning processes are fostered and promoted, the higher the learning capacity is. For the purpose of this research the following indicators have been selected to analyse continuous learning: 1) the existence of infrastructure for the distribution and safeguarding of knowledge, 2) the promotion of exchange of experiences through internal and external networks, and 3) the extent of use of stakeholder dialogue for enhancing learning processes. The first indicator is a necessity, because learning processes cannot take place without a proper organisation of information flows and knowledge dissemination among actors. The same goes for the second indicator, since learning networks allow for the sharing of best and worst practices among actors. The third indicator is added since it is believed that all actors, and in particular non-state actors, can be helpful in the generation of different kinds of knowledge for uncertain and complex problems and can facilitate the implementation of policy later on (Pahl-Wostl, 2009, p. 357).

Box 2.5. summarises the learning capacity and how it is operationalised.



2.5. The application of the framework in this research

This framework has been applied to first make a detailed analytical description of each city, and consequently to facilitate the comparison among these three cities. Per city each sub-capacity is described by strictly analysing the critical aspects according to the selected indicators, in order to allow for a robust comparison in the next stage. The analysis of indicators was done on the basis of a content analysis of key strategy and policy documents (sometimes complemented with grey literature), as well as the feedback in the semi-structured interviews with key actors and stakeholders. The interview guide followed the same structure as the analytical framework; per sub-capacity a set of key questions was asked. Section 2.4. has given a detailed outline of the theoretical foundation of the analytical framework. Nevertheless, for some indicators common sense has been used without a direct reference to literature.

Application of such a framework also faces some issues. Firstly, as with any framework this framework has the inherent problem that some form of overlap between critical aspects might occur. To a limited extent this was for instance felt to be the case between the aspects 'knowledge resources' and 'continuous learning processes'. On the other hand, it is also difficult to determine whether an important indicator has been left out, so that the framework might not be entirely complete. One such indicator could be the governance *culture*; for instance is one inclined to follow hierarchical steering from higher to lower government levels, and from governments to non-state actors? Or should governance culture rather be regarded as a contextual factor, which is the assumption made in this research? Secondly, there might be an issue in the potential subjective interpretation of the framework, based on hidden values underlying the framework. It is hoped that this is (partly) overcome by applying the framework not to one but to three similar cases. Furthermore, the three cities as well as the researcher are all located in Western Democratic countries with similar value systems. Thirdly, critical aspects such as 'environmental equity' and 'accountability' can be quite broad concepts which are difficult to 'capture' with indicators. I have tried to overcome this by selecting the really key indicators relevant to this research without trying to be complete. Lastly, this framework treats every sub-capacity and critical aspect with equal weight. While this is justified for the analytical and qualitative approach taken in this research (so that universal patterns might be found), it might require some form of weighting if used more as an assessment or evaluation tool.

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3.1. Introduction

Rotterdam is the second largest cities in The Netherlands and situated in the Dutch delta region. It lies in the province of Zuid-Holland, which is the most heavily populated and industrialised part of The Netherlands. Rotterdam has one of the largest ports of the world and accommodates a big petrochemical industry.

The municipality of Rotterdam consists of 600,000 inhabitants, while 1.2 million people live in the city region. Rotterdam is the greenest big city of The Netherlands; it offers 79 m² of green space per residence (Bezemer et al., 2002). three percent of its land is woods (1,000 ha), three percent is gardens (1,000 ha) en 10 percent is grass (3,000 ha); there are 640,000 trees in the municipality, which is about one tree per inhabitant (Rotterdam, 2009a). Rotterdam is leading in climate change policy in The Netherlands, both in mitigation and in adaptation. The Rotterdam Climate Initiative (RCI) was founded in 2007 as a public-private partnership and is linked to the international Clinton Climate Initiative network. RCI is a joint climate mitigation programme of the municipality, the Port of Rotterdam, Deltalinqs (consisting of private companies in the Rotterdam port and other industrial companies) and the Environmental Protection Agency Rijnmond (DCMR). Its bold ambition is to achieve a CO₂ reduction of 50% by 2025 (compared to 1990 levels), thus by far exceeding the national policy aim of 30% CO₂ reduction by 2050. In April 2008 Rotterdam Climate Proof (RCP) was added to RCI with the aim to make the city climate proof by 2025. RCP and the Rotterdam adaptation policy programme will be further elaborated upon in section 3.3.3. The first two sections of this chapter describe the spatial planning and adaptation policy context for Rotterdam, after which each of the five governance capacities of the spatial planning policy field will be analysed. The chapter will be concluded with a synthesis.

3.2. Spatial Planning Context

3.2.1. *The governance of spatial planning in The Netherlands*

The Netherlands is a decentralised unitary state. It has three levels of government: national, provincial and municipal. The Spatial Planning Act provides the regulatory basis for the division of planning tasks and responsibilities among the governmental bodies at the three levels. The latest Act of 2008 requires each body to make a spatial development perspective for its administrative jurisdiction in the form of a 'Structure Vision'. The Dutch planning system is based on a complete set of rules and principles that regulate land-use prior to decision-making (Nadin and Stead, 2008; Lanellis et al., 2003). It is known for its relative comprehensive, integrative character (Nadin and Stead, 2008) and is considered to be leading in the integration of environmental concerns into spatial policy (Runhaar et al., 2009). The spatial planning system is very mature, which is necessary in a country that faces extreme spatial pressure, in particular in the Western part of the country, where Rotterdam is located.

Since the early 1990s the national government started to decentralise responsibilities for spatial planning (as well as other policy fields) to the lower levels of government. The political view that "decentralised policy is better policy" has become dominant in the Netherlands according to Selnes and Kuindersma (2006, p.13). The central government imposes less regulation and involves lower levels of government, members of the public and market parties. The central government believes that a governance approach is essential because of the growing importance of and need for cooperation between different stakeholders in addressing spatial issues. The main reason behind the shift towards a governance approach is the lack of coordination and integration of sectoral policies (Termorshuizen and Opdam, 2005). Current national spatial policy, contained in the National Spatial Strategy ('Nota Ruimte', VROM 2004), reconfirms the departure from the restrictive planning discourse by promoting integrative spatial development at the regional level, by imposing even less regulation and by giving even more responsibility to the provincial government. The new motto symbolising the steering philosophy is "centralise what you must, and decentralise what you can" (VROM, 2004; Spaans, 2006, p.143). In addition, there is a shift from "imposing restrictions" to

“promoting developments” by adopting an area-dedicated approach (VROM, 2004). The concept of integrated area development (‘gebiedsontwikkeling’) gets a lot of attention as a means to achieve complex spatial projects with a multitude of societal interests (VROM, 2006). This is supposed to change the public-private balance in spatial policy and lead to the creation of public-private partnerships.

The decentralisation of spatial planning has resulted in a system where higher levels of government produce strategic frameworks for consecutive lower levels of government. Municipalities produce legally binding zoning plans and are in charge of the planning permission process. There is a strong tradition of consultation among government levels and the higher levels of government do have several means of intervention which they hardly ever use (Busck et al., 2008). The above description of the governance of Dutch spatial planning fits with the global societal trend towards decentralisation and governance structures in spatial planning.

3.2.2. Spatial policy for Rotterdam

The municipality of Rotterdam has to take the strategic planning guidelines of higher levels of government into account. The national spatial policies most relevant to the climate greening of Rotterdam, are the Compact City and Green Heart/National Buffer Zones policies, which have been guiding spatial development since the 1980s. The compact city policy requires 40 percent of new developments within cities’ boundaries (for the province of Zuid-Holland this percentage is even 80 for its urban areas); the Green Heart and National Buffer Zones aim to preserve the country side in between cities by excluding it from development. Together these policies aim to increase the density of Dutch cities so as to enhance their sustainability and to protect the surrounding country side. The indirect (unintended) effect however, is an ever increasing loss of green space within cities. This issue is acknowledged, but not addressed in the National Spatial Strategy (VROM, 2004). National government has devolved the responsibility for the green quality of the public realm to the provinces and municipalities; hence it is left to the lower levels of government to strike a balance between the built and the green environment (Kamphorst et al., 2008). By the end of 2008 the national government developed a new Structure Vision for the Randstad conurbation, which is the rim of the four largest Dutch cities, including Rotterdam. The Dutch government aims to create a green-blue Delta with metropolitan parks in between strong and compact cities. These parks should deliver nature and recreational services to urban dwellers and limited development is permitted if it strengthens these recreational services (VROM, 2008).

Regional policies which have an effect on the spatial planning of Rotterdam, are the Draft Structure Vision of the province of Zuid-Holland, as well as the Spatial Plan 2020 and Regional Blue-Green Structure Plan2 of the Rotterdam City Region. In the Dutch administrative spatial planning system a fourth non-formal government layer exists since 1994: the so-called city region, and Rotterdam has such a body. The Rotterdam City Region consists of the municipality of Rotterdam, as well as 15 surrounding municipalities. It is responsible for a number of regional policies for the wider metropolitan area. Although its authority is rather constrained by the latest Spatial Planning Act, together with the province it does have considerable influence on the spatial and green planning in the rural areas around Rotterdam. These regional spatial policy documents reconfirm the intensification (‘verdichting’) objective for Rotterdam, by requiring a further densification per hectare in the city. At the same time they call for a green-blue expansion of 6,000 hectares in the direct vicinity of Rotterdam through the creation and enhancement of regional parks for water retention and recreational purposes.

The primary municipal body responsible for city-wide spatial policy in Rotterdam, is the Service for Urban Planning and Public Housing (‘Dienst Stedebouw & Volkshuisvesting’). It has crafted the leading spatial policy document of the municipality of Rotterdam, i.e. City Vision Rotterdam (CV)(‘Stadsvisie Rotterdam’) from 2007. Interestingly it is not the formal Structure Vision of Rotterdam, as is required in the Spatial Planning Act. This status belongs to the Rotterdam Spatial Plan from 2001 (‘Ruimtelijk Plan Rotterdam’). Rotterdam intends to make structure visions for

specific areas in the city, rather than developing a new city wide structure vision. Despite its 'unofficial' status, the CV has been approved by council and is considered to be the guiding policy document in spatial planning in Rotterdam. It is closely tied with WaterPlan2, Rotterdam's integrated water management policy document, which was created in the same year by the municipality of Rotterdam in a joint effort with the water boards. In line with the strategic guidelines from higher levels of government the CV speaks about densification: building within city limits to meet its housing demand, while creating an attractive living environment for middle to higher income groups. In order to achieve this goal, the public realm (which includes green space) needs to be upgraded. The motto for green space is "less, but better" (Rotterdam, 2007a, p.75). It is realised that densification will lead to less green, but this should be compensated by more qualitative and visible green. The key challenges of the CV have been translated into 13 so-called 'VIP areas', which are integrated area development projects. The most prestigious project is the restructuring of the old harbour area into a huge new residential area in the heart of the city (project 'Stadshavens'). This project is used to experiment with building with water outside of the area protected by dykes. Another VIP project aims to create new green space in combination with a new business district in the northern part of the city (Rotterdam, 2007a).

3.3. Adaptation to Climate Change

3.3.1. Climate change effects

The key adaptation challenge for The Netherlands is flood risk: 60% of the country lies in flood prone areas, accounting for 70% of the Dutch Gross National Product. The Western part of the country is one of the most urbanised deltas of the world. Fortunately The Netherlands also possesses the highest flood defence standards in the world, with an expectancy of a flood event of once every 10,000 years (Kabat and Vellinga, 2005). Since the beginning of the 20th century Dutch temperatures have risen with 1.7°C and have increased twice as fast as the average world temperature (PCCC, 2009). The most recent modelling scenarios of the Dutch meteorological institute indicate the following major climate changes for the Netherlands by the year 2050 (KNMI, 2006):

- Temperature increase in summer between 0.9 and 2.8°C; in winter between 0.9 and 2.3°C;
- Increase in rainfall and intensity in winter between 3 and 7%;
- Decrease in rainfall in summer between -10 and +3%.
- Sea level rise: in 2050, 15 to 35cm; in 2100, 35 to 85cm; in 2200, 1 to 2.5m;
- Water discharge in rivers will increase in winter and decrease in summer time.

A recent study performed on behalf of the Dutch Delta Commission indicates an even stronger sea level rise, based on more progressive scenarios for global economic growth and use of fossil fuels: between 65 and 130cm in 2100, and between 2 and 4m in 2200 (Delta Commission, 2008).

It is expected that most Dutch cities will be even more exposed to extremes in heavy rainfall, owing to their location in the Western part of the country close to the sea. In addition, they will face even higher temperatures, owing to the UHI effect, although little is known still about the exact effect in Dutch cities (Rijke et al., 2009, Rahola et al., 2008). Two recent studies conducted by the Dutch research institute TNO have already shown an UHI effect of up to +7 to 12°C for the city of Rotterdam (Klok et al., 2009; Döpp and Albers, 2008). Specific climate modelling for the city of Rotterdam is currently underway; a Rotterdam Climate Atlas is planned to be ready in 2010 (RCP, 2008b). To summarize, the most important impacts for Dutch cities are considered to be: occurrence of the UHI effect, decrease of air quality as a result of heat extremes, increased urban flooding and increased drought (Döpp and Albers, 2008). Since Rotterdam is situated in the Dutch delta region, urban flooding is the area of most concern and thus water management is a key priority area in its adaptation policies. Additionally the salification of groundwater is foreseen to become worse as a result of climate change with impacts on urban green and agricultural land in and around Rotterdam.

3.3.2. National and provincial adaptation policy and the role of spatial planning

Dutch national government has made water an important structuring element in spatial planning; water management has been consolidated on the public agenda due to climate change (van Bommel and Kuindersma, 2008). This has resulted not only in infrastructural programmes for dykes and coastal defences, but also in the so-called 'Space for the Rivers' programme as a more adaptive strategy, which was launched in 1996 after two serious flood events in 1993 and 1995. This programme literally allows more space for the natural flow of rivers by reclaiming land for water retention purposes. So even before an explicit national adaptation strategy was formulated, adaptation policy existed in the form of water policy. Thus adaptation policy in the Netherlands is predominantly linked to spatial planning and water management. The National Adaptation Strategy (NAS), issued by the Ministry of Housing, Spatial Planning and the Environment in 2007 is a case in point; it is referred to as the National Programme for Spatial Adaptation to Climate Change, with the illustrative title 'Make space for Climate!' ('Maak ruimte voor klimaat!')(VROM, 2007a). The NAS emphasises integration of adaptation in other policy sectors, rather than the creation of a new, separate policy area. Not surprisingly, the two main policy sectors considered for integration are water management and spatial planning, as a direct result of the framing of adaptation as a water issue. As a consequence the attention for other adaptation themes is still rather limited (Swart et al., 2009; van Bommel and Kuindersma, 2008). The NAS does not specify responsibilities among government levels or sectors: implementation of the strategy is supposed to involve all relevant stakeholders including non-state actors, for instance through public-private partnerships. The strategy does not yet prescribe any specific actions; the intention was to publish a National Adaptation Agenda in 2009 based on stakeholder consultations, but to date this has not yet happened. No reference is made to green space as a potential water management or more generic adaptation measure (VROM, 2007a). The national Structure Vision 'Randstad 2040' for the Randstad conurbation describes how it should be developed into a premier sustainable and competitive region in Europe. One of four leading principles is 'living in a safe, climate proof, green-blue delta' and enhancement of the green-blue infrastructure is seen as an important theme for the realisation of this safe, climate proof delta (VROM 2008). Once again the dominant role of spatial planning in climate proofing is endorsed in this document.

The Dutch government also provides strong scientific support; it has initiated two big research programmes for adaptation. The first is 'Climate changes spatial planning' with the objective to enhance joint-learning between the spatial planning and climate change communities. A budget of €100 million is reserved for the period of 2004-2011. 'Knowledge for Climate' is the second research programme, with the aim to develop applied knowledge for climate proofing the Netherlands at the regional level, and with a budget of €100 million for the period of 2008-2013. Rotterdam has been identified as a hotspot for the development of a regional adaptation strategy in this programme.

Profound research has been conducted as to the regional climate effects by the province of Zuid-Holland. Detailed spatial maps are available, that focus on water quantity and quality issues (Zuid-Holland, 2008 and 2009a). Based on this knowledge an Action Programme Climate & Space ('Actieprogramma Klimaat & Ruimte'; Zuid-Holland, 2009b) has been developed, which will be executed through the Provincial Waterplan for water related affairs and through the provincial Structure Vision for spatial affairs.

3.3.3. Adaptation policy in Rotterdam

As was the case at the national level, adaptation policy in Rotterdam existed 'avant la lettre', although it was framed as water policy. The Rotterdam Architecture Biennale of 2005 which centred around Rotterdam being transformed into a 'Water City', and the creation of Waterplan2 in 2007 were two important events, which led to the visionary insight that water should be treated as an opportunity instead of a threat. It was believed that while resolving water adaptation issues an attractive Water City could be simultaneously created for the so much desired middle and higher income groups. Thus Waterplan2 already refers to climate change as a key driver for water policy. In

fact climate change is a key theme in this plan. It contains targets and activities for the creation of additional water surface: there is a need for more than 600,000 m³ of additional water storage in Rotterdam (and 800,000 m³ by 2025). This storage should be realised through extension of the canal system and lakes. Where space is scarce, the plan refers to new and innovative solutions to retain water such as water plazas, green roofs, water gardens and wadies. Waterplan2 concludes with an implementation programme, consisting of a list of spatial projects for the period 2007-2012 where additional surface water should be realised (Rotterdam, 2007b).

At the beginning of 2008 a separate Rotterdam Climate Proof (RCP) group was set up, borne out of a group of municipal officers who had been dealing with water policy and who were heavily involved in the creation of Waterplan2. In March 2009 RCP and the Rotterdam Climate Initiative were merged into one 'Climate Office', in order to create synergistic opportunities between mitigation and adaptation policies and programmes. The climate office resides directly under the municipal executive office (mayor and aldermen), giving it a very central position in the municipal organisation. RCP currently consists of a group of six officers. RCP published two documents: a Rotterdam Climate Proof Strategy and a 2009 Adaptation Programme (see box 3.1 for more information).

Box 3.1. Adaptation Strategy and Programme for Rotterdam

Document names: Strategy Document and Adaptation Programme 2009, issued in May 2008.

Responsibility: Rotterdam Climate Proof division of the Rotterdam Climate Initiative.

Most important adaptation issue: flood protection

Goal of the adaptation strategy: make Rotterdam climate proof by 2025; to adapt to create a safe, an economically strong and an attractive Rotterdam.

Key themes to achieve a safe, economically strong and attractive Rotterdam:

1. *Knowledge development regarding adaptation and water*
2. *Implementation through innovative pilots ("Rotterdam as a testing ground")*
3. *Marketing of the city across the world as a model for all delta cities.*

Examples of proposed actions according to 5 themes (for a complete overview see document):

- *Flood management: various researches and reports on flood models, landside safety, climate levees*
- *Accessibility: study on effects of climate change on water transport, study on the climate elasticity of demand for mobility*
- *Adaptive building: delivery of the Climate Proof Barometer and testing it on the City Harbour project, creation of an adaptive building atlas*
- *Urban Water System: research on effects of climate change on current water systems, instalment of green roofs and the first water plaza*
- *City Climate: analysis of heat stress, climate atlas physical effects on Rotterdams's city climate*

Examples of innovative adaptation pilots with multi-functional forms of land use:

- *Floating pavilion, to be installed in City Harbours in spring 2010 (1st picture)*
- *Water squares, the first to be installed in the next 1-2 years (2nd picture)*
- *Roof park project, a multifunctional levy to be built by 2011 (3rd picture)*



For more information:

http://www.rotterdamclimateinitiative.nl/documents/RCP/English/RCP_folderalgemeen_eng.pdf

http://www.rotterdamclimateinitiative.nl/documents/RCP/English/RCP_adaptatie_eng.pdf

[http://www.rotterdamclimateinitiative.nl/nl/rotterdam_climate_initiative/english/mission_ambition.](http://www.rotterdamclimateinitiative.nl/nl/rotterdam_climate_initiative/english/mission_ambition)

The strategy document describes the ambition of Rotterdam to become a climate adaptation leader and a city of water knowledge; to make use of adaptation in order to protect the city, strengthen its economy and create an attractive living environment. This ambition should be achieved first of all by developing knowledge regarding adaptation and water, secondly by implementing innovative pilots and thirdly by marketing the city across the world as a model for all delta cities (RCP, 2008a). The 2009 Adaptation Programme contains specific activities and expected end results for the next couple of years, divided into five themes: flood management, accessibility (of the city and its port as a main logistic hub), adaptive building, the urban water system and city climate (RCP, 2008b). Again the focal point is water. Heat stress is mentioned in relation to the city climate theme, but so far has not dominated the adaptation agenda because knowledge with respect to the UHI effect in Rotterdam has been lacking until recently. When it comes to using green space as an adaptation measure, the strategy document does mention the option of greenery to moderate heat stress and heavy rainfall and it calls for a reassessment of policies related to the city's greenery (RCP, 2008a). However, in the 2009 Programme only green roofs are mentioned specifically as green measure (RCP, 2008b). Rotterdam is currently in the process of exploring the role of green space for climate (adaptation) purposes in more detail. At the end of 2009 it published a Climate & Green tool box ('Klimaat & Groen') consisting of 45 tools for designers and policy officers, with which they can climate green Rotterdam based on three spatial scales (Rotterdam, 2009a).

3.4. Legal capacity

3.4.1. *Regulative institutions to protect existing urban green space*

The legal capacity of the spatial planning policy field to protect existing urban green space and trees, and thus to prevent further loss of permeable ground, shade and cool areas, has a direct effect on the resilience of cities to excessive rainfall and heat stress. In this paragraph an analysis is made of the relevant spatial planning rules, policies and instruments from national to local level in order to provide the multilevel governance perspective.

Dutch national spatial policy primarily deals with green space in rural areas. The National Spatial Strategy contains various designations for natural heritage areas, European nature conservation sites (Natura 2000) and cultural landscapes to protect the country side from development. Nothing is stipulated to protect *urban* green space other than a guidance number for the amount of available green space per residence, i.e. 75 m² (VROM, 2004). Master plans in Rotterdam are being scored against this norm, but it is a soft norm. According to a recent study 79 m² of public green space is available per residence in Rotterdam, and this is the highest number of the 4 biggest cities in The Netherlands (Bezemer et al., 2002). Urban green policy at national level is handled by the Ministry of Agriculture, Nature and Food Quality, via its programme 'Green and the City' for the 30 largest cities. It is a research and investment programme which is currently being phased out; it does not contain any regulations to protect urban green. Provincial spatial and nature conservation policies focus to a large extent on the provision of green surrounding the cities and the development of the National Ecological Network which is to be completed by 2018 (RLG, 2005). The new Draft Structure Vision of the province of Zuid-Holland has designated six provincial landscapes to enhance their protection from development and stimulate the development of recreational services for the cities. In addition it stipulates that *urban* parks shall not be used for densification purposes (Zuid-Holland, 2009c).

The protection of urban green space is predominantly a matter of the municipalities. Municipalities can designate green spaces in zoning plans to give them legal protection. Since the latest Spatial Planning Act of 2008 municipalities are obliged to make zoning plans within the city's limits (before this was only required for the outlying area). Hence the new Act promotes the legal capacity at the local level because it forces municipalities to designate all of their land within their administrative jurisdiction. The designation 'Green' gives limited protection, because it can be changed into a playing field for instance. The designation 'Nature/Forest' offers more protection (Kamphorst et al., 2008). The city-wide Rotterdam City Vision (CV) has embedded the city parks, district parks and

recreational green in its main structure of the public realm in order to protect them against development. Other green is not covered in this document. The CV mentions the intention to investigate the potential of allotment gardens and sport fields as redevelopment areas, in order to fulfil its housing requirements (Rotterdam, 2007a).

In 2005 the municipality issued a Green Plan. This plan contains detailed maps of city parks, district parks and gardens, regional parks, the rivers and canals, which together form the green structure of Rotterdam. The allocation of these green spaces in the plan offers legal protection, according to the document (Rotterdam, 2005) although it is a bit outdated and its relevance is limited within the municipal civil service. Another municipal document relevant for protection of urban green, is the new Trees Structure Vision. It describes how street and other urban trees should contribute to the quality of the public realm and to the improvement of the city climate, through the moderation of heat stress. It is intended to be an assessment framework for the development of spatial plans. In practice this means that this vision should be taken into account in master plans and any other development plan. The most precious and monumental trees and tree structures are spatially embedded in this Vision and thus receive additional protection. It also mentions that one of the activities is to research the potential of using zoning plans for tree protection (Rotterdam, 2009b). The city also has a by-law to prohibit tree cutting. Apart from the zoning plans, the municipality does not have other legal instruments to protect *private* green space.

It can be concluded that at the local level various spatial and a few other legal instruments exist to protect existing green space. Nevertheless, in practice it comes down to actually applying these instruments to prevent further loss of green space. This is where the informal rules come in. Or as expressed by some spatial planning experts, Dutch planning is led by municipalities using “informal ways of using formal rules” (Nadin and Stead, 2008, p.42; Needham, 2009). There are forces at work that are counteractive. Much has to do with the value of green space. The value of land for building is much higher than for green; this makes the building of green fields far less expensive than the restructuring of existing space. The selling of public land is quite attractive for municipalities and results in an ever increasing pressure on existing green space (Kamphorst et al, 2008; RLG 2005). In Rotterdam the green space that is gradually lost, is mostly sports and playing fields.

3.4.2. Regulative institutions to create new urban green space

Here the rules, policies and other spatial instruments are analysed that are meant to create additional urban green space and trees, as well as to add green to existing space, such as green roofs, walls and other multi-functional forms of land use.

Spatial planning has legal instruments at its disposal to acquire and finance new green space. The provinces in particular have various means to expropriate land, redress costs for greening at supra-local level across municipal boundaries and to develop green space via public-private partnerships. The financial profit from the development of one project can be used for the financial deficit of another project. For instance, the costs of public green space development can be redressed via the exploitation of a new residential area. The new national Land Development Act ('Grondexploitatiewet'), which is a supplement to the new 2008 Spatial Planning Act, regulates the allocation of costs of land development. It creates possibilities for municipalities to demand the design and planning of open(green) spaces, amongst others, from developers in case of new building locations. It provides municipalities with more ammunition in their dealings with private developers and housing corporations; they have the fall-back option of public law to enforce the allocation of costs for certain public services in case of new or re-development (VROM, 2007b). Rotterdam does not yet have much experience with this new law; it is being piloted in the city harbour project.

Besides spatial planning the water management sector, which historically has strong regulatory power because of the huge flood risk in The Netherlands, also contains a regulation of interest to adaptation through green space. Ten percent of the area of new or re-development projects must be destined for surface water retention within the area or if this is not possible, at the edge of the urban territory. This ten percent compensation norm is often realised in the form of a combined green-blue

solution such as a canal with green borders, or even through a 100 percent green solution such as a wady.

The municipality of Rotterdam has investigated the possibility of using legal spatial instruments for the requirement of green roofs. The outcome was that neither the zoning plan nor the Building Decree ('Bouwbesluit') offer potential. A zoning plan can only exclude, but not include things, as laid down in the Spatial Planning Act. The Building Decree contains uniform technical building regulations at the national level, and municipalities cannot deviate from it. Currently the Building Decree does not yet contain adaptation measures such as green roofs, although this would be a very interesting option, according to some respondents. There is not yet a national spatial policy regarding green roofs. During 2008 and 2009 green roofs were heavily promoted through an incentive scheme for residents and companies. For more information on Rotterdam's green roof policy, see box 3.2.

To conclude, there is a considerable scope of spatial instruments, some very new, which can be used to expand urban green space. Implementation of these instruments comes down to consultations and negotiations with private developers and housing corporations. Several respondents have pointed to the fact that the municipality is still struggling with its role as principal instructing party ("opdrachtgeverschap") and its dealings with market parties. Respondents also made notice of the power of the development industry to dictate the development agenda due to their land positions.

Box 3.2. Green Roof Policy and implementation in Rotterdam

Key activities are:

- 1) *Subsidy scheme: €25/m² is provided by the municipality and an additional €5/m² by the water boards, with a budget of € 500,000 for 2008 and € 1 million for 2009. A total budget of € 7,6 million is reserved for 2008-2012 for all activities in the green roof programme. This subsidy is for private home owners. For social housing corporations and companies the subsidy is 50% of the installation costs. The minimum surface area is 40 m².*
- 2) *Study regarding the legal possibilities of making green roofs mandatory: see section 3.4.2. for results*
- 3) *Preparation of a green roof policy including a requirement for all new publicly owned buildings and those under roof repair*
- 4) *Communication campaign to raise awareness and diminish concerns among home owners and developers (re leakage)*

Status of implementation:

In 2009 30,000 m² have been installed

Another 40,000 m² is foreseen for 2010.

More information can be found on: http://www.rotterdamclimateinitiative.nl/nl/groene_daken or <http://www.rotterdam.nl/groenedaken> (only in Dutch)

3.4.3. Environmental Equity

The analysis of environmental justice involves the extent of information and awareness in local spatial planning policies and processes regarding the environmental equity situation of certain population groups with respect to the availability of green space and the vulnerability to flood risk and heat stress, as well as the inclusion of redistribution mechanisms to promote an equitable situation in these respects.

While Rotterdam is a rather green city comparatively speaking, its greenery is not always situated in the right places. There are relatively large high quality parks, but there is relatively little greenery within the neighbourhoods, in particular in some parts of Rotterdam (Bezemer et al., 2002). In a GIS based study on environmental equity for the Rijnmond Region, of which Rotterdam is the largest municipality, Kruize et al. (2007) found that an inequitable situation exists for lower-income groups in

terms of availability of public green space; and that higher income groups tend to live in more spacious and green locations because they are better able to select their housing location. The study also makes reference to the many activities that have been done in the past to improve housing conditions for lower income groups in this region (Kruize et al., 2007). To some extent the consciousness for environmental equity is found in spatial policy in Rotterdam. The issue of unequal distribution of green space is acknowledged in the City Vision, which speaks about a deficit of green in the inner central area and certain other older city districts near the centre. However, no redistribution policies are made explicit with regard to the inequitable situation of lower incomes; the policy goal of upgrading the public realm and enhancing the greenery in the city centre is meant to attract middle and high income groups. As Kruize et al (2007) conclude, the availability of green space is to a large extent left to the market forces in absence of a specific spatial redistribution policy. The interviews with respondents confirm that environmental equity currently does not play a big role in spatial planning in Rotterdam, although ten green playing fields for children are currently being developed in the socially deprived areas of the city. With respect to the vulnerability to climate change, no information is available as of yet whether certain types of citizens are more exposed to flood risk or heat stress. The recently published tool box Climate & Green does contains detailed information about the availability of different kinds of green space per city district. It concludes that certain older districts are more likely to be vulnerable to heat stress as a result of their compact building style (Rotterdam, 2009a). Regarding heat stress, the results of the research on the UHI effect will help in further informing such a vulnerability assessment in the near future. The public health and environmental offices in the Rijnmond region have just published a literature research into the health benefits of greenery. They found the relation between green space and health benefits to be most prominent for lower income groups, elderly and young people and advise the Rotterdam council to develop a green policy for child friendly districts (Vervoort et al., 2009). In sum, environmental inequity in terms of green space availability is acknowledged, but not yet fully addressed, although planning tools (such as GIS maps) are available to remediate this. The environmental equity situation regarding vulnerability to climate change still needs to be mapped, once the climate atlas for Rotterdam is available.

3.4.4. Key barriers and opportunities to the legal capacity

The legal capacity did not trigger many barriers or opportunities in the conducted interviews. The analysis suggests that there is a potential barrier in the informal practice of spatial planning (hesitance to use the formal rules that are available to protect or enhance green space). The most important opportunity is the development of a formal green infrastructure policy (Green Structure Vision) for Rotterdam, which provides protection for all kinds of green spaces.

3.5. Managerial capacity

3.5.1. Integration of adaptation and green planning into spatial planning

Here the following three indicators are analysed: the extent to which spatial policy documents contain adaptation issues, goals and measures; the extent to which the urban planning process contains provisions to climate proof the city; and the extent to which green infrastructure planning is a mature and integrated part of overall city planning and used as an instrument for adaptation.

As is clear from section 3.3.2. the national government has formulated strategic guidelines for adaptation in which they prescribe a dominant role for the spatial planning policy field. As a result spatial planning documents such as Structure Visions are gradually showing explicit adaptation goals and measures as and when they are up for revision, as is the case with the regional Draft Structure Vision of the province of Zuid-Holland. A sustainable, climate proof delta province is one of the five main themes in this Structure Vision. One of the main differences with its predecessor in fact is the increased attention for climate change adaptation (Zuid-Holland, 2009c). Nevertheless, this Structure Vision still focuses on water related issues such as flood risk, drought and salification, and mainly

related to rural areas. Heat stress is not covered. Green adaptation measures are mentioned in relation to water retention at the edge of urban areas. As is clear from section 3.3.3. Waterplan2 of the city of Rotterdam pays most attention to adaptation, while the City Vision focuses on housing affairs and is too abstract to contain enough guidance on adaptation. The structure vision for the new city harbour area ('Stadshavens') is the first to contain climate considerations for both mitigation and adaptation. However, this is still an exception; most master plans for new area development projects do not yet contain specific climate considerations, except for (quantitative) water issues.

Since water is such an important theme in Dutch society, national water policy obliges spatial planners to take water quality and quantity management into account in their planning processes through the so-called 'Water Test'. This means that flood risk and water retention have to be considered. Several respondents indicated towards expanding this test into a 'Climate Test', which would take mitigation and adaptation issues into consideration, including water related issues. However, this would have to be effectuated at the national level. At the municipal level there are currently no provisions in place to automatically include adaptation in the standard planning processes and procedures of Rotterdam; the organisational structure to do so is still lacking. Actually, the most important goal of Rotterdam Climate Proof (RCP) is the creation of such a structure to ensure that adaptation is considered in every policy division in the city by 2012. As one RCP officer said "our main purpose is to make ourselves obsolete" (John Jacobs, 2009). Hence, in absence of a formal structure, it is the RCP team that tries to integrate adaptation into planning processes. This is done by raising awareness; by asking project leaders of area development projects whether their master plan is climate proof; by developing tools such as an assessment framework, climate guide and climate barometer for spatial planning; by having discussions with city government regarding the inclusion of adaptation in officers' targets and so on. There are ample opportunities to integrate adaptation into planning processes in the near future. For instance, it is expected that the city policy on green roofs which is due any moment, will contain a requirement for green roofs for city owned buildings in case of new or re-development. Green roofs could also be included in the procurement guidelines of the Development Corporation Rotterdam ('Ontwikkelingsbedrijf Rotterdam'). Another suggestion within the city's authority, is to develop a so-called 'RAS method' ('Rotterdamse Adaptatie Strategie) which will run parallel to the already created REAP method ('Rotterdamse Energie Aanpak en Planning') for CO₂ neutral building. This REAP method deals with mitigation measures on different spatial scales (building, neighbourhood, district, city, region). The RAS method will do the same albeit for adaptation measures, focusing on three types of measures (to decrease the risk, to prevent damage, and to restore).

Both water and green space have become an integral part of city planning and designing, but green infrastructure planning receives relatively little attention, as is also evident from the fact that an overall green structure vision for the city is lacking. Urban green planning is predominantly done for the purpose of recreational services and amenity values, i.e. to upgrade the public realm. Currently urban green planning for adaptation is limited to green roofs for water retention purposes. A key reason for this limited approach is that heat stress so far has not been an issue in Rotterdam. Planning for green space *around* the city receives more policy attention, but is again predominantly geared towards recreational and nature conservation purposes. Nevertheless, whenever new green is planned around the city, water retention is automatically taken into account.

In sum, while adaptation is slowly and gradually being integrated into spatial planning documents and processes, the creation of a separate RCP team is the main strategy of the Rotterdam municipality to realise this integration until formal structures and processes are in place. Green infrastructure planning is not yet tied in with adaptation planning, but this might change in the near future once heat stress gets more attention and the Climate & Green toolbox becomes embedded in the municipal organisation. Linking green and adaptation planning might also enhance green infrastructure planning, since this is a policy area that could still receive much more attention in the planning and designing of Rotterdam.

3.5.2. Organisation of spatial, green and adaptation planning

This section deals with the extent of fragmentation of tasks and responsibilities for spatial, adaptation and green planning in the city; the horizontal coordination of spatial planning with other policy fields; and the vertical coordination with other government levels.

The organisation of tasks and responsibilities for spatial planning is spread out across different agents, both horizontally within the municipality and vertically among three government layers (taking the City Region into account). This so-called institutional fragmentation is a phenomenon which was dominating the interviews in terms of perceived barriers. Three key city divisions are responsible for the physical planning and implementation of Rotterdam. These are the Service for Urban Planning and Public Housing ('Dienst Stedebouw & Volkshuisvesting'), responsible for policy development; Municipal Works ('Gemeentewerken'), responsible for policy execution; and the Development Corporation Rotterdam ('Ontwikkelingsbedrijf Rotterdam'), responsible for the buying and selling of land and buildings. Currently these three divisions are in a transition phase; they will be merged into one integrated department for the physical planning of the city. In stark contrast, adaptation planning remains primarily in the hands of one municipal body, i.e. Rotterdam Climate Proof (RCP). This was a conscious strategy to avoid fragmentation in the early stages of this new policy field, with the ultimate goal of mainstreaming adaptation into existing policy fields once policy development and implementation has matured. Division of tasks, responsibilities and funds for green planning in the surroundings of Rotterdam is relatively clear: the Province provides the funding, the City Region does most of the planning and steering, and the municipalities do the execution of green projects. Planning of *urban* green space, however, is again constrained by fragmentation at the municipal level; responsibility is divided among the three physical divisions mentioned above. The situation is further aggravated by the low political priority urban green planning has at the national and local level, leading to a lack of driving force behind green infrastructure planning in Rotterdam. Furthermore the city lacks an overall integrated green policy, thus making it to a large extent dependent on the willingness and abilities of the sub-municipalities.

In terms of *vertical* coordination, Rotterdam has quite a unique position as one of the largest cities in The Netherlands. This lends the city quite a lot of power, and offers the opportunity to be in direct contact with national government, thus circumventing provincial government. The Province of Zuid-Holland tries to govern on a supra-regional scale and tends to avoid interference with (inter-) municipal affairs, thus employing a certain distance in dealing with the municipalities. While the relationship of Rotterdam with the province is under strain, the cooperation with the City Region is very good. The latter is helped by the fact that many local politicians have an official role in the board of the City Region. Furthermore the City Region relies heavily on the staff of the municipality of Rotterdam for all kinds of professional services. The City Region is also the primary body to achieve *geographical* coordination among the 24 municipalities that make up the Rotterdam region, which they manage to do quite well according to respondents.

Judged on the basis of the feedback during the interviews, *horizontal* coordination among city divisions is not only constrained by fragmentation, but also by compartmentalisation. This entails silo-thinking and the inability to think laterally across the boundaries of one's own policy sector. Compartmentalisation occurs at all government levels in The Netherlands and especially at the municipal level close to execution (RLG, 2005). Rotterdam does not escape from this, with a civil service organisation of 10,000 people distributed among many divisions and even departments within divisions. Silo-thinking is also endorsed by personal targets which are formulated along divisional lines; and by the limited links among policy documents. It is hoped and expected that the creation of one central division responsible for the physical urban planning of Rotterdam will also facilitate a better coordination of work and cooperation among city officers. However, it is also a matter of culture. Waterplan2, which has been developed through the cooperation among various city divisions and other stakeholders, is regarded as the perfect example for the aspired new way of working. Another recent example is the restructuring of parts of the three physical divisions into area development teams, responsible for the 13 VIP projects formulated in the City Vision. In these

projects the geographical area is leading and all relevant stakeholders are brought together to manage these areas. With respect to adaptation planning, a formal structure has been put in place in the form of the coordination team 'Water & Climate' consisting of key municipal stakeholders and the water boards, which meets every month. Nevertheless, much coordination of adaptation issues is still based on the informal networks of the people heavily involved in adaptation, and the RCP team specifically. Now that this team has physically moved away from the three key city divisions, extra effort will need to be made to foster existing working relationships.

In conclusion, vertical and in particular horizontal coordination of spatial planning is severely constrained in Rotterdam, both as a result of fragmentation and of compartmentalisation. The situation gets worse for the ability of spatial planning to climate proof Rotterdam by means of green space; not only is spatial planning fragmented and compartmentalised, but this is also the case for urban green planning. Furthermore urban green policy lacks political priority because its societal values and benefits are not holistically and integrally appreciated. This puts considerable constraint on the managerial capacity to climate green Rotterdam. Rotterdam's strategy to overcome fragmentation and compartmentalisation is through the creation of a separate RCP team until adaptation is mainstreamed in the municipal organisational structure.

3.5.3. Use of management tools and strategies

This involves the analysis of management strategies and tools to promote the effectiveness of spatial planning in climate proofing Rotterdam, both in terms of policy development and in terms of implementation, as well as effectiveness in terms of the promotion of multi-functional forms of land use, as a means to achieve both socio-economic and environmental targets.

A key strategy to promote the effectiveness of spatial planning in The Netherlands is integrated area development ('gebiedsontwikkeling'). In its ideal form it involves all relevant stakeholders and results in public-private partnerships. Experience with these partnerships is rapidly growing in Rotterdam. There are quite a lot of urban renewal sites in the form of integrated area development projects and they offer potential to integrate adaptation and green planning. Much urban renewal nowadays involves housing corporations as private parties. The new Land Development Act (see section 3.4.2.) can help the Rotterdam municipality in striking deals with these housing corporations. Some water retention and green space provisioning is handled at this spatial scale. According to some, the downside of this is that it could lead to 'post stamp' plans for urban water and urban green. One intends to overcome this through the creation of a database in which new water and urban spaces can be accumulated over time, in order to create more integrated water and green space provisions. Nevertheless, most large urban green spaces are still in the hands of the municipality, just as large green developments around the city are still for 95 percent realised by public means.

Rotterdam is trying out other new management tools and strategies. For instance, in order to make the engineering department of Municipal Works more effective its employees are paid on an hourly basis, not only by external parties but also by other municipal divisions. Another strategy is the creation of a Project Management (PM) approach. A PM office, which consists of project managers working on spatial policy development has been created, and a specific PM way of working for the physical projects in Rotterdam has been developed, supported by tools, guidelines and a dedicated website ('De Rotterdamse Standaard voor projectmatig werken'; Rotterdam, 2008). Other tools are the use of workshops, brain storm sessions and other forums to bring stakeholders together for policy development and implementation. A final means to promote the integration of social, economic and environmental concerns into spatial planning, is via the stacking of land-use functions. Rotterdam is very keen on applying multi-functional forms of land use for adaptation purposes, such as green roofs, water plazas and green cable car lanes. On top of that it also wants to experiment with multi-functional uses of levees. The 2009 adaptation programme promotes the use of levees as connecting elements, park landscape elements, promenades and cycle paths (RCP, 2008b). The first of such a multi-functional project is realised within the next two years, combining a 1 kilometre levee of 8 metres height with a district park, a commercial centre and parking ('Dakpark' project).

Rotterdam also participates in two 'Climate Buffer' projects initiated by the national government. One is meant to create water retention capacity in combination with nature development and a business park ('Schieveen' project). The other is meant to generate water retention capacity, while creating a recreational water link between a big park and a nature conservation area south of Rotterdam ('Blauwe Verbinding' project). Thus, Rotterdam seems to be very eager to use new management strategies for spatial and adaptation planning and to experiment with multi-functional land use.

3.5.4. Key barriers and opportunities to the managerial capacity

In Rotterdam, the most important barrier to the managerial capacity of spatial planning is compartmentalisation. This was also mentioned as the most important barrier as perceived by respondents in 8 out of 11 interviews. Furthermore the managerial capacity is constrained by institutional fragmentation and the lack of an organisational structure for the integration of adaptation into spatial documents and processes. The key opportunities are, first of all the anchoring of adaptation into all kinds of spatial processes, standards and procedures, the most important one being the Water Test, but also into standards for sustainable building and in the targets of planning officers. Secondly, there appears to be considerable potential to integrate adaptation and green planning in the planned restructuring of many city districts in the form of integrated area development projects. Thirdly, there is an opportunity to integrate spatial, adaptation and green planning through the creation of a Green Infrastructure Vision for Rotterdam.

3.6. Political capacity

3.6.1. Accountability

Indicators analysed are an open and transparent planning process and an active involvement of stakeholders and the public in urban planning processes.

The involvement of stakeholders and the public at large in spatial planning processes is first and foremost regulated by the Spatial Planning Act. This Act prescribes the formal procedures for stakeholder and community participation with which every zoning plan, master plan or structure vision must comply. Stakeholder input and the reactions to this input by the planning authority are well documented and publicly accessible, as required by the Act. However, how decisions are ultimately made and by whom is less transparent. This is primarily a matter of political involvement that delivers the checks and balances to the planning process, rather than public involvement. Nevertheless civil society is capable of pressurising these politicians. Nature conservation and environmental NGOs as well as citizens groups, can be a considerable counterforce in preventing further loss of green space and this has happened on many occasions in Rotterdam. While the Act determines procedures for spatial planning documents after they have been created, it is becoming increasingly popular to involve stakeholders in the creation of the plans themselves. Although it is not yet common practice in Rotterdam, spatial planners have had various successful experiences with public participation in the crafting stage of a plan. The master plan for the 'Dakpark' project for instance, has been based on pro-active consultation of citizens living in the district. Their explicit wishes for the design of the park have been taken into account. Another area development project, which has received much attention in the spatial planning community, is the master plan process for the Hoboken area. Contrary to common practice within the Service for Urban Planning and Public Housing, this plan was created in a purely bottom-up manner and is used as an inspiring example of stakeholder participation. As a whole, accountability appears to be growing due to increased efforts to involve stakeholders and the public in policy making.

3.6.2. Political will

Here the extent of political support and how this support is achieved and contained are analysed.

The political buy-in of adaptation to climate change is very high in Rotterdam. Spatial planning has played a role in raising awareness and enthusiasm for adaptation, by making 'The Flood' the key theme of the second International Architecture Biennale Rotterdam of 2005. Urban designers and water engineers jointly decided to create a new vision for Rotterdam, which they titled 'Rotterdam Water City 2035'. It was the first time creative designers and technical professionals sat together; they created this new vision in only two weeks' time. In hindsight this vision represented a big turning point in Rotterdam's water management; for the first time water was framed as a friend instead of an enemy. Water was seen as the chance for urban designers to transform Rotterdam into an attractive city; water as the starting point and not the stumbling block for urban design. This inspiring vision was translated into a book, mock-ups and an exhibition, and sparked off considerable political interest for adaptation in Rotterdam. By the time Al Gore shocked the world with his film 'An Inconvenient Truth' Rotterdam was already prepared and seized the political window of opportunity with this new vision. What helped the take up of adaptation was the breakdown of this vision into smaller innovative projects such as green roofs and water plazas, which were readily taken on board by politicians. These projects are perceived to be manageable within a short timeframe (the time horizon of politicians), are not too costly but yet quite visible to the external world. Nevertheless, most of the political will since 2006 seems to have been driven by the passion and stamina of a limited number of people in water management and by the Rotterdam Climate Proof team (RCP), rather than by the spatial planning community. RCP currently resides directly under the municipal executive office, which gives them considerable political power. A challenge is how to keep momentum going, and how to make the adaptation programme less dependent on the support of politicians in seat. One way RCP is addressing this, is by installing an advisory committee consisting of 25 independent key players in Dutch society. Another way is by showing the economic spin-off of the adaptation programme; how the expertise Rotterdam is building in water issues, can attract business and generate jobs.

3.6.3. Leadership

Leadership is analysed by looking at the extent of top-down and bottom-up leadership, and involvement of external parties in pushing the adaptation agenda.

Rotterdam's frontrunner status in The Netherlands has been driven by a combination of top-down and bottom-up leadership with some external support, but not from the spatial planning community. Top-down leadership has been provided by a few key people. The former Mayor Opstelten has been very important for climate policy in general. He founded the Rotterdam Climate Initiative and committed to a 50% CO₂ reduction by 2025 during Clinton's visit to Rotterdam. Just before his term ended, he appointed a Climate Director and founded the Rotterdam Climate Office, the first one in The Netherlands, in which he integrated the mitigation and adaptation programmes. Alderman Bolsius who is responsible for the portfolio of finance, the harbour and the public realm in Rotterdam, has been key in driving the agenda for green roofs and its incentive programme. He is also the driving force behind an extensive programme to upgrade the quality of the public realm, including urban greenery and thus has created favourable conditions for climate greening Rotterdam. A number of passionate civil servants have been critical in providing bottom-up leadership. These people were involved in the Rotterdam Architecture Biennale and the creation of the Rotterdam Waterplan2. They have an impressive network of informal relations with people in various city divisions. According to various respondents this has been much more productive in driving horizontal and informal cooperation, than by enforcing the adaptation agenda in a top-down manner via the directors of city divisions. In terms of external partners, the International Advisory Board of Rotterdam has been quite influential in pushing the climate agenda, in particular via Lubbers, the former Prime Minister of the Netherlands. In sum, the presence of leadership has been a key driver of the adaptation agenda in Rotterdam.

3.6.4. Key barriers and opportunities to the political capacity

This analysis suggests that the political capacity does not contain major barriers. The perceived barrier, as indicated by respondents during the interviews is the dependence on the short-termism of politicians and consequently to maintain a high level of political support. The key opportunity for increasing the political capacity is by linking adaptation to an important other governance theme, such as seeking synergies with mitigation, or combining adaptation through green space with the current high profile quality programme for the public realm.

3.7. Resource capacity

3.7.1. Economic resources

This entails the analysis of the available budget and land for adaptation and green infrastructure planning.

As of yet no dedicated adaptation budget is provided by the national or provincial government other than funds for research in Rotterdam, which is one of the hot spots of the Knowledge for Climate programme (KfC). Like all other big Dutch cities, Rotterdam receives national funds for urban renewal ('ISV geld'), with which it finances the restructuring of older city districts by means of area development projects. By integrating adaptation concerns into these projects, part of these funds can be applied for adaptation, resulting in a win-win solution. In contrast to Rotterdam Climate Initiative, the Rotterdam Climate Proof programme is a 100 percent public activity, funded entirely by the municipality. The programme has been established for four years (2008-2012) and a budget of €31 million has been allocated. This budget is split into €22 million for investment into the programme's activities and €8 million for staff and knowledge development. The total research budget is € 17 million, the rest being provided by KfC and other stakeholders (RCP, 2008a). Other municipal budgets can also be used for adaptation by integrating water and green areas into the public realm programmes. For instance, a considerable budget is available for creating green space along the river Muse ('Rivierenpark'), stemming from the Rotterdam Water City 2035 vision. Rotterdam is also in the fortunate situation, that it still owns big parcels of land in some parts of the city. The most common way to generate funds for development of green space is by selling off this land to private developers. The latest new urban development project is 'Park Zestienhoven', which will become a new city district with quite a lot of urban green space funded by land sales. Just outside the city limits new green space will be created; almost 6,000 hectares of new nature and recreation areas will be developed until 2020, with integrated water retention targets (City Region, 2005). Funds for this regional green are provided by the National Government and divided by the Province. All in all, Rotterdam is in a rather luxurious position with considerable funds and land available for the planning of adaptation through green space.

3.7.2. Human resources

Here the number of people involved in adaptation planning, their skills and know-how and the extent to which the organisational culture is conducive to change, are analysed.

The Rotterdam Climate Proof (RCP) staff consists of six people, who are 100 percent dedicated to adaptation planning. This is quite unique and symbolises the considerable priority the climate policy programme has been awarded by the local government and politicians. These people are driving adaptation projects and activities through the municipal organisation. In addition they pay considerable attention to generating publicity for RCP's activities and for branding Rotterdam as a Water and a Climate City. Next to these six people a small but growing group of civil servants within the three major divisions for physical planning is also part-time involved in adaptation activities, and in particular the water management department of Municipal Works. They participate in various adaptation projects, or are involved in research projects related to adaptation.

Adaptation is such a new policy field that the skills and know-how of the staff still need to be built up. The technical knowledge of the RCP staff for instance, is quite focused on water management issues.

Moreover, they still need to acquire process management skills, in order to successfully bring all adaptation activities to completion. This can be resolved through training programmes. However, it became quite clear during the interviews that most people in the physical divisions tend to think rather sectorally, while a wicked problem such as adaptation really needs an integrated approach. This not only reflects but also reinforces the compartmentalisation phenomenon, which was analysed to be one of the key barriers to the managerial capacity. To some extent this stems from the staff's education which is also very sectoral, but to a large extent it has to do with the fact that they are not challenged to think laterally; they are hired for and judged by their sectoral expertise, and this is in particular the case with the staff of the Engineers Office (Ingenieursburo) of Municipal Works who are paid by the hour. Another example is the fact that urban planning and landscape planning are both separate professions and separate departments within the Service for Urban Planning and Public Housing, and this can seriously hamper adaptation planning through green space. Another aspect mentioned by some respondents is the lack of skills of spatial planners to effectively deal with market parties in these area development projects. Last but not least, the three physical divisions have quite different organisational cultures, which tend to clash. Each division has a set way of doing things and naturally this further amplifies the sectoral thinking. For instance, there is quite some resistance of spatial planners to the Water Test, because it adds further complexity to their complicated urban renewal projects. Hence, while the quantity of human resources is more than sufficient, the quality of human resources appears to be an issue in the sense that people are trained and motivated to think sectorally, while adaptation requires lateral thinking.

3.7.3. Knowledge resources

Indicators analysed are the level of technical and social knowledge regarding adaptation and green infrastructure planning, and support of external experts (epistemic community).

It is shared by almost all respondents that both technical knowledge and social scientific knowledge regarding adaptation and green infrastructure planning still need to be further developed. Knowledge generation is one of the three transcending pillars of RCP, with the ultimate goal of making Rotterdam a knowledge centre for innovative water management and urban delta technology (RCP, 2008a and 2008b). In 2008 three researches were undertaken by the Service for Urban Planning and Public Housing to understand the needs and values of citizens regarding green space, and these have delivered many new insights. Much of the technical and social scientific knowledge on adaptation will be gradually built through the KfC hotspot programme for Rotterdam. KfC also automatically provides an epistemic community of experts and researchers from universities, businesses and consulting firms, whose intention is to develop applied knowledge, so as to bridge the gap between the research and policy making communities. In addition, Rotterdam is setting up a Climate Campus together with RCI and the project management office of the City Harbour project, consisting of a high-tech science, business and NGO community (RCP, 2008b). The new national water research centre will also be located in Rotterdam. Therefore it can be concluded that there is still a considerable lack of knowledge, but this is acknowledged and being addressed in various ambitious research programmes with heavy involvement from external experts.

3.7.4. Key barriers and opportunities to the resource capacity

The barriers to the resource capacity of spatial planning are: lack of knowledge, reflecting the very early stage of adaptation policy. However, more importantly, the analysis indicates towards a serious lack of skills to think laterally. Respondents have also mentioned the lack of skills to be a good instructor and negotiating party with private developers to be a barrier. The most important opportunity is provided by education programmes for staff focused on acquiring new skills.

3.8. Learning capacity

3.8.1. Dealing with uncertainty

This section deals with the way uncertainty is treated, the extent of technical approaches used to increase the evidence base, and the extent of managerial approaches used to handle uncertainty. Dealing with uncertainty is quite challenging in Rotterdam, since the local effects of climate change and its impacts are not yet known. Moreover, most of the information needed to take informed decisions about adaptation measures is still missing, such as the effectiveness of green roofs to remediate storm water run-off for instance. However, Rotterdam appears to have acknowledged and embraced these uncertainties; rather than relying solely on technical measures to reduce uncertainty, these uncertainties are turned into opportunities for experimentation. Rotterdam Climate Proof (RCP) is driving an agenda of real life experimentation and innovation to explicitly take uncertainty into account. The restructuring project of the old city harbour outside of the levees is going to be the testing ground for creative new solutions, such as flood proof and floating buildings; for “learning by doing” as stated in the 2009 adaptation programme (RCP, 2008b, p.10). The ‘Dakpark’ project mentioned before is another example of trying out new multi-functional forms of land use with adaptation measures. In the new development area of Nesselande one is experimenting with lava stones for surface water retention. In the coming years the first water plaza will be created that can retain water in times of extreme rainfall. There will also be pilots with new green space in the inner city centre as part of the public realm quality lift. All kinds of visible pilot projects are being set up across the city. As one respondent expressed: “experimentation is part of Rotterdam’s identity” (Karen van Vliet, 2009). Next to these experiments, technical solutions in the form of a tool kit are also developed by RCP in an effort to reduce uncertainty. This tool kit consists of a Climate Atlas listing local climate effects, a Climate Route Planner showing all measures to be taken, and a Climate Barometer monitoring progress in adaptation planning. A Cost-Benefit Analysis has been conducted for green roofs; the monitoring of a green roof project has started in order to measure its effectiveness. Research is currently being set up for measuring the effects of climate change on urban green and trees species. In conclusion, Rotterdam is embracing uncertainty in order to experiment with new innovative adaptation solutions.

3.8.2. Continuous learning processes

An analysis is made of the existence of infrastructure for the distribution and safeguarding of knowledge, for the exchange of experiences through internal or external networks, and the use of stakeholder input for enhancing learning processes.

It is acknowledged by many respondents that an organisational (workshops, trainings, brainstorm sessions etc.) or technical (databases, websites, intranet) infrastructure is currently missing, to distribute information across relevant people of the various city divisions, as well as to safeguard the continuation of knowledge transfer in light of the turnover of human resources. One respondent even said “adaptation is so leading edge that you need to organise your own knowledge development and feedback” (Lissy Nijhuis, 2009). The use of stakeholder input to enhance learning is also something which is not yet fully exploited; this seems to be primarily an internal challenge among the municipal divisions (because of the silo-thinking), rather than with external partners such as water boards or scientific experts. This internal restriction becomes even more evident in the exchange of experiences in order to enhance continuous learning processes; this exchange again takes place primarily with external networks. Rotterdam is very keen on learning from other cities, and sharing its own expertise and experience with other cities. Sharing of experiences with the three other big cities in The Netherlands happens on a regular basis; a special ‘Alliance of Climate Proof Cities’ has just been created among the four largest cities, in order to share best practices in adaptation and to translate the climate proof green-blue delta of the 2040 Randstad Structure Vision into implementable actions. Nevertheless, Rotterdam is most keen on sharing experiences with foreign cities. It belongs to the ‘C40 cities climate leadership’ transnational network and the allied

Clinton Climate Initiative. Within this network, Rotterdam has taken the initiative to create a separate group of global delta cities, called 'Connecting Delta Cities', together with Hong Kong, Shanghai, Jakarta, New Orleans, London and New York. In September 2010 an international conference 'Deltas in times of climate change' will be held in Rotterdam. It intends to bring leading scientists and policy makers from all over the world together to share experiences and best practices, and to strengthen international cooperation in adaptation planning for delta cities. In December 2009 Rotterdam organised a global urban summit in order to share experiences regarding the sustainable development of cities, and climate change was one of the key topics. In other words Rotterdam, and in particular the Climate Office, is very active in facilitating and encouraging exchange of experiences through transnational networks, conferences, expert workshops and other events. At the same time, the organisation and facilitation of *internal* knowledge infrastructure and *internal* exchange networks is still underdeveloped; it is also perceived to be a key barrier according to respondents.

3.8.3. Key barriers and opportunities to the learning capacity

The key barrier to the learning capacity is the very limited infrastructure for knowledge generation, the safeguarding of knowledge and information exchange within the municipality. Several respondents also referred to the uncertainties with respect to the real cost and benefits of adaptation measures, and in particular lack of scientific support for the effects of green roofs in storm water run-off and heat moderation. A key opportunity lies in the sharing of knowledge, experience and best practice in all kinds of internal and external networks.

3.9. Synthesis

Rotterdam is a leader in policy development for adaptation in the Netherlands and beyond. It is one of the first cities in the world that has formulated a specific adaptation strategy and programme. What makes Rotterdam's adaptation strategy stand out, is that it seizes the opportunity to put Rotterdam on the world map as the Climate and Water City: a knowledge expert for delta cities dealing with the effects of climate change, in particular in dealing with water related issues. Water is seen not as a threat, but as an opportunity to increase Rotterdam's amenity value for its citizens. While water is the dominant feature of the adaptation strategy, the role of green infrastructure so far is very limited, apart from some activities regarding green roofs. The installation of green roofs across the city is still rather modest. The role for green space might change in the near future as the results of the UHI study become available, which will include information regarding the ability of green space to cool the urban environment. A few policies and several activities have been initiated, with a focus on water management. See box 3.3. for an overview of the most important policy developments, implemented activities and future policy intentions.

Rotterdam's approach to adaptation planning appears to be quite hands on, in the sense that the majority of efforts are centred around activities instead of policy development. This is in line with Rotterdam's preference for experiments as a means of testing out innovative adaptation measures. Some experiments are planned to be implemented in 2010. The priority of the Rotterdam Climate Proof team for 2010 is the continuation and safeguarding of the implementation of the 2009 adaptation programme. This is preferred over initiating new activities which might dilute the attention of the municipal organisation towards the execution of the 2009 programme. The ultimate aim for the longer term is to have adaptation considerations mainstreamed into existing planning processes, and in particular those of spatial planning, so that Rotterdam Climate Proof can cease to exist.

Box 3.3. Adaptation policy development and implementation in Rotterdam

Most important implemented adaptation policies:

- ❖ *Integrated water management policy in Waterplan2 and related policies*
- ❖ *Formulation of a specific adaptation strategy and programme*

Most important adaptation activities and research projects (executed or in execution phase):

- ❖ *Green Roof incentive programme since 2008*
- ❖ *Establishment of a separate group of six officers for adaptation, Rotterdam Climate Proof*
- ❖ *Innovative experiments with multi-functional land use forms: floating pavilion, water square and roof park levy as testing grounds*
- ❖ *Installation of a Climate Campus*
- ❖ *UHI research project*
- ❖ *Development of a Climate Atlas, Route planner and Barometer*
- ❖ *International branding of Rotterdam as the Climate City through exhibitions, conferences etc.*

Most important future policy intentions for adaptation:

- ❖ *Formulation of a specific policy for green roofs*
- ❖ *Making green roofs mandatory on all city-owned buildings in case of new or re-development*
- ❖ *Integration of adaptation goals in all spatial planning processes by 2012*

Considering the early stage of policy development and implementation, this study cannot and is not meant to evaluate the effectiveness of these policies and activities. Instead it aims to analyse the potential capacity of cities to govern adaptation planning, with a focus on the spatial planning policy field. There is a common recognition of the role of spatial planning in governing adaptation to climate change. A framework of analysis has been developed, in which the governance capacity is broken down into five sub-capacities: the legal, managerial, political, resource and learning capacity (see chapter two for more details). This chapter has presented an analysis of these capacities, based on the adaptation policies, activities and policy intentions of the Rotterdam municipality. Of all the five capacities the *legal* capacity of spatial planning is most developed and offers most formal opportunities to climate green Rotterdam, although it is then up to the actors to actually utilise this capacity. The *managerial* capacity is severely constrained; institutional fragmentation and compartmentalisation of both urban and green infrastructure planning restrict vertical and horizontal coordination and cooperation. This is especially hurtful because adaptation really needs a holistic, integrative approach through governance arrangements. Rotterdam is using the newly created organisational structure of the climate office to remediate this. The Rotterdam Climate Proof team represents the major managerial strategy to integrate adaptation planning into urban policies and processes, and to coordinate adaptation planning across municipal divisions. Rotterdam is also actively applying other managerial strategies, instruments and tools, such as coordination groups, integrated area development project teams and multi-functional development projects. The *political* capacity of Rotterdam is a big asset, although it is not generated by the spatial planning policy field. The political support for adaptation to climate change has been very high from 2005 onwards. This is mainly due to considerable top-down and bottom-up leadership provided by a handful of strong and passionate people, who have managed to convince politics that adaptation and water policy create considerable opportunities to achieve the wider goal of transforming Rotterdam into an economically thriving and liveable metropolis. High political will has resulted in a high *resource* capacity in terms of available budget, land and human resources for adaptation planning. Nevertheless, overall resource capacity for adaptation planning is still constrained by the limited degree of lateral thinking as a key barrier to the potential of human resource skills.

Resource capacity is further constrained by the lack of knowledge in general, reflecting the early development stage of climate adaptation science and policy. *Learning* capacity is quite developed in terms of the way uncertainty is managed by Rotterdam Climate Proof by using new, unconventional strategies such as piloting and experimenting with new innovative solutions. Continuous learning processes are fostered through external stakeholder input and networking, but the infrastructure for promoting internal learning processes is missing.

Overall, the potential capacity of the spatial planning policy field to contribute to the governance of climate adaptation in Rotterdam is primarily fulfilled by means of regulative institutions. Furthermore it offers new management strategies such as integrated area development and multi-functional land use, and considerable accountability due to mandatory transparency of planning processes. However, the other positive contributions to the governance capacity in Rotterdam lie outside of the competence of spatial planning.

Most of the barriers and opportunities have to do with the managerial capacity. Based on the analysis of the governance capacity and the feedback of respondents (11 interviews with 14 people), the key barriers that pose limits to the governance capacity are:

- Compartmentalisation among and within municipal divisions (managerial capacity)
- Institutional fragmentation of both spatial and green infrastructure planning (managerial capacity)
- Lack of a formal organisational structure for the integration of adaptation into spatial planning processes (managerial capacity)
- Lack of human resource skills to think laterally & integrally (resource capacity)
- Lack of technical and social scientific knowledge (resource capacity)
- Absence of internal infrastructure for knowledge gathering, information and experience exchange (learning capacity)

The key opportunities for increasing the governance capacity are:

- Integration of adaptation planning into spatial planning processes for integrated area development, into the mandatory Water Test, into the REAP ('Rotterdamse Energie Aanpak en Planning') standard for sustainable building, and into the procurement guidelines of the Development Corporation Rotterdam (managerial capacity)
- Using the urban renewal programme to incorporate adaptation concerns by means of integrated area development (managerial capacity)
- Making an overall formal Green Infrastructure Vision for the city which integrates adaptation concerns (legal/managerial).
- Linking adaptation to another important governance theme and stressing the economic spin-off (political capacity)
- Learning from the experiences, best practices in all kinds of internal and external networks (learning capacity).

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4. Climate Greening London



4.1. Introduction

London is the capital city of the United Kingdom (UK). London is situated along the river Thames in the heavily populated South-East of England. With 7.2 million inhabitants it is the largest city in the UK as well as in Europe. The Greater London Area contains 8.5 million inhabitants. While in the past its economy was based on an extensive manufacturing industry, today it has a very large concentration of financial and related professional business services with many international banks and global corporations residing in the famous one square mile of the financial district. London claims itself to be one of the greenest cities in the world. Open (green)space accounts for 30% of the London land area, with over 3,000 parks and green spaces (London Parks & Green Spaces Forum, 2009). There are around seven million trees in the Greater London Area, a quarter of which are in woodlands. Woodlands occupy eight per cent of London's land area; an estimated 20 percent of London's land area is under the canopy of individual trees (GLA, 2005). 16 Percent of the Greater London Area are protected with nature conservation designations (Wilby and Perry, 2006).

London was one of the first cities around the world to develop climate change adaptation policies. Climate change was Mayor Livingstone's key political priority when he was in power between 2000 and 2008. The Mayor's Climate Change Action Plan from 2007 states the ambition to achieve a CO₂ reduction of 60 percent by 2025 (compared to 1990 levels), which was twice the national target at that point in time (in the meantime the UK Climate Change Act 2008 has set a new target of 80 percent CO₂ reduction by 2050 against a 1990 baseline). London's adaptation strategy stems from 2008 and will be further elaborated upon in section 4.3.3. The first two sections of this chapter describe the spatial planning and adaptation policy context for London, after which each of the five governance capacities of the spatial planning policy field will be analysed. The chapter will be concluded with a synthesis.

4.2. Spatial Planning Context

4.2.1. *The governance of spatial planning in The United Kingdom and England*

The UK is a centralised unitary state with four levels of government: national (UK), regional (England, Scotland, Wales and Northern Ireland), county and district. Although Scotland, Wales and Northern Ireland have had devolved governments since the end of the 1990s, England (which is by far the largest part of the UK, hosting 85% of the population) is still governed directly by the UK government. The Greater London Area is the only region in England, that has its own government. London has a two-tier government structure: firstly the regional body called the Greater London Authority (GLA) which prepares Pan-London strategies; and secondly the local authorities, consisting of 32 boroughs and the City of London Corporation (the 1 square mile of the financial district)⁴. The GLA consists of an elected Mayor and an elected Greater London Assembly which scrutinises his work. The national government also has a Government Office for London, as a kind of regional UK government office. This office mainly has a supervising role and acts on behalf of the Secretary of State for spatial planning matters in London (Cullingworth and Nadin, 2006). Since the end of the 1990s the devolution of decision making has given London more opportunity to govern itself in the globalized market place (Bailey, 2009). The Greater London Authority Acts of 1999 and 2007 have given London relatively extensive powers, exclusive to the capital city, one of which is to make a Regional Spatial Strategy in the form of the statutory 'London Plan'. However, the GLA has limited resources and competences in comparison with other regional bodies in European countries (Cullingworth and Nadin, 2006). Along similar lines, Bailey (2009) indicates that, although unique in the UK, the new institutional framework is still rather weak and that more transfer of power and financial resources would be needed from central government.

⁴ Taking account of the two-tier structure in London the interviews were extended to incorporate two boroughs (Southwark and Islington). Both are inner London boroughs with high land pressures. Southwark was selected because it is subject to many regeneration projects (as this creates opportunities for the incorporation of adaptation measures). Islington was selected because it is leading in London and the UK in adaptation planning. It has a dedicated adaptation officer.

The UK planning system is based on English common law, which is an indicative law system. Rather than setting rules and principles in advance, it relies on case by case interpretation and is therefore discretionary by nature (Nadin and Stead, 2008; Lanelis et al., 2003). Planning policies are rather generic and leave room for flexibility; zoning plans are absent. Traditional land use planning in the UK was meant to regulate the private sector and to control development, with a strong sense of preservation of the country-side (Cullingworth and Nadin, 2006). Until the recent devolution trend and planning reform in the UK, the planning system was characterised as rather top-down with a strong central tier in the form of national government, exercising considerable influence on the land-use planning processes. In 2004 a new Planning and Compulsory Act was launched, causing a shift from rather top-down to more decentralised planning in the form of regional planning and inclusion of local stakeholders (the Act requires the creation of regional spatial strategies and local development frameworks); from development control to more plan led development; from traditional land use planning to a more comprehensive form of spatial planning encompassing wider sustainability goals; from government to governance (Cullingworth and Nadin, 2006).

Contrary to what one might expect from a rather centralised government system, the UK does not have a national spatial plan or strategy for the country as a whole. In contrast to the devolved Scotland and Wales, England also still does not have a spatial plan (Cullingworth and Nadin, 2006). However, the Department of Communities and Local Government (DCLG) which is responsible for planning policy in the UK, does issue the so-called Planning Policy Statements (PPS) or Planning Policy Guidance (PPG) for specific planning issues. These inform the planning policies of lower levels of government, such as the regional spatial strategies, in this case the London Plan. In their turn the regional spatial strategies inform the local development frameworks (LDF) of local authorities, in this case the London boroughs. The terminology used is that the LDFs must be "in conformity with" these national and regional policies. This means that the LDFs must be updated following the publications of the London Plan. The influence of higher tiers of government is further strengthened by the fact that the Secretary of State can require an adjustment of a local plan and has the right to call in a plan, although this rarely happens (Cullingworth and Nadin, 2006). Similarly according to the Greater London Authority Act the Mayor of London is a statutory consultee of the LDFs of the London boroughs and has the power to intervene in case of strategic planning applications and take over the role from the local authority. Hence there is still considerable influence of higher over lower government levels, restricting the autonomy of regional and local authorities in London. Nevertheless, the local authorities (i.e. the London boroughs) are ultimately responsible for judging planning applications and providing planning permission for developments.

4.2.2. Spatial policy for London

The national planning policies relevant to the climate greening of London are those relating to Brownfield development, the compact city and green belts. Together these policies aim to create sustainable and compact cities which do not encroach on the so much loved countryside. This is in particular relevant for the South East part of England, which has to meet huge requirements for new housing. The London Thames Gateway for instance, is a huge regeneration programme in East London, which will provide 160,000 new homes between 2004 and 2014. It is the largest development site in Europe. PPS3 'Housing' contains directions regarding the re-use of land that has previously been developed; at least 50 percent of new housing should be achieved on previously developed land. It also prescribes local authorities to set targets for densification: a density of 30 houses per hectare is set as a national indicative minimum (DCLG, 2006a). PPG2 'Green Belts' aims to restrict urban sprawl and protect the countryside against development (DCLG, 1995). The green belt around London has already been designated since 1938 and the borders of London have been fixed ever since. The London green belt is by far the largest in the UK with around 500,000 hectares, 82 percent of which consists of farmland (Carter-Whitney, 2008). Together these policies result in a tremendous pressure on open (green)space within London. As Wilby & Perry (2006) state, inappropriate development is one of many threats to London's biodiversity.

Under the GLA Act the Mayor of London has a statutory duty to produce a Pan-London regional spatial strategy. The London Plan (LP) is the most important statutory document of the GLA and *the* integrating framework for all mayoral strategies. It gives strategic guidance to the development of London and gives the boroughs direction in their planning policies and processes (Bailey, 2009). The London Plan 2008 consolidated version reconfirms the compact city policy principle. Its first objective is “to accommodate London’s growth within its boundaries without encroaching on open spaces” (GLA, 2008a, p6). It asks for higher densities, as well as the protection of the Green Belt, Metropolitan Open Land, and other designated open spaces. It recognises the role of Green Infrastructure as a network of open spaces and corridors (GLA, 2008a).

4.3. Adaptation to Climate Change

4.3.1. Climate change effects

Already in 1997 the UK Climate Impacts Programme (UKCIP) was established by the national government, in order to coordinate the research of climate change impacts in the UK and to inform policy making. UKCIP publishes climate projections on a regular basis. Its most recent publication is the UK Climate Projection from June 2009 (UKCP09). In the meantime the research has advanced in such a way that it can elaborate upon spatial (of 25 km resolution) and temporal details and provides different scenarios of climate change with probabilities attached to them. Based on UKCP09 the following climate changes are projected for (Southern) England by 2080 under the medium emissions scenario (UKCP09, 2009):

- Mean temperature increase in the summer of 4.2°C (between 2.2 and 6.8°C)
- Increased precipitation in winter up to +33% (between 9 and 70%)
- Decreased precipitation in summer down to -40% (between -65 and -6%)
- Decreased mean cloud amount in summer down to -18% (between -33 and -2%).

The UK has already faced an increase in flood events, for instance in the summer of 2007 but also very recently at the end of November 2009. Other issues are coastal erosion, in particular on the coastlines of the South and East, which will get worse through climate change; and water shortage during summer, in particular in South East England.

UKCP09 has also made specific projections for London, for instance (GLA, 2009a):

- Mean temperature increase in summer of 1.5°C by 2020, 2.7°C by 2050, and 3.9°C by 2080
- Increased precipitation in winter of 6% by 2020, 15% by 2050 and 20% by 2080
- Decreased precipitation in summer of 6% by 2020, 18% by 2050 and 22% by 2080.

London has already experienced an increase of average summer temperatures by over 2°C over the period 1977-2006 (GLA, 2010). This increase in summer temperature will further aggravate the urban heat island (UHI) effect. London has already experienced the negative health impacts of the UHI effect during the European heat waves of 2003 and 2006. During the heat wave of August 2003 at least 600 people were killed while the UHI effect showed an intensity of 9-10°C (GLA, 2006). A technical study commissioned by the GLA to investigate the extent of UHI effect for London has shown that the UHI effect has increased over centuries from approximately +2°C of temperature during the night in the 19th century, to 4-6°C of UHI intensity during the nights in the 1960s, to +7°C or more in recent times compared to the country side. Furthermore recent special observation programmes have shown an intensity pattern across London at night, which has identified hot spots that coincide with high density development in central London, while Richmond Park is about 1°C cooler than its surroundings. The direct correlation with high density built up areas is reconfirmed by a study based on surface temperatures measured by satellites (GLA, 2006). Another impact is the increased probability of flooding as a result of sea level rise and more frequent and higher tidal surges, as well as increased risk of surface water flooding. 15 Percent of London is located in the flood plain of the river Thames and its tributaries, representing 1.25 million people and 480,000 properties. Without the Thames Barrier London would flood twice a day owing to tidal surges (GLA, 2010). Surface water flooding is also increasing: because of torrential rain London’s sewer outlets

overflow into the Thames regularly (50 times in 2008) and over 680,000 properties are at risk of surface water flooding (GLA, 2010). Finally, London has also suffered from dry spells in 2005 and 2006. Drought as a result of decreased rainfall in summer, as well as increasing public water demand could lead to water shortages (GLA, 2010). So in other words temperature rise, exacerbated by the UHI effect, flood risk from excessive rainfall, and drought are the main adaptation issues for London.

4.3.2. Adaptation policy at the national level

Even before a national strategy for adaptation was formulated in 2008, the UK government was already dealing with water management and flood risk. The 'Making Space for Water' programme was launched as a new approach to flood and erosion management. It speaks of 'managed realignment' through the creation of wetlands, river widening and restoration, and coastal realignment (Swart et al., 2009). The Environment Agency, which is a non-departmental public body with close links to of the Department for Environment, Food and Rural Affairs (DEFRA), has had an adaptation strategy since 2005 focused predominantly on water issues, such as flood risk management, water resources, and freshwater ecology. The Environment Agency is also responsible for the creation of a tidal flood risk management plan for the Thames Estuary (DEFRA, 2008). Moreover, various spatial policies of the UK government also require planning bodies to consider adaptation measures. The most significant documents are PPS1 supplement 'Planning and Climate Change' from 2007 and PPS25 'Development and flood risk' from 2006. PPS1 requires regional and local planning bodies to contribute to sustainable development by addressing both mitigation and adaptation. This PPS takes precedence over other PPSs in case of difference of emphasis on climate change. Climate change is stated a key government priority for the planning system; climate change considerations should be integrated in all spatial planning concerns and should be a key integrating theme in regional spatial strategies. New development should be planned taking both mitigation and adaptation to climate change into account. Although there is a lot of emphasis on mitigation, it also specifically states that a criterion for selecting land for development is the "contribution to be made ... for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity" (DCLG, 2007, p.15). PPS25 requires planning bodies to do a sequential test based on risk levels, to ensure that flood risk is taken into account in all planning processes, and to avoid development in areas prone to flood risk (DCLG, 2006b).

The Climate Change Act of 2008 required the government to develop a statutory adaptation programme. DEFRA published a National Adaptation Strategy (NAS) for England in 2008, in order to provide a cross-sectoral approach to adaptation. It is called 'Adapting to climate change in England. A framework for Action' (DEFRA, 2008). The first phase of the programme is about gathering additional evidence of climate change impacts and its consequences, raising awareness and developing ways to work cross-sectorally in a multi-level governance structure from national to local; the second phase from 2012 onwards is about the actual implementation of the NAS. The NAS requires the mainstreaming of adaptation into sector policies by embedding it into government processes and key programmes. Consequently all government departments must review their policies. Delivery of the programme should be done through partnerships with key stakeholders from the public, private and third sector (DEFRA, 2008). In England several regional climate change partnerships have already been formed with local stakeholders, which give advice regarding environmental, social and economic vulnerabilities and impacts for the region. The Three Regions Climate Change Group is the biggest one, formed by the three regions of East of England, the South East and London.

The UK government also provides strong scientific support; it has initiated various big research programmes for adaptation. The most well known ones are UKCIP which focuses on assessment of climate change impacts, and the Tyndall Centre for Climate Change research, which focuses on vulnerability and applied science for adaptation. In 2007 a new research programme was initiated: the Living with Environmental Change programme with a budget of £ 1 billion for 10 years and with the aim to strengthen the evidence base for policy making. The uncertainties regarding climate change impacts is one of the priority areas of this programme (LWEC, 2009).

4.3.3. Adaptation policy in London

The London Climate Change Partnership (LCCP) was already formed in 2002. The GLA coordinates this group of stakeholders of 30 key organisations from the public, private and third party sector in the fields of climate science, development, transport, finance, health, environment and communication. Its aims are to raise awareness, support policy making and provide information regarding adaptation to climate change. For the latter purpose LCCP provides regular courses and other training material. LCCP has published guidance documents on adaptation with checklists for development and for retrofitting existing homes (LCCP, 2009). The GLA used to have one dedicated full-time officer who headed LCCP, until the recent cutbacks of the Environment group of the GLA. The current staff working on adaptation at the GLA consists of one full-time person, who also heads the LCCP. The GLA Act of 2007 has made the creation of an adaptation strategy a statutory duty of the Mayor. Mayor Johnson published a very extensive Draft Adaptation Strategy (DAS) in August 2008 for review by internal (GLA) stakeholder groups. A second draft for public consultation has been released in February 2010. The aim of DAS is “to assess the consequences of climate change on London and to prepare for the impacts of climate change and extreme weather to protect and enhance the quality of life of Londoners.” (GLA, 2010, pp.15-16). Separate chapters of the DAS first handle the three key issues of climate change for London: flooding, drought, and overheating. Consequently the impacts of these issues on health, the environment, the economy and infrastructure are discussed. Actions are categorised according to a ‘Prevent, Prepare, Respond, Recover’ framework. Green space plays a prominent role in the adaptation strategy. A key action to address both the flood and the overheating issue, is the ‘urban greening programme’, using street trees and green spaces to absorb and retain rainwater, and to cool the city. The function of existing green spaces should be enhanced, for instance as flood storage areas. The DAS states: “We believe that by increasing green space and vegetation cover in the city, we can manage and offset rising temperatures (and manage flood risk)” (GLA, 2010). An ‘urban heat island action area’ is defined for the boroughs in central London. The role of spatial planning is widely acknowledged in the DAS: from avoiding or reducing the use of flood vulnerable land, to designating flood storage areas (such as parkland or sports fields), to locating heat-vulnerable land uses away from warmer areas in the city; and to and design green spaces and breeze pathways to cool the city (GLA, 2010). See box 4.1. for an overview of the content of the latest version of the DAS.

In addition, a Draft Water Strategy was launched in August 2009 for public consultation. One of its three objectives is to reduce the threat of sewer, groundwater and surface water flooding and to mitigate its effects. Sustainable urban drainage, use of porous surfaces and green roofs are some of the key measures mentioned to achieve this (GLA, 2009b). Another GLA policy document which deals extensively with both mitigation and adaptation, is the London Plan. Green roofs, a tree planting programme and a Pan-London green grid form essential parts of the draft adaptation strategy, all of which have been also been incorporated into the London Plan. Green roofs are required on all large developments (GLA, 2008a), while the smaller developments are dependent on planning negotiations at the boroughs’ level. A special technical report for green roofs and walls was made to support the green roof policy in the London Plan. It contains a first draft of a preferred standard for green roofs for designers and developers (GLA, 2008b). More information regarding green roofs can be found in section 4.4.2.

Box 4.1. Adaptation Strategy of London

Document name: The draft climate change adaptation strategy for London. Public consultation draft. Issued in February 2010 for public consultation by the Mayor of London/Greater London Authority.

Primary responsibility of: Environment Department of the Greater London Authority

Most important adaptation issues:

Flood risk from heavy rainfall, the river Thames and its tributaries, and from the North sea.

Heat stress from rising temperatures and the urban heat island effect.

Drought in summer from decreased rainfall and evaporation.

Objectives of the adaptation strategy:

- ❖ *to identify and prioritise the climate risks and opportunities facing London and understand how these will change through the century*
- ❖ *to identify and prioritise the key actions required to prepare London, and to define where responsibility for delivering and facilitating these actions lies*
- ❖ *to promote and facilitate new development and infrastructure that is located, designed and constructed for the climate it will experience over its design life*
- ❖ *to improve the resilience of London's existing development and infrastructure to the impacts of climate change*
- ❖ *to ensure that tried and tested emergency management plans exist for the key risks and that they are regularly reviewed*
- ❖ *to encourage and help business, public sector organisations and other institutions prepare for the challenges and opportunities presented by climate change*
- ❖ *to promote and facilitate the adaptation of the natural environment*
- ❖ *to raise general awareness and understanding of climate change with Londoners and improve their capacity to respond to changing climate risks*
- ❖ *to position London as an international leader in tackling climate change.*

Key proposed actions:

- ❖ *To improve our understanding and management of surface water flood risk: map who, what and where is at flood risk today; use climate projections to understand how climate change will affect the floods of tomorrow; work with the emergency services, utilities companies and other partners to make the most critical services in London flood-resilient; use green spaces and plants to absorb floodwater.*
- ❖ *An urban greening programme to increase the quality and quantity of green space and vegetation in London: 're-green' the city by using vegetation and green spaces to provide shading, cooling and insulation. Not only will this help to cool the city and take the edge of heat waves, but it will make the city a more beautiful and pleasant place to live.*
- ❖ *To retrofit up to 1.2 million homes by 2015 to improve the water and energy efficiency of London homes: make sure that new development is designed for the temperatures of tomorrow and that mechanical cooling (e.g. air-conditioning) is only used where necessary; continue to work the four major London water companies to ensure that delicate balance between water supply and demand is maintained; help Londoners to use less water by installing water meters in homes. This will not only make the city more drought resilient but will save Londoners money; ensure that new development – especially social housing – is very water efficient.*
- ❖ *Overall action: to mainstream adaptation across the GLA group and key sectors in London.*

Download the strategy document from:

http://www.london.gov.uk/climatechange/sites/climatechange/staticdocs/Climate_change_adaptation.pdf

For more information on London's adaptation strategy and activities:

<http://www.london.gov.uk/climatechange/strategy> and <http://www.london.gov.uk/lccp/>.

4.4. Legal capacity

4.4.1. *Regulative institutions to protect existing urban green space*

The legal capacity of the spatial planning policy field to protect existing urban green space and thus to prevent further loss of permeable ground, shade and cool areas, has a direct effect on the resilience of cities to excessive rainfall, drought and heat stress. In this paragraph an analysis is made of the relevant spatial planning rules, policies and instruments from national to local level in order to provide the multilevel governance perspective.

Central government is very strict in protecting the country side, amongst others by means of its PPG2 policy on green belts, with the primary goal of combating urban sprawl by permanently preserving open land. Protection of *urban* green by national government policies appears to be less pronounced. It is provided to some extent by PPS3 on Housing and PPG17 on Open Space, Sport and Recreation. PPS3 promotes the regeneration of derelict Brownfield land instead of using Greenfield land. PPG 17 requires local authorities to audit their open spaces, assess current and future needs for them, and formulate an Open Space Strategy. It states that “Existing open space, sports and recreational buildings and land should not be built on unless an assessment has been undertaken which has clearly shown the open space or the buildings and land to be surplus to requirements” (DCLG, 2005, p.6). Other than these two general policy principles, protection of urban green is left to the local authorities.

As the strategic body for the whole of London, the GLA has developed many planning policies to protect existing green space, most of which are in the London Plan (LP) or in supplementary planning guidance documents. The new draft LP contains a policy on the establishment of a Pan-London Green Infrastructure as a strategic network of open spaces. Open spaces are designated according to a hierarchy of protection levels. Metropolitan Open Land, consisting of all larger parks, has the same high protection level as the London Green Belt, in essence prohibiting development. Eight of the larger parks are also royal parks and historic sites and thus receive additional protection. The LP contains a policy on the protection of trees and woodlands. Moreover, the LP stipulates that each borough should produce an Open Space and a Tree Strategy. Regarding the protection of private green space the LP also contains a policy for the protection of allotments as a means to produce urban food. It also advises boroughs to introduce a presumption against back garden development in their LDFs (GLA, 2009a). Besides the LP the GLA has also developed several other planning documents for urban green planning to serve as guidance for the boroughs. Firstly there is a Supplementary Planning Guidance on the East London Green Grid, which gives guidance on how the extensive regeneration of East London should be used to integrate the development of a network of open spaces, rivers and other corridors taking climate change considerations into account (GLA, 2008c). Secondly there is a Best Practice Guidance on Open Space Strategies, which is meant to support the boroughs in developing their open space strategies in order to create their own local network of open spaces (GLA, 2008d). Thirdly there is a Trees and Woodland Framework as part of GLA’s biodiversity strategy, in which trees and woodlands should be recognised as integral parts of open space planning for protective purposes (GLA, 2005). In their turn the boroughs designate open land in their jurisdictions through their Local Development Frameworks. Most of the smaller parks and recreational areas fall under the designation ‘Borough Open Land’, which has very high protection (at almost the same level as Metropolitan Open Land). The rest group called ‘other open space’, can be developed upon if they are re-provided elsewhere. The boroughs can also develop local policies (by-laws) to protect certain types of green space or trees. Playing fields are the only green space that do not receive any specific protection, although they must be checked against the guidance of PPG17. Consequently, when green space is lost, it is mostly playing or sports fields.

In conclusion, many policies exist at both levels of local government to protect existing green space. Someone seeking planning permission needs to take these policies into account. In practice, the LP is a powerful document, which the boroughs have to abide by. If boroughs are silent on an issue or if their local plan is outdated, the LP takes precedence. As one respondent put it “the London Plan has

actual teeth and therefore the power of the GLA is really around planning” (Taylor Valiant, 2009). Nevertheless, it is not the GLA but the boroughs which are responsible for the enforcement of these policies. According to several respondents, the number one issue with planning in the UK is the disconnect between planning policy and what happens on the ground, because boroughs’ development control teams are generally understaffed.

4.4.2. *Regulative institutions to create new urban green space*

Here the rules, policies and other spatial instruments are analysed that are meant to create additional urban green space, as well as to add green to existing space, such as green roofs, walls and other multi-functional forms of land use.

In London as in the rest of the UK, the creation of open space is usually part of a planning gain deal of a big development, negotiated by the borough in the case of each individual development project. These kind of deals are possible because of the so-called ‘section 106’ of the UK Town and Country Planning Act, which encourages mixed use development. When section 106 is applied to a planning application, the developer transfers land to the local authorities via a legal agreement and in return the developer gets planning permission. This often leads to the creation of little local parks, because the land in London is so expensive. Section 106 can also be used for other community objectives, such as social housing and health facilities, but often it is used for the creation of open space and sometimes for acquiring funds to maintain or improve existing open space. In addition, DCLG will soon introduce the new so-called ‘Community Infrastructure Levy’ (CIL) based on a revision of the Spatial Planning Act. It is meant to give local authorities extra resources to invest in public services and social infrastructure, including green(open) space. Developers will need to pay a charge based on a cost per unit, which local authorities then must spend on local infrastructure to support the new development. The Mayor of London will also be empowered to charge a CIL to fund strategic infrastructure. It is unclear when and exactly how this CIL will come into effect (DCLG, 2009a). At the Pan-London level, the new draft LP contains a policy on urban greening in its chapter on climate change. This policy contains a target for an increase of the amount of green surface area in central London by at least five percent by 2030 and a further five percent by 2050. This should be achieved by integrating green infrastructure from the beginning in the design process of development proposals, by including elements such as green roofs and trees; major developments should demonstrate how they can contribute to this target (GLA, 2009a). Although he does not have the legal responsibility the new Mayor Johnson has chosen to commit himself to the planting of 10,000 trees in 40 priority areas by 2012. Tree cover should be increased by five percent by 2025. Furthermore he has chosen to enhance 1,000 hectares of green space through the East London Green Grid, the creation of the new Olympic Park (102 ha), and the Priority Parks programme, which aims to upgrade 11 rundown parks (GLA, 2010; GLA, 2009e). At the local level, a number of boroughs have adopted their Open Space Strategies as supplementary planning guidance. This then mandates that all new developments create new open space.

With respect to green roofs, until 2008 they were primarily promoted for biodiversity reasons. Nature conservation law (the Wildlife and Countryside Act 1983 [as amended] and Countryside and Rights of Way Act 2002) made green roofs ‘a material consideration for local planning authorities, where protected species are present, that developments enhance and mitigate the development for [the protected species in question]’. In the case of London this was for the black redstart bird (Gedge, 2009). Since 2008 the primary reason for promoting green roofs has changed to climate change. The LP contains a specific green roofs policy for adaptation purposes which requires them on all major developments such as regeneration projects, where feasible. It also requires that boroughs incorporate this policy in their respective planning documents. Consequently most boroughs will have supplementary planning guidance (SPD) on green roofs, usually through an SPD on Sustainable Design and Construction. In practice this requires green roofs to be a ‘material consideration’ in planning applications, which means that a developer should justify why they cannot incorporate a green roof or wall. Still it is a negotiation process, in which the planner of a borough will be looking at

the overall quality of the development in terms of meeting a number of policy aspirations, and this will not always necessarily result in inclusion of a green roof. Furthermore, it will depend on the negotiations skills of the planning officers. However, the more environmentally minded boroughs will incorporate green roofs on all bigger developments by default. Islington is the best example; it has set itself a target of 1 hectare of green roofs per year. More details on London's green roof policy can be found in box 4.2.

In sum, regeneration projects and all other bigger developments in London offer considerable potential for the creation of new green space, because planning act section 106 can be used to negotiate new public green space and the policies on green roofs put the onus on the developer to prove why a green roof cannot be incorporated. The introduction of the Community Infrastructure Levy in the near future will empower the Mayor and the boroughs to demand a charge from developers, with which they can create new or enhance existing green infrastructure.

Box 4.2. Green roof policy and implementation in London

London's green roof policy is integrated into the London Plan 2008 as a specific policy for adaptation:

Policy 4A.11 Living Roofs and Walls:

"The Mayor will, and boroughs should, expect major developments to incorporate living roofs and walls where feasible and reflect this principle in DPD policies. It is expected that this will include roof and wall planting that delivers as many of these objectives as possible:

- *accessible roof space*
- *adapting to and mitigating climate change*
- *sustainable urban drainage*
- *enhancing biodiversity*
- *improved appearance.*

Boroughs should also encourage the use of living roofs in smaller developments and extensions where the opportunity arises."

In the forthcoming SPG on Sustainable Design and Construction a preferred standard for designers will be incorporated for green roofs.

Boroughs activities:

- ❖ *Islington is the only borough with an annual target of 1 hectare and consequently has the highest percentage of installed area in London (16%) (Living Roofs, 2009)*
- ❖ *City of Westminster, City of London, Tower Hamlets, Camden and Lambeth are actively promoting green roofs*

Status of implementation of green roofs:

- ❖ *506 installations, accounting for 432,592m² of green roof cover (as audited between January 2004 and March 2009 by Living Roofs).*
- ❖ *Mayor's commitment to implement 100,000 m² of green roofs by 2012 (GLA, 2010; GLA, 2009e).*
- ❖ *Major future projects: Greenwich peninsula 100,000 m²; Barking Riverside regeneration 400,000 m²*
- ❖ *Most green roofs are a sedum mix (they can overwinter and require less water in summer). Where buildings have access to the roofs, the green roof will be more diverse with plants and wild flowers.*
- ❖ *First driver has been biodiversity (habitat for the black redstart bird), second driver: climate change.*
- ❖ *More information can be obtained at: <http://www.livingroofs.org/livingpages/auditlondon.html>.*

Jubilee Park, Canary Wharf



Cannon Street Station



Radisson Hotel



4.4.3. *Environmental Equity*

The analysis of environmental justice involves the extent of information and awareness in local spatial planning policies and processes of the environmental equity situation of certain population groups with respect to availability of green space and the vulnerability to flood risk and heat stress, as well as the inclusion of redistribution mechanisms to promote an equitable situation in these respects.

London is an attractive destination for a diverse range of population groups and therefore has a unique ethnic mix of people. Extreme poverty and extreme wealth all come together in London. The boroughs of Tower Hamlets and Hackney in East London are the two most deprived areas in the whole of the UK, with a huge concentration of social housing and immigrants. Health inequality as a result of social, economic, cultural and environmental inequalities is the focal point of policy making on equity in London. The draft London Health Inequalities Strategy was published by the GLA in September 2009, which identifies health inequalities and actions to reduce them. In this strategy the Mayor advises the planners of the GLA and the boroughs to consider health inequalities in major planning applications and in local planning documents (GLA, 2009c). The LP also explicitly states reduction of health inequality to be one of its objectives. GIS analysis has identified areas of deficiency in access to nature in London based on distance to green space. These areas of deficiency coincide with areas of multiple social deprivation. They used to be industrial sites which were redeveloped in the 1960s and 1970s for social housing purposes (GLA, 2008a). A supplementary planning guidance 'Equality and Diversity' to the LP has been published that gives specific guidance to the boroughs in addressing the unequal situation with respect to different target groups. It stipulates that London's regeneration efforts should concentrate on the most deprived areas located in the central and eastern part of London (GLA, 2007). The expectation is that climate change will exacerbate health inequalities as a result of heat stress, flooding and other extreme weather events (GLA, 2010). Access to green space is acknowledged to be one of the co-determinants of vulnerability to heat. A GIS map of the urban heat island effect in London has been developed. After the heat wave in the summer of 2003 the national government has made a heat wave plan for England, in which the responsibilities are assigned to national and local governments for alerting and advising people. A London heat wave plan is expected by Autumn 2010. According to the draft adaptation strategy flooding is also likely to impact worst on deprived communities, many of which are in the areas that may be affected, are less likely to be insured and are more affected by the stress of the flood itself. The draft adaptation strategy contains a spatial map of 'high social flood vulnerability' based on research by the Environment Agency (GLA, 2010). The LP and draft adaptation strategy also specifically propose to target areas of deprivation for the creation of new green space as a priority for the urban greening programme, in order to address the inequitable situation regarding vulnerability to heat. For instance, the commitment of the new Mayor to plant 10,000 new street trees by 2012 will be used to target these deprived areas. Likewise, the inclusion of green space or green roofs in all major redevelopments should take reduction of inequity into account. The inequitable situation regarding flood risk is not (yet) addressed with specific policies.

To conclude, the inequitable situation regarding vulnerability to climate change and access to green space is acknowledged in spatial and adaptation planning, adequate information is available, and some policies are in place to redress inequality.

4.4.4. *Key barriers and opportunities to the legal capacity*

Out of the five capacities that make up the governance capacity, the legal capacity did not raise significant barriers among respondents. According to them the discrepancy between planning policy and planning practice could lead to a questionable implementation of planning policy. Another barrier that comes out of the analysis is that the legal provisions of planning policy for green roofs mainly affect new or re-development, and thus do not address the retrofitting of existing buildings, which still offers the largest potential for green roofs.

4.5. Managerial capacity

4.5.1. Integration of adaptation and green planning into spatial planning

Here the following three indicators are analysed: the extent to which spatial policy documents contain adaptation issues, goals and measures; the extent to which the urban planning process contains provisions to climate proof the city; and the extent to which green infrastructure planning is a mature and integrated part of overall city planning and used as an instrument for adaptation.

Climate change is a primary issue for spatial planning in the UK. The national government is revising a lot of their policies with climate change in mind. This becomes evident in key policy documents such as the Sustainable Communities Strategy which sets the context for new development in the UK. The supplement to PPS1 on climate change is another case in point. It is expected that a separate PPS will soon be released on climate change. The Royal Town Planning Institute, which is the professional institute for planners in the UK, currently views climate change as the main affair in planning. It has published an action plan with seven commitments called "Planning to live with Climate Change" (RTPI, 2009). Similarly, climate change has been embedded in the spatial planning agenda of the GLA, mainly through their statutory document that carries most weight, i.e. the LP. The first LP from 2004 already mentions climate change as a separate issue. It contains a separate paragraph and policy on climate change, focusing primarily on mitigation. The most substantial changes to the LP 2008 consolidated version relate to climate change issues. It contains a full chapter on climate change and contains policies on both mitigation and adaptation. The new draft 2009 version is equally strong on climate change, and even more explicit on adaptation issues. In fact GLA's intention is to mainstream mitigation and adaptation into all of GLA's policy documents as part of the sustainable development agenda (GLA, 2010). In their view it is not about creating separate policies for adaptation, but about how existing policies might be affected by the impacts of climate change and how these should be mitigated (Nickson, 2009). At the local level however, most spatial planning documents of the boroughs still focus on mitigation when it comes to climate policy, although a few boroughs such as Islington, Camden and the City of London, are advancing on adaptation policy.

The national government also employs certain measures to ensure that adaptation is being considered in planning processes of local authorities. To begin with they have made the Environment Agency a statutory consultee for all developments in the London flood plain, as well as for any development larger than 1 hectare, in part to ensure the incorporation of sustainable drainage systems such as green roofs. Therefore they will be automatically consulted on many planning applications, although the boroughs do not necessarily need to follow their advice. The 'Local Government Framework' of the Department for Communities and Local Government (DCLG) is another way of the national government to influence adaptation planning at the local level. This framework contains national indicators, on which the boroughs have to report on a regular basis. One of these indicators is on adaptation (number 188, requiring the production of a comprehensive adaptation action plan) and one is on flood risk management (number 189). Boroughs have to select 35 of 199 indicators for which they have to agree stretch targets with the national government, laid down in a so-called 'local area agreement' (DCLG, 2009b). At the moment six boroughs have signed up to indicator 188, which is still rather low compared to the 19 boroughs that have signed up to indicator 186 on mitigation. However, this national indicator does push the adaptation agenda at the local level. Another initiative from DCLG is the 'Code for sustainable homes'. It is a national voluntary standard for sustainable building, which ranges from code 1 to 6 (most sustainable design). Some boroughs are making particular code labels mandatory for developers in order to get planning permission. Although a lot of the items in this code are concerned about mitigation, there is no reason why adaptation concerns could not be incorporated. One more recent development should be noted. In October 2008 the national government issued an amendment to the Town and Country Planning General Permitted Development Order 1995, which permits the paving of front gardens of more than five m² only when permeable materials are used, in order to reduce the impact of flooding. This new regulation will have to be enforced and controlled by the local authorities and is

another way to include an adaptation goal into planning processes (DCLG, 2008). Other than these national requirements there are no standard procedures yet at the local level to automatically and routinely consider the full scope of adaptation issues and measures in planning processes, except for the fact that boroughs can make supplementary planning documents for Sustainable Design and Construction in which they can incorporate adaptation measures.

Although the GLA does not have an explicit strategy document on green infrastructure planning, this topic does appear to gain momentum in GLA's spatial policies. While the previous Mayor already made a strategy for an East London Green Grid, the current Mayor has announced its expansion to the whole of London. Urban greening is a separate programme in the new draft LP. It is not only mentioned as a key element for raising the physical and quality of life in London, but it is also viewed as a primary adaptation measure in the policy on adaptation in the LP (GLA, 2009a). The PPG17 requirement for boroughs to make open space strategies as well as the plea in the LP to do so, also stimulates green planning at the local level. The new draft adaptation strategy also views the urban greening programme as one of its key actions (GLA, 2010).

In summary, adaptation is gradually starting to get embedded in spatial policy documents and spatial planning processes. The national government has created a number of (legal) requirements to ensure adaptation is being considered at the local level in a rather top-down manner. The LP is the most important vehicle of the GLA to facilitate the integration of adaptation in local spatial documents. The GLA is giving green infrastructure planning considerable attention and is promoting it as a key adaptation measure.

4.5.2. Organisation of spatial, green and adaptation planning

This section deals with the extent of fragmentation of tasks and responsibilities for spatial, adaptation and green planning in the city; the horizontal coordination of spatial planning with other policy fields; the geographical coordination of spatial planning across London; and the vertical coordination with other government levels.

The responsibility for spatial planning in London is spread out horizontally across the 33 boroughs and vertically across three government tiers: the Government Office for London as the national government authority, the GLA as the Pan-London strategic authority, and the 33 boroughs as the local authorities, the latter two tiers being the most important (the government office appears to play more of a coordinative role). A lot of private and third parties are involved as well, in particular through partnerships of regeneration projects. This creates a complex map of governance structures, in which partnerships between governments at different levels, complemented with private parties and specialised national government agencies such as the Environment Agency, play a considerable role. This institutional fragmentation is not limited to spatial planning, but appears to be even more severe when it comes to green planning in London. Open(green) space in London is funded and owned differently. For instance, The Department of Culture, Media & Sport manages the eight royal parks through its non-departmental body The Royal Parks Agency. Another national government body, called the Forestry Commission, is responsible for the implementation of a tree planting scheme in London. At the GLA, two departments are involved in green planning: the environment department and the London Development Agency (which is also part of the GLA), which is responsible for the public realm. At the local level open(green) space is mostly in the hands of the boroughs, although sometimes registered social landlords are also responsible for the green space of social housing areas. Each borough in London has a different organisation to manage their green spaces: sometimes it is a traditional parks department, and sometimes they are joined with street services or cultural services for example. Regarding adaptation planning, in general this seems to be less fragmented. At the GLA level the environment department is responsible with a dedicated adaptation officer (although this used to be five people). At the boroughs' level it is also mostly the environment department, if adaptation is managed at all. One borough, Islington, has a separate adaptation officer and this is very unique in the UK. The water management side of adaptation (flood risk management) again is hugely fragmented across different government levels and agencies.

While institutional fragmentation hinders the coordination among different government tiers, relationships between the GLA and the boroughs can put a further strain on the vertical coordination of spatial and green planning in London. And that is where party politics play a role in the governance of London: the political colour of the Mayor and the boroughs determine the extent of cooperation. For instance, in the past this caused major disagreements over housing targets to accommodate for London's growth. The new Mayor Johnson is seeking a slightly more consensual approach. The LP provides a strategic overview and leaves the implementation more to the individual boroughs. Fortunately the relationship between the GLA and the national government appears to be facilitated quite smoothly through the Government Office for London according to respondents. Nevertheless this relationship remains quite hierarchical, since in the end the national government (Secretary of State) needs to ratify the LP. Geographical coordination among 33 boroughs is difficult because the boroughs work quite independently and communicate poorly among each other. Furthermore coordination among boroughs is equally constrained by party politics: boroughs of the same political colour are more likely to work together across their jurisdictional boundaries.

Apart from a fragmented governance landscape, horizontal coordination among policy departments is further impeded by compartmentalisation. This entails silo thinking and the inability to think across professional boundaries as a result of a strong sectoral structure and working style with government functions vested in separate departments. This is a phenomenon in the UK which starts at the top of the hierarchy at national government level and trickles down to all levels (Flinders, 2002; Nadin, personal communication; Leach personal communication). At the GLA compartmentalisation across different divisions exists, for instance between the environment team and the LDA group on green infrastructural matters. Within boroughs this phenomenon is present, for instance in green space planning and management as a result of the strict professional boundaries between parks managers and planners, sports people, children's services, education etc.

It can be concluded that institutional fragmentation and compartmentalisation are posing very serious constraints on the managerial capacity, as is also confirmed by many respondents.

4.5.3. Use of management tools and strategies

This involves the analysis of management strategies and tools to promote the effectiveness of spatial planning in climate proofing London, both in terms of policy development and in terms of implementation, as well as in terms of the promotion of multi-functional forms of land use, as a means to achieve both its socio-economic and its environmental targets.

The primary strategy that seems to be employed in London for joining things up, is by means of partnerships. While this is a typical aspect of the UK governance of spatial planning (Cullingworth and Nadin, 2006), it is exacerbated by the fact that the GLA is not an implementation body and needs other agents to deliver its policies. There are numerous examples of these partnerships that form networks of state-society relations. In spatial planning there are many different constellations of partnerships for the larger development and regeneration projects, often in the form of public-private partnerships. Green Infrastructure planning also increasingly gets done via specifically created partnerships, such as the East London Green Grid partnership. The London Parks and Green Spaces Forum was established by a consortium of organisations including the GLA in 2003. The Forum tries to compensate for the institutional fragmentation of green space planning and management in London by bringing all involved parties together and exchanging information and experiences. The GLA is currently in the process of setting up an urban greening group to manage the new urban greening programme in the LP. With respect to planning for adaptation, as mentioned earlier there is a London Climate Change Partnership. There is also a London Climate Change Group, run by London Councils which is a special local body that is supposed to coordinate across the boroughs and to act as a voice for them. Next to people from the boroughs, several GLA bodies and the Government Office for London are also represented in this group, which aims to coordinate both mitigation and adaptation across London. DRAIN London is a partnership of various bodies at different government levels, which is looking at surface water flooding, the hotspots of high risk

areas and actions to remediate these risks, such as restoration of natural river flows and green roof projects for sustainable urban drainage. At the local level each borough has a strategic partnership, consisting of the council, the police, national health service and the chamber of commerce. These partnerships produce a community strategy, which sets out the vision for the borough. Furthermore boroughs have established working groups for project implementation. In case of a planning application, specialists of several departments get drawn in at an early stage in order to have a smoother development control process.

Multi-functional forms of land use which incorporate adaptation measures, are still quite rare in London. Some opportunities have arisen in case of major interventions in the landscape. For instance, Sutcliff Park and Chin brook Meadows have been completely redesigned to simultaneously deal with flood alleviation. Nevertheless, the draft adaptation strategy admits that many areas of open space are underutilised, in particular with respect to flood storage (GLA, 2010). The new draft LP does promote multi-functional green and open spaces for recreational, sports, food production, mitigation, adaptation and biodiversity services. However, so far green roofs appear to be the most promoted form of multi-functional land use for climate proofing London.

In other words, efforts to counteract fragmentation and compartmentalisation are centred around two themes: firstly the integration of adaptation considerations into all spatial and other policy documents by the GLA, so that it will gradually influence the policies and processes of other bodies; secondly and most importantly various initiatives to join up parties through partnerships and working groups.

4.5.4. Key barriers and opportunities to the managerial capacity

In London the most important barrier to the managerial capacity is institutional fragmentation, both horizontally and vertically. The two-tier planning system in London is a key feature of the vertical fragmentation, further aggravated by the various central government agencies that have some responsibility or task in London. Lack of geographical integration across the 33 boroughs is also a key barrier, as well as compartmentalisation. Fragmentation of ownership and authority, and the complexity created by the involvement of so many different bodies, were also mentioned as the most important barriers as perceived by respondents in 6 of 11 interviews. The most important opportunity as perceived by respondents is using existing green space more efficiently; green roofs are the most obvious solution in this respect and provide millions of hectares of unused space in London. Another important perceived opportunity is the utilisation of the regeneration potential in London for adaptation and green space planning. The analysis further suggests that there are opportunities in a more inclusive integration of adaptation in planning processes and standards, such as the code for sustainable homes.

4.6. Political capacity

4.6.1. Accountability

Indicators analysed are an open and transparent planning process and an active involvement of stakeholders and the public in urban planning processes.

Traditionally participation in the UK has been rather limited. However, the EU Directives on Freedom of Access to Information and the UK Freedom of Information Act 2000 have given the public much more access to information of public authorities (Cullingworth and Nadin, 2006). Nowadays all kinds of documents are routinely published and accessible via internet, although most authorities do not actively stimulate access to information to make it truly transparent. The consultation of planning processes by stakeholders and the public is regulated by law, prescribing formal procedures. Since the planning reform of 2004 opportunities for community involvement have expanded, although the responsibility for the ultimate decision-making remains with local authorities as stated in PPS1 (Cullingworth and Nadin, 2006). The Department for Communities and Local Government has created a central planning portal through which all information regarding planning processes and all

planning documents of local authorities can be retrieved. The portal is geared towards user groups: there is a portal for the general public, one for the professional user and one for the government user (DCLG, 2009c).

The LP and other strategy documents of the GLA undergo a two-stage consultation process: one for Internal stakeholders (the London Assembly and GLA functional bodies) and one for the public at large. Both of these stages are based on draft documents after they have been published; there is no formal procedure for stakeholder involvement during the creation phase. After the stakeholder input has been provided, it is then within GLA's authority to determine how the comments will be incorporated into the final document. At the local level, planning policy documents also undergo public examination. The final documents are approved by the council. The processes around planning applications are also open to public examination. Local residents and a variety of stakeholders are actively consulted. These might be professionals from the local organisation, GLA bodies, and the Environment Agency. Based on the comments received, the planner officer makes a final recommendation for the planning committee of the council to decide upon. A report of the planning application process is made public via the website of the borough, and can be retrieved by means of a reference number of the planning application. Objections have to be in the report. In addition there is a London Development Database, which monitors the planning permissions of all 33 boroughs through to completion. Moreover, each borough and the GLA are statutorily required to make an Annual Monitoring Report, which assesses the effectiveness of the planning documents and is based on key performance indicators (GLA, 2009d).

Nevertheless, for an ordinary person it is a very complex and technical process, and it is very difficult to understand who makes the decision and how this decision is made. That is where the developers, supported by their lawyers, are at an advantage according to some respondents. In practice, the control over the planning process is predominantly political; the councillors deliver the checks and balances. Nevertheless, civil society groups are able to influence the councillors. This is certainly the case for green space. There is so much public opposition to loss of green space; for instance many parks in London have a friends group made up of local people. These friends groups are generally very active and quite powerful in the sense that they can heavily influence the councillors. All in all, nowadays there are a lot of legal requirements to accommodate for an open and transparent process for the more professional users. Civil society is able to pressurise the system bottom-up by influencing the councillors.

4.6.2. Political will

Here the extent of political support and how this support is achieved and contained are analysed.

The political support for climate policy in London is very high, albeit primarily directed towards mitigation policy. There has been a considerable push from big businesses and the banking industry. Another driver has come from the insurance industry, which end up paying for flood damage. The previous Mayor Ken Livingstone has been key in driving the climate change agenda, and he has used the LP as the key document to push this agenda down to the boroughs' level. With an elected mayor, the GLA is very party political. The same is true for the councils of the borough. Policies tend to be fixed until the next round of politicians, hence these periods (of four years) are often too short to implement policies. A switch of Mayors could therefore lead to a shift of strategic direction for London. Fortunately, this has not happened for climate policy when Mayor Johnson took over. Nevertheless, the party political system of the GLA and the boroughs, as well as the short-termism of politics are seen as dangers to the continuation of adaptation planning by respondents.

Although adaptation is rising on the political agenda, it still has the perception of being very long away and being very expensive, while mitigation efforts such as energy efficiency are seen as delivering more short-term financial benefits. The funding stream from the national government is almost all for mitigation. With the exception of a few, most activities of boroughs are also centred around mitigation. Or as one respondent said: "adaptation is still the poor cousin" (Boow, 2009). Therefore, many respondents mentioned the establishment of strong linkages of adaptation with

mitigation as a good opportunity to take adaptation forward; in particular because mitigation is a big driver for retrofitting homes, for instance by promoting green roofs as both insulator and heat moderator. Furthermore the political profile of adaptation can also be enhanced by the London Climate Change Partnership and their frequent publications. Recently the GLA also used the momentum of the publication of the new UKCP09 climate projections to inform its stakeholders and raise their political awareness and support.

4.6.3. Leadership

Leadership is analysed by looking at the extent of top-down and bottom-up leadership, and involvement of external parties in pushing the adaptation agenda.

The reason why London is so advanced in climate change policy is certainly to a large extent due to the leadership of Mayor Ken Livingstone. Through his strong planning powers he has really pushed climate change into the development agenda of London. He has put so many climate policy requirements in GLA's spatial and other policies, that it has created a culture shift and has set the norm in London. The new Mayor has continued this approach, and the expectation is that there will be even more of a push for green infrastructure for climate change and for general quality of life purposes. The Environment Agency has also played a key role in pushing the adaptation agenda in general (for flood alleviation purposes) and for green roofs in particular (for sustainable drainage and biodiversity purposes). An external party such as Living Roofs was crucial in the promotion of green roofs with the GLA and with the boroughs, as well as other members of the London Biodiversity Partnership. The NGO Groundwork also played a role in realising many projects on the public realm and adaptation, thus pushing the adaptation agenda on the ground (Groundwork, 2009). Bottom-up leadership has been provided by dedicated officers from the environment team of the GLA and from a few people in the boroughs. On the whole, leadership from the two Mayors seems to be the key driver of the climate change agenda in London.

4.6.4. Key barriers and opportunities to the political capacity

As a result of the two-tier governance system, the political capacity in London appears somewhat dependent on the political colour of both the Mayor and the councils of the boroughs. When they come together, there is a lot of potential political support and power. When they diverge, there is a big potential constraint to the consistency of policy across London and therefore to the political capacity. Respondents indicated that the lack of political buy-in (by boroughs) and the political tensions between the Mayor and the boroughs could pose barriers to the political capacity. The biggest opportunity is presented by the linkage between adaptation and other important societal themes, and in particular linking up with mitigation. Another suggestion, made by two respondents is stressing the business opportunities from adaptation; there is a big market to stop flooding and overheating for local businesses by retrofitting homes on a tailor made basis.

4.7. Resource capacity

4.7.1. Economic resources

This entails the analysis of the available budget and land for adaptation and green infrastructure planning.

There is no direct funding mechanism for public green space since this is not a legal requirement in the UK unlike for public education, health and housing. Consequently there is no central source of government funding apart from The Big Lottery & Environment Agency river restoration projects. The national government does occasionally have thematic campaigns such as the 'greener, safer, cleaner' initiative from the Department for Communities and Local Government for the funding of public parks as a result of an assessment that the management of public parks in England is in serious decline. On the whole, however, green space is very poorly resourced and undervalued in England as in many other parts of the world, which has fostered a culture of widespread decline (CABE space,

2004). In November 2009 the Commission for Architecture and the Built Environment (CABE) started the 'Grey to Green' campaign, in which they try to influence public decision makers to transfer some of the investments for grey to green infrastructure in light of the dangers of climate change. They have calculated that a 0.5 percent shift of investment from grey to green infrastructure would represent a 141 percent increase in green infrastructure expenditure by local authorities (CABE, 2009). There is equally little funding for adaptation from the national government since most of the money for climate change is spent on mitigation. Again, funding is based on occasional projects such as the DRAIN London project, which is partly funded by the Department for Environment, Food and Rural Affairs (DEFRA). DEFRA is also putting some money for adaptation research into the London Climate Change Partnership. At the level of the GLA, the Mayor has freed up some of his limited budget for the urban greening programme related to climate change: he has made funds available for the planting of 10,000 trees until 2012 and the upgrading of a number of run-down strategic parks in London, for a total amount of approximately £ 10 million. The GLA is also trying to establish a revolving fund for green roofs, into which the benefits of a green roof are recharged back while the extra cost of its initial development is subsidised by the fund. Moreover, the GLA is trying to quantify the ecosystem services of green space for climate change and other benefits, as a potential solution to the undervaluation of green space. As the owners of most public land in London, the boroughs are the primary responsible bodies for the funding of green space. However, the management of existing green space usually falls down as a lower priority in case of budget cuts. The maintenance of green space is so expensive, that it is a reason for not taking on additional green space. Moreover, land in London is simply too expensive for boroughs to acquire new green space, although they do have the power to do so under the Compulsory Purchase Act. In sum, economic resources for adaptation and green space planning are very limited as a result of the setting of public priorities from national to local governance levels.

4.7.2. Human resources

Here the number of people involved in planning, their skills and know-how and the extent to which the organisational culture is conducive to change, are analysed.

Adaptation and spatial planning fall under the responsibility of the Development and Environment Group of the GLA. The Environment group has faced serious cut-downs from 40 to 22 people; the people involved in adaptation are down from five to only one person since the fall of 2009. The planning group is quite well resourced with 45 people, of which 15 are entirely dedicated to the LP. The number of people involved at the local level depends heavily on the boroughs. All boroughs will have a considerable amount of people involved in spatial planning, both in policy development and in development control. With the exception of Islington, the number of people involved in adaptation planning is still very limited. The staff of the GLA are quite renowned for their expertise and technical support they provide to the boroughs; for instance the energy team within the Environment group consists of climate scientists and energy engineers. Within the GLA a lot of expertise can be pooled, for example to give input to the LP in order to provide coherent responses to issues. The knowledge of the planning team on climate change and on adaptation planning to stop flooding and overheating is steadily growing, although respondents indicated that they are still at the beginning of a huge learning curve, in particular in the planning teams of the boroughs. However, adaptation planning by means of green space is first and foremost hindered by lack of skills to design and maintain green infrastructure at the local level, according to CABE. New organisational skills are needed to break down the professional barriers and integrate services such as green space and water management, children's play, nature conservation and so on (CABE, 2009, p. 9). One respondent even goes further in saying that these professional boundaries are reinforced by the professional institutes for architecture, horticulture and landscape planning, who maintain their own culture for protectionist reasons. More training is needed to bring these professions together, for example through urban design courses.

To conclude, the GLA suffers primarily from a limited quantity of human resources to climate green London. The local authorities primarily lack the quality of human resources to do this, in the sense that they lack the management skills to break down professional silos in order to have an integrated approach needed for climate greening the city.

4.7.3. Knowledge resources

Indicators analysed are the level of technical and social knowledge regarding adaptation and green infrastructure planning, and support of external experts (epistemic community).

The knowledge base for adaptation is gradually growing albeit mainly geared towards technical knowledge. As mentioned in section 4.3.2. national government puts a lot of money into research on climate change and adaptation. The UK Climate Impacts Programme (UKCIP), funded by DEFRA, is a very elaborate source for adaptation knowledge, provided by a wide research community consisting of renowned institutes such as the Tyndall Centre for Climate Change Research. Next to detailed climate projections UKCIP has developed an extensive range of tools to inform policy. For instance, a special tool for local authorities has been made to gain knowledge on their exposure to weather and climate change, called 'The Local Climate Impacts Profile' (LClips). 23 London boroughs are currently in the process of using this tool to get forward planning of adaptation into the mindset of local politicians, coordinated by the London Councils. Furthermore, UKCIP has developed 'The Brain', which is a knowledge database with a collection of research activities on climate change impacts, adaptation actions, research activities and academic literature on climate change adaptation research (UKCIP, 2009). The LCCP also conducts research on a regular basis to raise the technical knowledge level regarding adaptation measures. In close cooperation with Living Roofs, the GLA has made many studies and reports available on green roofs (GLA, 2008b). Living Roofs is currently collecting data on green roofs in London on behalf of the GLA. This data base can then be used to target GLA's green roof policies towards areas of deficiency and/or urban heat island areas. With respect to green space a records centre for open space and biodiversity has been established since 2006 that collects and stores information provided by the boroughs and various other partners (GiGL, 2009). Knowledge on the building of new and regeneration of existing areas can be found in the London Development Database. As a result of these data bases and other tools, technical knowledge is increasingly made available for adaptation planning purposes by various scientific experts.

4.7.4. Key barriers and opportunities to the resource capacity

The key perceived barriers by respondents are the lack of budget for the urban greening programme at both the GLA and the local authorities level, and the lack of knowledge of planning officers on adaptation. The analysis further suggests that the lack of skills to think laterally and to overcome compartmentalisation is another important hurdle to the effective adaptation planning of boroughs. The main opportunity to increase the resource capacity appears to be offered by education and training programmes for staff, both to acquire know-how on adaptation, as well as to acquire new management skills.

4.8. Learning capacity

4.8.1. Dealing with uncertainty

This section deals with the way uncertainty is treated, the extent of technical approaches used to increase the evidence base, and the extent of managerial approaches used to handle uncertainty.

London has very recent forecasts of climate change effects at the sub-regional level at its disposal in the form of the UKCP09 projections, and London Councils has set up the London LClips project to estimate the impacts of climate change at the local level. Therefore the knowledge regarding local climate impacts is rapidly building, although it is acknowledged that these are projections and not predictions and thus a certain degree of uncertainty will persist. Still, uncertainty was expressed as being a big barrier by many respondents, in particular with respect to which intervention is needed in

which location (e.g. “if I do X, this will lead to Y reduction in storm water runoff”). Knowledge of the local impacts and financial implications of adaptation policies and measures is still in its infancy. Moreover, adaptation measures are perceived to be very costly. This is posing a real challenge, since policies in the UK that go out for public consultation need to have a strong evidence base to support them. That is why policy documents such as the LP are accompanied by impact assessments. Another example is the Living Roofs technical report which has provided the evidence base for the green roofs policy in the LP (GLA, 2008b). The LP is also managed according to the so-called ‘Plan, Monitor, Manage’ approach; the best available information is used at the time of writing the plan, and then the plan is monitored and reviewed on a regular basis. That is why the LP has already experienced its third review since its creation in 2004. Besides conducting impact and financial assessments to attempt to provide the technical and economic rationale of measures, the GLA also takes a pragmatic approach by looking at overseas examples of proven technical adaptation solutions. Next to the employment of technical approaches, new approaches have also been explored to deal with uncertainty. The Tyndall Centre for Climate Research has developed simulation modules for the GLA, based on scenario building for socio-economic, climate and land use changes, as well as options for GLA’s policy responses. These options are fed by various stakeholders in London (Hall et al, 2009). The Tyndall Centre is also helping to inform the current review of the LP by modelling expected growth projections and GLA’s policy responses to key climate change impacts. Furthermore, real-life experiments are being conducted with research institutes. For instance the Scorchio project which aims to develop a computer model that will use land cover types to represent the urban climate feedbacks and thus assess the vulnerability to the urban heat island and climate change and possible adaptation options. Another example is the Lucid research project, which aims to explore the effects of changes in for instance green cover on the local climate, hence it can refine the understanding of the amount and sort of green space required for the reduction of the urban heat island effect (GLA, 2010). In the Drain London project green roofs are installed and monitored to get real data on quantification of their water drainage potential and impact on the urban heat island effect. At the local scale a progressive borough such as Islington is also conducting case studies of experiments with adaptation measures, many of which are green. For instance, they are actively participating in CABE’s Greening the Grey programme: 5 projects to remove hard standing surfaces, to plant vegetation, and to create green walls have resulted in an increase of 600 m² of permeable surfacing in 1,5 years time. Other projects concern the piloting of different permeable paving materials and systems for tree watering. In sum, in London uncertainty is perceived to be a big barrier and both traditional technical solutions to reduce uncertainty and more modern management techniques and experiments to deal with uncertainty are employed to gain a better understanding of climate impacts and adaptation interventions.

4.8.2. Continuous learning processes

An analysis is made of the existence of infrastructure for the distribution and safeguarding of knowledge, for the exchange of experiences through internal and external networks, and the use of stakeholder dialogue for enhancing learning processes.

As was already clear from the section on knowledge resources, there are several databases that policy makers and other stakeholders in London have at their disposal for promoting the dissemination and continuation of knowledge transfer, and which can be accessed via intranet or internet. In addition, the GLA and LCCP organise numerous workshops and training sessions internally and for the boroughs around sustainable design and master planning for climate change. There are also various internal and external networks that facilitate the exchange of experiences and the sharing of best practices. Examples of networks for the spatial planning community are the GLA internal support networks for planners, the Planning Portal of DCLG and the website of the Town Country Planning Institute. There are also networks to support local authorities. London Councils has built a portal (not public) for the boroughs in which they can share their best practices. Boroughs can also make use of the ‘Communities of practice’ of the national government agency IDEA, in which

individuals can blog, host webinars, post documents and form all kinds of communities and share their experiences. Specific networks in the area of green infrastructure planning and management are the London Parks and Green Spaces Forum and the network of parks friends groups that exist in several boroughs, which is facilitated by this forum. In terms of climate change there are two pan-London networks: the LCCP and the London Environmental Coordinators Forum. On a wider geographical scale there is the Three Regions Climate Change Group for sharing information and experience in the South-Eastern part of England. A borough like Islington has also initiated its own Islington Climate Change Partnership, although it is primarily geared towards mitigation. The Mayor of London also participates in the C40 cities climate leadership transnational network and the allied Clinton Climate Initiative, and as such has the possibility to exchange experiences with other cities around the world. Stakeholder dialogue is embedded in the various partnerships mentioned above since these partnerships contain various stakeholders from government, private and third party organisations. Occasionally the GLA also holds special stakeholder dialogue sessions with specific stakeholder groups. In October 2009 six sessions were planned around the UKCP09 projections and their impact on these stakeholders in London.

It can be concluded that the infrastructure for the facilitation of learning processes in London is present in various forms of databases and networking facilities created by the ample presence of forums and partnerships.

4.8.3. Key barriers and opportunities to the learning capacity

The biggest barrier as perceived by respondents is the uncertainty regarding the local impacts of adaptation interventions, which was mentioned in five out of eleven interviews. The biggest opportunity for supporting learning processes are offered through the networks of various stakeholder constellations, often as a result of the numerous partnerships that have been created in London.

4.9. Synthesis

It can be concluded that London is a leader in policy development for adaptation to climate change. It is one of the first cities in the world to formulate a specific adaptation strategy. Moreover, the Greater London Authority (GLA) had already integrated explicit adaptation policies into its city wide spatial plan, the London Plan, as early as 2004; the 2008 consolidated version of the London Plan contains no less than a separate chapter with various policies on both climate change mitigation and adaptation. A substantial role in climate proofing London is awarded to the 'urban greening programme', as an important means to moderate excessive rainfall and heat. The policies for urban greening are meant to serve a wider range of sustainability goals, although adaptation to climate change is a very important one. The greening programme consists of a wide range of green policies and measures to protect and enhance existing green space, and to expand green space. The new green roof policy from 2008 is an important means to expand green space, in particular in the densely built central London area for which a target of 5 percent green space expansion by 2025 has been set. The roof surface area covered with green roofs expressed in percentage of total roof coverage in London is still very modest. The achieved number of almost 500,000 square meters by mid 2009 is nevertheless impressive compared to many other global cities, the more so since green roofs have not been financially supported via an incentive programme. Moreover, their uptake is expected to increase because of the new policy.

Several adaptation policies have been initiated by the GLA, many of which have been incorporated into the London Plan to 'secure' their dissemination across the London boroughs to the local authorities. For an overview of the most important policy developments, implemented activities and future policy intentions, see box 4.3. It remains to be seen how much of all these GLA policies and future intentions will materialise in practice as they are translated into the policies of the 33 boroughs, which in effect implement most of these policies and activities. One of GLA's short-term priorities involves the stimulation of green roofs via a prospectus and investigation into an incentive

scheme, in order to achieve an additional 100,000 m² by 2012. One of the short-term activities to enhance green space, is the expansion of the East London Green Grid over the entire city. Furthermore, GLA will work on policies and activities that are geared towards the adaptation of existing houses and buildings, since most existing adaptation efforts have focused on new and re-development, activated through the London Plan. Moreover, one will try to convince national government to amend current building regulations, so as to include provisions for making buildings climate resilient.

Box 4.3. Adaptation policy development and implementation in London

Most important implemented adaptation policies:

- ❖ *Green roof policy through the London Plan (Mayor of London/Greater London Authority)*
- ❖ *'Urban Greening Programme' through the London Plan and Draft Adaptation Strategy*
- ❖ *Draft Adaptation Strategy (February 2010, Mayor of London/Greater London Authority)*
- ❖ *Draft Water Strategy (August 2009, Mayor of London/Greater London Authority)*
- ❖ *A few boroughs have issued their own adaptation strategy, for example*
 - *City of London Corporation*
http://www.cityoflondon.gov.uk/Corporation/LGNL_Services/Environment_and_planning/Sustainability/Climate_change/.
 - *Islington*
http://www.islington.gov.uk/Environment/sustainability/sus_climate/adapting_climate_change.asp.

Most important adaptation activities and research projects (executed or in execution phase):

- ❖ *London Climate Change Partnership, headed by the Greater London Authority (since 2002)*
- ❖ *UKCIP: UKCP09 with localised climate projections for London and "the Brain"*
- ❖ *Tree planting programme and Priority Parks Programme by Mayor Johnson*
- ❖ *Boroughs initiatives, with Islington being most active with a dedicated adaptation officer. See http://www.islington.gov.uk/environment/sustainability/sus_building/buildings_climate.asp.*

Most important future policy intentions for adaptation relevant for this research (for a complete overview see the Draft Adaptation Strategy):

- ❖ *Re green roofs: Study on and implementation of a green roof incentive programme for the retrofitting of existing homes; prospectus on the benefits of green roofs.*
- ❖ *To manage temperatures by increasing green space in the city: enhance 1,000 hectares of green space; prepare supplementary guidance for a London-wide green grid; increase green cover in the Central Activities Zone.*
- ❖ *Restoration of 15 kilometers of London's rivers.*
- ❖ *Lobby the government to amend building regulations to require buildings being rebuilt or renovated to be climate resilient.*

Considering the early stage of policy development and implementation, this study cannot and is not meant to evaluate the effectiveness of these policies. Instead it aims to analyse the potential capacity of cities to govern adaptation planning, with a focus on the spatial planning policy field. There is a common recognition of the role of spatial planning in governing adaptation to climate change. A framework of analysis has been developed, in which the governance capacity is broken down into five sub-capacities: the legal, managerial, political, resource and learning capacity (see chapter two for more details). This chapter has presented an analysis of these capacities, based on the adaptation policies, activities and policy intentions of the London. The *legal* capacity of the spatial planning policy field appears to be most developed for climate greening London. Formally it offers considerable potential to protect existing green space and create new green space and thus to

contribute to London's adaptation to climate change, although there might be a considerable discrepancy between planning policy and planning practice on the ground, as stated by some respondents. The *managerial* capacity of spatial planning however, faces huge barriers. The first and most severe barrier is institutional fragmentation. Responsibility for urban and green planning is spread across a multitude of actors: horizontally (different functional departments/bodies), vertically (different government tiers) and geographically (33 boroughs). The second important barrier is compartmentalisation, which is a typical phenomenon of UK government from the national to the local level. The vertical structure created by specialised government departments is generally regarded very suitable in delivering discrete policies, but not very effective in dealing with a wicked problem such as adaptation. In the face of uncertainty, adaptation requires lateral and integrative thinking in order to develop difficult, non-evident and often contradictory solutions with the involvement of many actors with different value systems. The key way London is trying to overcome these barriers is by means of networks arrangements in the form of partnerships, forums and working groups. Another way is to mainstream adaptation considerations into the documents of all relevant policy sectors so that it will gradually create a culture shift. The *political* capacity is quite developed, thanks to the strong leadership of two consecutive Mayors since 2000. Through their planning powers they have managed to steer London's development agenda towards climate change. However, the political capacity is also quite vulnerable because of the specific political situation in London with a highly politicised GLA and 33 local authorities, each with their own political leadership. The *resource* capacity on the whole is rather low: economic and human resources for climate greening London are limited, while knowledge resources are considerably more advanced, in particular in terms of technical knowledge. Much of this knowledge comes from extensive research programmes, run by renowned experts in the field of climate change on behalf of the national government. The *learning* capacity is quite well developed. Although a high level of uncertainty is regarded to be an important barrier, many strategies are employed to either reduce or manage uncertainty. Moreover, continuous learning is fostered by a rapidly developing knowledge infrastructure as well as by many internal and external networks that help to exchange experiences among actors and stakeholders.

Overall, the potential capacity of spatial planning seems rather average; it contributes with formal policies for the protection and enhancement of green space, with the planning powers of the Mayor, and with some of the knowledge infrastructure and networks. The rest of the positive contributions to the governance capacity seem to lie outside of the competence of spatial planning. The most important barriers are related to the managerial capacity. Based on the analysis of the governance capacity and the feedback of respondents (11 interviews with 13 people), the key barriers are:

- Institutional fragmentation (managerial capacity)
- Lack of geographical integration (managerial capacity)
- Compartmentalisation (managerial capacity)
- Vulnerable political situation in London (political capacity)
- Lack of funds and land for adaptation measures that require green space (resource capacity)
- Lack of skills of staff to think laterally and integrally (resource capacity)
- Uncertainty regarding local impacts and costs of adaptation measures (learning capacity).

The key opportunities for increasing the governance capacity are:

- Using existing (green)space more intensely, i.e. multifunctional land-use (managerial capacity)
- Using the regeneration potential for inclusion of green adaptation measures (managerial capacity)
- Integrating adaptation into spatial planning/building processes (managerial capacity)
- Linking adaptation to mitigation (political capacity)
- Exploiting business opportunities of adaptation measures on a local scale (political capacity)
- Educating staff (resource capacity)
- Using the numerous stakeholder networks in London for sharing best practice (learning capacity).

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5. Climate Greening Toronto



GREATER TORONTO AREA



5.1. Introduction

Toronto is the largest city in Canada and the fifth largest city in North America. It is the capital of the Province of Ontario and lies between historic rivers on the shore of Lake Ontario, one of the five Great Lakes of North America. Toronto is the financial capital of Canada, although Ottawa is the official capital of Canada. It has a population of 2.5 million, while around 5 million people live in the Greater Toronto Area (Toronto, 2010a). Toronto is still a green city despite extensive development in recent decades. There are 4,680 hectares of parkland, which is 13 percent of Toronto's area. Around 42 percent of this parkland is un-groomed natural green space consisting of native woodland and ravines. There are around 7 million trees in Toronto, a quarter of which are in woodlands (Toronto, 2004).

Toronto is one of the leading cities in North America on climate change policy. Toronto's mayor heads the C40 cities climate leadership network. Toronto was the first municipality in Canada to use deep lake water cooling to reduce energy demands of buildings and was the second municipality in Canada to develop a city wide adaptation strategy 'Ahead of the Storm', which was published in 2008. In the Climate Change, Clean Air and Sustainable Energy Action Plan of 2007 the city committed to 30 percent CO₂ reduction by 2030 and 80 percent by 2050 (against 1990 baseline levels). This by far exceeds the national target of the Canadian federal government of a CO₂ reduction of 20 percent by 2020 and 60 to 70 percent by 2050 against 2006 levels. Toronto's adaptation strategy will be further elaborated upon in section 5.3.3. The first two sections of this chapter describe the spatial planning and adaptation policy context for Toronto, after which each of the five governance capacities of the spatial planning policy field will be analysed. The chapter will be concluded with a synthesis.

5.2. Spatial Planning Context

5.2.1. *The governance of spatial planning in Ontario, Canada*

Canada is a confederation of ten provinces and three territories; a federalised state with three levels of government: federal, provincial and municipal. The provinces and territories are co-sovereign together with the federal government and are the determining scale of government for most governance matters. Canadian municipalities do not have constitutional rights; they are under direct legislative control of provincial governments (Wolfe, 2005). The provinces, and not the federal government, have full jurisdiction over the government system in cities, which exist at the behest of the province. The current City of Toronto was created under provincial legislation, through the forced amalgamation of six municipalities and one regional authority in 1998 (Keil & Young, 2003). Thus a two-tier government system was moulded into a single tier structure (Bourne, 2005). The new City of Toronto Act which came into force in 2007, has given the Toronto municipal government and mayor some new albeit limited powers exclusive to Toronto (Boudreau et al., 2009), although the planning powers are not different from other municipalities in Ontario (D'Abramo, 2009).

Land use planning is the official term in Canada for the planning of the natural and built environment: the planning system is focused on land use, which indicates a more narrow focus on planning issues regarding the physical environment (OPPI, 2007). Nowadays a more integrated and comprehensive form of planning can be observed, that takes broader social, economic and environmental issues into account (Wolfe, 2005; MAH, 2005a). There is no such thing as a Canadian planning system, because the federal government has no direct planning powers. The provinces have the authority for spatial planning under the constitutional division of powers. In turn the provinces delegate their planning powers to the municipalities through Municipal and Planning Acts. These acts regulate the tasks and obligations of the municipalities. Although the municipalities are under close supervision of the provinces, they are the government level which runs the planning system. Municipalities prepare an overall spatial plan, often called an Official Plan, which sets out the long term planning policy of a city or region. They adopt detailed planning by-laws for zoning, building and environmental regulations and are responsible for the control of land use (Wolfe, 2005). The

planning system has an administrative nature: zoning is an important feature of spatial planning for determining the arrangement of land uses, laying out in advance and in detail all permitted uses (OPPI 2009). Public-private partnerships have become very common in Canada in the case of large new or re-developments.

The Ontario Ministry of Municipal Affairs and Housing (MAH) employs a policy-led planning system, by issuing a Provincial Policy Statement (PPS) under the Ontario Planning Act. The PPS document provides policy direction for matters of land use and development for municipal governments and informs their consecutive official plans. All municipal planning decisions “shall be consistent with this PPS” and “planning authorities shall keep their official plans up-to-date with this PPS” (MAH, 2005a, p.24). All municipal official plans are to be approved by the Minister of Municipal Affairs and Housing. Furthermore, Ontario’s Planning Act mandates the province to dictate planning policy to municipalities (Boudreau et al., 2009). Hence the province of Ontario maintains considerable influence over Toronto’s planning affairs, despite of the limited devolution of powers stemming from the ground breaking City of Toronto Act.

5.2.2. Spatial policy for Toronto

In the past suburban growth was facilitated by rather lax planning restrictions from the province as a direct result of the neo-liberal laissez faire economic policy (Hanna and Walton-Roberts, 2004). Urban sprawl and its associated low density residential patterns have been an ever present challenge in Canadian planning. In recent years ‘proximity planning’ has gained momentum as part of the sustainable development movement; it aims to reduce reliance on the car as the most important means for travelling (Wolfe, 2005, p.4). Similarly, the so-called smart growth policies have appeared all over North America in an effort to contain urban growth (Amborski, 2005). In line with these spatial planning trends the Province of Ontario increased its efforts in urban containment and launched its Smart Growth Initiative. Through its newly created Ministry of Public Infrastructure Renewal the new provincial government published ‘Places to Grow’ in 2006. This is its growth plan for the Greater Golden Horseshoe, the fast growing region in South Ontario to which Toronto belongs. This plan is accompanied by a ‘Places to Grow Act’. As a policy framework the plan directs growth and acts as guidance for decisions on land use and infrastructure planning. It contains a target for intensification: 40 percent of all new residential development should take place in existing urban areas (PIR, 2006). In the same period the Ministry of Municipal Affairs and Housing published a ‘Green Belt Plan’, accompanied by a ‘Green Belt Act’. The Green Belt Plan is a major component of the Growth Plan for the Greater Golden Horseshoe. It prescribes the areas that should be protected from development including agricultural land, and is complementary to the Niagara Escarpment Plan and Oak Ridges Moraine Plan which protect these two important and unique ecological sites in the vicinity of Toronto (MAH, 2005b). The latest PPS of Ontario from 2005 supports these policies of smart growth and protection of the natural heritage. The objective of this PPS is to “focus growth within settlement areas and away from significant or sensitive resources” (MAH, 2005a, p.2). It prescribes intensification and re-development and the designation of growth areas, as well as the promotion of the compact form and greater mixing of land uses. According to Amborski (2005, p.12) these plans and acts altogether represent a strong regulatory approach by the province, leaving little room for flexibility or discretion by municipal governments, which appears to strengthen the top-down approach to planning in Ontario. In contrast to many cities in the United States which were largely shaped by the private sector, government policies and in particular those from Ontario government have shaped Toronto in the past; the layout of Toronto has been built by public policy (Keil, 2009). That’s why Frisken (2007, p.25) called Toronto the “Public Metropolis”.

The municipal body responsible for spatial planning in Toronto is City Planning. It published the Toronto Official Plan (TOP), a city wide comprehensive plan containing the city’s development vision for the next 30 years, which was crafted after amalgamation in order to replace the previous official plans of the seven municipalities. The TOP consolidated version was finally approved in 2007. It is required by legislation and affects not only private property, but also binds consecutive City Councils

(D'Abramo, 2009). One of its key objectives is to accommodate a population increase between 500,000 and 1 million people in the next 20 to 30 years. It identifies areas for housing development in order to accommodate this population growth (Toronto, 2007a). Five areas of big change are chosen for intense redevelopment in order to spare the suburban low density residential areas, which comprise 75 percent of Toronto's land area (Boudreau et al., 2009, p.105). Next to these five areas, development should be concentrated along the main avenues as intensification corridors. High rise development is encouraged by the removal of density and height limits in the TOP, and promoted by planners and developers for both aesthetic and urban containment-sustainability reasons. All in all Boudreau et al. (2009) come to the conclusion that growth in Toronto is viewed as inherently good and should be accommodated for by looser regulations. The TOP also contains a 'Green Space System', consisting of connected parks and open spaces with either a natural heritage or recreational value, as well as the waterfront of Lake Ontario. This system is regarded a necessary element of city building and should therefore be protected and enhanced (Toronto, 2007a).

5.3. Adaptation to Climate Change

5.3.1. Climate change effects

Since 1948 average annual temperatures in Ontario have already increased by up to 1.4°C and annual precipitation has increased by 5 to 35 percent (Chiotti and Lavender, 2008). Climate modelling studies made on behalf of the Ontario Ministry of Natural Resources, indicate the following major climate changes for Southern Ontario (the region where Toronto is situated) by 2100, based on the high CO₂ level scenario:

- Temperature increase in summer between 2 and 5°C
- Temperature increase in winter between 3 and 6°C
- Decrease in precipitation in summer down to 20%
- Decrease in precipitation in winter between 10 to 20% (Colombo et al., 2007).

The Canadian Climate Change Scenarios Network has also released its latest projections based on 24 modelling studies. The temperature increase for Southern Ontario is projected to be between 2.3 and 3.0°C by 2050 based on a middle CO₂ level scenario (CCCSN, 2009). Specific research for the Great Lakes Region conducted on behalf of Natural Resources Canada, gives the following predictions for Toronto specifically:

- Annual temperature increase between 2.5 and 4°C by 2050
- Annual precipitation increase between 2 and 13%
- Increase in occurrence and intensity of extreme rainfall events
- Decline in the total number of winter storm events
- Lower water levels in Lake Ontario by almost 1 meter (NRC, 2006).

Sea level rise does not have a direct effect on Toronto (Toronto, 2008a). Toronto has already experienced an average temperature increase of 2.7°C over the last 40 years, as well as many extreme weather events (Penney and Dickinson, 2009). The most famous example from the past century is Hurricane Hazel, which occurred in 1954, killed 81 people and caused Can\$25 million in property damage in Toronto. More recently there are several examples of floods and heat waves. The flash flood of August 2005 as a result of heavy rainfall flooded more than 4,200 basements and caused a property damage of an estimated \$400 to 500 million. Furthermore, the storm water run-off from this flood event also polluted Lake Ontario and posed a threat to the drinking water quality of Toronto. During the heat wave in the summer of 2005 41 days were recorded with a temperature above 30°C and an unprecedented smog, causing an estimated 6 premature deaths. It is estimated that on average heat contributes to 120 deaths per year in the City (Toronto, 2008a). Furthermore, 2007 has experienced the driest summer in 50 years, and 2008 one of the wettest and snowiest winters in 50 years (Toronto, 2008a). This has resulted not only in human health related issues, but also in further damage to Toronto's trees, which are already heavily stressed by the urban

environment and pests. Recently several studies have been conducted regarding the occurrence of the UHI effect in Toronto, based on geospatial information, satellite thermal imagery and an in-situ network of 30 air and surface temperature stations (NRC, 2009). Results are still pending. An older study which defines urban heat islands as the percentage of area which experiences a temperature of at least 5°C above the average of the whole city, has shown that this area has increased from 9,8 to 12,9 percent in Toronto between 1985 and 2004 (UHI, 2010). As stated in the Adaptation Strategy, rising temperatures, changing precipitation patterns, increasing occurrence of extreme weather events and lower water levels for lake Ontario and inland streams are the main climate change effects, which have a range of impacts on the City of Toronto (Toronto, 2008a).

5.3.2. Federal and provincial adaptation policy

At the federal level Natural Resources Canada published a climate change assessment report 'From Impacts to Adaptation: Canada in a Changing Climate 2007'. It is a comprehensive document outlining the key climate change effects and its impacts for six regions in Canada. The document does not outline a strategy or programme for adaptation. It is limited to very generic recommendations regarding the mainstreaming of adaptation into the Ontario Clean Water Act and other policy programmes that deal with infrastructure, renewal and growth strategies. It advocates the use of risk management methods to integrate adaptation into existing planning processes (NRC, 2008). Natural Resources Canada has created a Climate Change Impacts and Adaptation Division which funds many kinds of adaptation research projects across Canada and develops adaptation tools to support decision making. Recently this division has initiated six regional adaptation collaboratives in order to advance adaptation planning and decision-making (NRC, 2010).

Already shortly after Hurricane Hazel in 1954 the Ontario government decided to designate flood prone, low lying areas as regional parks instead of redeveloping them (Toronto, 2004). Regional conservation authorities were made responsible for watershed management in order to reduce flood risk. One of the first steps the Province of Ontario made towards explicit adaptation planning, was to issue a risk-management guide in 2006 for municipalities to assist in climate change adaptation. It aims to help municipalities with the incorporation of adaptation concerns into their planning and management activities (Bruce et al., 2006). Another important step was to appoint an expert panel on climate change adaptation. In November 2009 this expert panel issued a report on behalf of the Ontario Ministry of the Environment: 'Adapting to Climate Change in Ontario: Towards the Design and Implementation of a Strategy and Action Plan'. This report contains 59 recommendations from this expert panel (ENV, 2009). It is not yet clear when and to what extent these recommendations will inform policy making on adaptation by the Province. To date the province has not yet stipulated a specific adaptation strategy or programme. The 2005 PPS of the Ontario Ministry of Municipal affairs and Housing stipulates that land use patterns within settlement areas must minimise the impact to air quality and climate change and promote energy efficiency (MAH, 2005a, p.5), which refers to a mitigation rather than an adaptation objective. It is the only direct reference the PPS makes to climate change. Nevertheless the PPS does contain several environmentally friendly statements that could indirectly relate to adaptation, such as the protection of surface and ground water functions and the reduction of storm water run-off and the maintenance of pervious surfaces. The Ontario Clean Water Act, which aims to protect drinking water sources, has not yet incorporated adaptation concerns. According to De Loë and Berg (2006, p.28) and in line with the federal report of Natural Resources Canada "the Ontario Clean Water Act has created an outstanding opportunity to mainstream climate change". Ontario has a separate Ministry of Research and Innovation, which is currently investing Can\$290 million in climate change research and innovation projects all across Ontario (ENV, 2007). Nevertheless, it can be concluded that activities related to adaptation policy at the higher Canadian government levels are still at the early stages of development.

5.3.3. *Adaptation policy in Toronto*

With policy direction at the federal and provincial level mostly lacking, the City of Toronto developed its own adaptation strategy 'Ahead of the Storm', which was issued in April 2008 for public consultation after some months of preparation including an internal deliberation process and consultation with two expert panels (personal communication, MacLeod). Even prior to this, adaptation concerns were incorporated into other policy fields in response to the huge impacts of past extreme weather events. Two city divisions have been very active in adaptation planning 'avant la lettre'. Toronto Public Health developed a heat alert and response system already in 1999, which it has updated on a regular basis ever since and which contains protocols to protect Torontonians against hot weather (Toronto, 2009d). Toronto Water has been very active in storm water management. In 2003 it published its 'Wet Weather Flow Management Policy' in order to reduce the impacts of storm water flooding incidents on Toronto's built and natural environment. The capital budget associated with this policy is a substantial \$ 1 billion for 25 years. Its leading principle is to prioritise source control over end of pipe solutions. Furthermore, Toronto Water initiated a basement flooding programme and basement flooding protection subsidy scheme, to help citizens protect themselves against flooding (Penney, 2008; Toronto, 2003). For the Greater Toronto Area (GTA) another institution has been very active in adaptation planning 'avant la lettre', i.e. the Toronto And Region Conservation Authority (TRCA). TRCA is one of the conservation authorities established under the Conservation Authorities Act of the Province of Ontario in the 1940s-1950s. TRCA was installed after Hurricane Hazel and is mandated to ensure the conservation, restoration and responsible management of natural resources within nine watersheds and Lake Ontario Waterfront in the GTA. TRCA is inherently an adaptive management agency that is actively working on increasing regional awareness of climate change issues relating to natural resource management. TRCA aims to decrease vulnerabilities to climate change by building resilient natural systems and watersheds and reducing risk to communities. Key means to do so is by acquiring and enhancing green space, and by flood warning and forecasting to prepare for flood emergencies (TRCA, 2008). TRCA also engages in modelling climate scenarios, in developing watershed plans for more accurate information on impacts, in monitoring stormwater management best practices and in promoting sustainable community design. Another important aspect of TRCA's work involves community awareness and education about climate change issues.

To develop a specific adaptation strategy for the City of Toronto an 'Adaptation Steering Group' (ASG) was established, which consisted of representatives of various city divisions. This multi-functional steering group was headed by an officer of Toronto Environment Office (TEO), who has been appointed as a dedicated human resource for adaptation planning in Toronto since 2007. Furthermore the ASG was assisted by Clean Air Partnership (CAP), an environmental NGO which has a track record of conducting research and preparing advice on clean air and adaptation policy for the City of Toronto. ASG's end product was to deliver a comprehensive adaptation strategy. In order to make the strategy more easily accepted by Council, it stresses activities the city is already employing in terms of adaptation, as well as short-term actions that can deliver quick results. The need for a long-term comprehensive strategy is acknowledged in the document, but posed as a future action (Toronto, 2008a). What is clear from this strategy is that adaptation is not regarded as a stand-alone activity; it should be incorporated into all relevant City of Toronto policies, programmes and activities, also referring to the "mainstreaming of climate adaptation" (Toronto, 2008a, p.30). A summarised overview of the key elements of the adaptation strategy can be found in box 5.1.

Subsequently the TEO wrote a staff report on this strategy, which was unanimously adopted by the City Council in July 2008. This report contained as principal recommendations to incorporate adaptation into the Official Plan and that all other city divisions affected by climate change should from now on include adaptation goals in their respective plans (Toronto, 2008b). Key features of Toronto's adaptation efforts to date are first of all the development of a green roof incentive scheme that has been running since 2006, followed by a green roof by-law in 2009, which has made green roofs mandatory for all new developments from January 31st, 2010 (see also section 5.4.2. and box

5.2. for more details on the green roof policy and implementation). Furthermore, key adaptation issues such as storm water run-off and heat stress are incorporated into the Toronto Green Standard (TGS), which sets performance targets for the design and construction of new developments, and becomes effective at the beginning of 2010 together with the green roof by-law. Apart from green roofs various other green space measures are part of the adaptation programme, such as a commitment to double the tree canopy, expansion of parkland naturalisation and guidelines for greening the surface of parking lots (Toronto, 2008a). Thus the City of Toronto has an extensive programme on paper for adaptation with a considerable role for green space.

Box 5.1. Adaptation Strategy of Toronto ‘Ahead of the Storm’

Issued in April 2008 for public consultation. Endorsed by City Council in July 2008.

Primary responsibility of: Toronto Environment Office

Most important adaptation issues addressed:

Flood risk from rivers and storm water

Heat stress from rising temperatures and the UHI effect.

Goals of the document:

- ❖ *Provide a rationale for incorporating adaptation to climate change into City of Toronto policies, programs and activities*
- ❖ *Build on existing partnerships to engage the City urban area, comprising small and large businesses, residents and other stakeholders, in actions to provide protection from climate change;*
- ❖ *Describe programs and actions already underway that provide protection from climate change;*
- ❖ *Suggest further short-term actions that will increase protection from climate change and provide other benefits to Toronto; and*
- ❖ *Recommend a process to systematically assess the risks to Toronto of climate change, prioritize areas for action, and develop strategies to reduce the impacts and protect Toronto.*

Key proposed actions:

- ❖ *Immediate actions from 2008 onwards consisting of for instance the ‘Live Green Toronto’ program to engage neighbourhood communities in greening programs, a research program on the UHI effect to inform land-use planning, a program to reduce stream erosion and increase stream restoration, an analysis of where green roofs could be required, expansion of parkland naturalization, increase of enforcement of tree protection and planting requirements for private lands.*
- ❖ *Long term actions to develop a comprehensive adaptation strategy through a 9-step process:*
 - 1. Create internal mechanisms for adaptation process*
 - 2. Engage public, business and other stakeholders*
 - 3. Incorporate climate change adaptation into policies and business planning*
 - 4. Analyze how Toronto’s climate is changing*
 - 5. Identify vulnerabilities to climate change*
 - 6. Risk assessment: identify impacts requiring priority action*
 - 7. Identify and assess adaptation options to reduce risk*
 - 8. Develop and implement adaptation strategies*
 - 9. Monitor and evaluate adaptation actions and adjust as needed.*

For more information: <http://www.toronto.ca/teo/adaptation.htm>.

5.4. Legal capacity

5.4.1. Regulative institutions to protect existing urban green space

The legal capacity of the spatial planning policy field to protect existing urban green space (including trees) and thus to prevent further loss of permeable ground, shade and cool areas, has a direct effect on the resilience of cities to excessive rainfall, drought and heat stress. In this paragraph an analysis is made of the relevant spatial planning rules, policies and instruments both at provincial and local level, in order to provide the multilevel governance perspective.

Apart from some federal parks and lands, the provinces in Canada are the government level which has legislative authority over the conservation and management of public green space. At the provincial level there are various policies and accompanying acts which protect green space in the countryside. The PPS of Ontario makes a very generic statement about the prohibition of development in significant habitats, wetlands, woodlands and other areas of natural and scientific interest, as well as adjacent lands “unless it has been demonstrated that there will be no *negative impacts* on the natural features or their *ecological functions*”, and it is not specified what these negative impacts or ecological functions might be (MAH, 2005a, p.14-15). The Ontario Green Belt Plan and Act stipulate which lands are ‘Protected Countryside’ lands. Together with the lands under the Niagara Escarpment and Oak Ridges Moraine they form the permanently Protected Countryside under the Green Belt Plan. It also gives permanent protection to the water resource systems (watersheds) which are so abundant in this area. However, the Ontario Green Belt covers only a very small proportion of green space under the jurisdiction of the municipality of Toronto in the North East; it does not cover urban parkland or green space in Toronto and it makes no connection with this urban green space. The Ontario Growth Plan encourages the municipalities to establish an urban open space system (PIR, 2006, p.31). Other than that no mentioning is made in provincial policies about how urban green space should be managed and protected.

The protection and management of urban green space in Toronto appears to be a primary responsibility of the municipal government, while TRCA also plays a considerable role in the wider GTA in particular with respect to the protection and management of the natural environment, including the watersheds. The City of Toronto is able to regulate development in a strict way through its Toronto Official Plan (TOP) and its accompanying secondary plans (for 29 of its 44 wards), zoning by-laws and site plans (Bourne, 2005). The TOP is considered to be a strong regulatory planning policy document that binds private land owners as well as the public authorities themselves and contains strong environmental statements compared to other Canadian cities. The TOP restricts loss of green space in three ways. Firstly, all of Toronto’s growth is strictly contained within the earlier mentioned growth sites. Secondly, large sites of natural heritage or recreational value and their interlinks receive special protection under the Green Space System (GSS); they should be preserved, improved and enhanced whenever feasible, and no city owned land in the GSS can be sold (Toronto, 2007a). The OP contains a Natural Heritage map; development applicants are required to complete a natural heritage impact statement (describing impacts of the development on the natural heritage system) if the proposal is within or adjacent the Natural heritage system (Toronto, 2007a). Many of these sites are ravines from major rivers such as the Humber, Don and Rouge river. These river ravines are not part of the Ontario Green Belt, but the City of Toronto has requested the province to consider this. It is yet unclear whether this request will materialise in the near future (D’Abramo, 2009). Nevertheless, development is restricted directly at the river bank: the Official plan has a policy requiring a 10 metre setback from a ravine or top of bank for a building (Toronto, 2007a).

Thirdly, TOP also designates ‘Parks and Open Space Areas’, where development is generally prohibited with the exception of cultural or recreational facilities and some other limited public services. Specification is given as to what kind of development is allowed. Similar to land belonging to the GSS, public land with these designations cannot be sold (Toronto, 2007a). The City of Toronto is also very active in the protection of its 7 million public and private trees. There are several Urban Forestry by-laws and policies in place to protect city street trees, park trees, trees on private land and

trees in ravines. They are meant to prevent tree cutting, or limit it with a permitting system, and to protect trees during construction activities. Tree protection zones are specified within which no construction or other harmful activity is permitted (Toronto, 2009a).

TRCA owns a lot of valley land throughout the city in the form of parks and ravines for the purpose of flood and erosion control. With 15,000 hectares in the GTA it is the largest landowner; it is therefore the premier authority able to protect and secure green space, its authority being supported by fill and flood regulations to protect river valleys and streams. TRCA has never sold off any land (TRCA, 2008). Whenever possible it tries to restore the natural flows of rivers. Together with Toronto Water TRCA runs a programme for stream restoration in order to protect the city's infrastructure (Toronto, 2008c).

In Toronto a considerable amount of green space is in private hands; there are 35,000 private properties with natural features and 4 million trees on private properties (which is more than half of Toronto's trees). Green space on private property is protected by zoning by-laws, supported by by-laws that protect trees and ravines on private land, although the building of pools, sheds, patios and other outbuildings is not regulated (Burkhardt, 2009). However, the actual enforcement of all these by-laws in practice is hindered by a lack of human resources, as indicated by some respondents. Furthermore, private property rights are a cornerstone of land-use development in Canada (Massam and Han, 2005). Especially in the 1960s and 1970s development was booming and became a right that did not require planning permission as long as a development complied with zoning regulations, hence the expression 'as of right development' (Ubbens, 2009). According to several respondents even today development is still a major challenge for the protection of open(green) space, in particular for private land; a considerable amount of farmland is still being developed. This is supported by the fact that the Ontario Municipal Board (OMB), an independent tribunal which hears appeals against planning decisions, has a reputation for being development friendly (Boudreau et al., 2009; Ubbens, 2009; Keil, 2009). This Board makes the ultimate decision whether a development is approved or not, even if the City Council and City Planning oppose. As one respondent said "the OMB is now the default mechanism for resolving any controversial development proposals in the City and indeed the province" (Burkhardt, 2009). Nevertheless, there are considerable spatial policies and other regulatory instruments in place that aim to protect public and private open(green) space.

5.4.2. Regulative institutions to create new urban green space

Here the rules, policies and other spatial instruments are analysed that are meant to create additional urban green space and trees, as well as to add green to existing space, such as green roofs, walls and other multi-functional forms of land use.

Under the Ontario Planning Act municipalities may request five percent of the land from a residential development and two percent from other developments to be dedicated as parkland or public land for other recreational purposes (MAH, 2009). The TOP has adopted this regulation as the minimum norm, and has set a higher norm (of 0.4 hectares of parkland per 300 units) for a number of developments, amongst which priority areas where a need for parkland is identified. TOP also stipulates policies for cash-in-lieu options which are often applied in areas with higher densities. In these cases the area would become too small for a park anyway; alternatively the value of land in that location is given in the form of money, which can be used to acquire parkland in the vicinity of the development (Toronto, 2007a). New parkland is also generated through the efforts of TRCA. This organisation has been running a 'Greenlands Acquisition Project', with which it continuously acquires green space in order to protect the natural heritage, air quality and the health of the population. TRCA intends to acquire another 4,000 hectares of green space in the near future in Toronto and region (TRCA, 2008, p.20). Additionally, both the City of Toronto and TRCA have put substantial efforts in place to increase the tree canopy in Toronto. In the strategy document of the Parks, Forestry and Recreation division a commitment was made to double Toronto's tree canopy from 17 percent to 34 percent of tree cover by 2050. This commitment really gained momentum when it was taken on board as a climate mitigation and adaptation measure in the 'Climate Change, Clean Air and

Sustainable Energy Action Plan' of 2007 (Toronto, 2007b). Tree planting was also heavily promoted by deputy Mayor Pantalone, who became known as the 'tree advocate'. Under his command the city developed a Tree Advocacy Program to enable private parties and citizens to help grow Toronto's forest (Toronto, nd). Around 80,000 to 100,000 trees are planted each year by the Urban Forestry division in cooperation with many partners. Other groups such as the NGO LEAF (Local Enhancement and Appreciation of Forests) operate a tree planting programme for private backyards. TRCA also has a huge tree planting programme. In 2007 alone it planted more than 250,000 trees in the Greater Toronto Area (TRCA, 2008). As one respondent said "developing a tree culture is definitely on the rise" (MacLeod, 2009).

The municipality also has various policy guidelines and regulations in place to add green to existing space. To begin with the greening of parking lots is a mandatory requirement for new developments. The City Planning division has issued design guidelines for greening parking lots (Toronto, 2007c). Recently these guidelines have been integrated into the 'Toronto Green Standard' (TGS). TGS is meant to make future development in Toronto environmentally friendly. It contains design standards required for all new and re-developments for three types of buildings (low rise non-residential, low-rise residential and high-rise) and will be effective from January 31st, 2010. TGS is split into minimum performance targets which are mandatory and controlled through the planning process (tier 1), and stretched performance targets which are voluntary and incentivised (tier 2). The standard contains all kinds of requirements for urban heat island reduction and storm water retention. It gives possible strategies how to reach the performance targets, but leaves it up to the developer to decide how the performance targets should be met. Green roofs and green surface parking lots are part of these potential strategies (Toronto, 2009b). Even more ambitiously, City Planning has developed a green roof by-law unique to North-America, which was adopted by City Council and will be in effect from January 31st, 2010. This by-law, made possible by the City of Toronto Act, makes green roofs mandatory for all larger new and re-developments from 2,000 m² onwards with a minimum of 20 percent green roof coverage. Furthermore, green roofs are promoted for existing buildings through an incentive programme. Green roofs are mandatory on buildings owned by the city and its agencies boards, commissions and corporations, in case of new buildings or roofs that are in need of repair, where retrofitting a green roof is feasible. More details on green roof policies can be found in Box 5.2. There is no policy in place yet for green walls, although they are also proposed as a strategy in the TGS.

In sum, the City has many (very new) planning policies and regulations in place for the creation of new green space. The TGS is anticipated to give clarity to developers, although there will always be a grey area due to the exhaustive process of negotiation around a planning approval, according to some respondents.

5.4.3. Environmental Equity

The analysis of environmental justice involves the extent of information and awareness in local spatial planning policies and processes regarding the environmental equity situation of certain population groups with respect to the availability of green space and the vulnerability to flood risk and heat stress, as well as the inclusion of redistribution mechanisms to promote an equitable situation in these respects.

Toronto is a city that has attracted many immigrants throughout the centuries. Around half of Toronto's population belongs to a visible minority, and more than 100 languages and dialects are spoken in the city (Toronto, 2010a). It is a city with considerable and increasing disparities in wealth, which leads to similar disparities in health. In its report 'The Unequal City' Toronto Public Health has demonstrated a clear link between health and income inequalities in Toronto; furthermore it has shown correlations between minority status and health inequalities. It concludes that measures which reduce poverty should have priority in health improvement strategies (McKeown et al., 2008). Public Health is acquiring information as to where vulnerable populations are in terms of heat stress, to support and inform their hot weather response plan.

Box 5.2. Green roof policies and implementation in Toronto

Eco-roof incentive program:

- ❖ In 2006 and 2007 for private residences, funded by Toronto Water for water retention purposes. Subsidy of Can\$10/m² in 2006 and \$50 m² in 2007 with a total budget of \$200,000 per year.
- ❖ In 2008 and 2009 for industrial, commercial and institutional buildings, funded by Toronto Environment Office, for heat stress moderation purposes. Program consists of both green roofs and eco-roofs (sun reflective coating). Subsidy for green roofs is \$50/m² and \$5/ m² for cool roofs, with an annual available budget of \$1.4 million.
- ❖ From 2010 onwards for retrofitting existing industrial, commercial and institutional buildings (new developments will fall under the new green roof by-law). The budget for 2010 is set for \$ 0.8 million.
- ❖ More information can be obtained at: http://www.toronto.ca/livegreen/bus_eco-roof.html.

Green roof by-law:

- ❖ The First law for green roofs in North America, in effect from January 31st, 2010.
- ❖ Green roofs were already mandatory for all new and to be renovated publicly owned buildings. The new law will ensure that green roofs will be installed on all new bigger developments.
- ❖ New law applies to all new buildings with over 2,000 m² floor space, with the exception of industrial buildings. The coverage requirement for green roofs varies between 20 to 60% of the floor area depending on the floor space of the building. All industrial buildings are required to have a green roof surface of a minimum of 10% of the floor space from 2011 onwards.
- ❖ The law also prescribes minimal standards for the Construction of green roofs, for instance a minimum thickness of 100 mm.
- ❖ There is a cash in-lieu option of \$200/m² but only after one has obtained permission from the head of the planning division or even City Council.
- ❖ The Toronto Green Standard will support the Green Roof by-law.
- ❖ More information can be obtained at: <http://www.toronto.ca/greenroofs/>. Download green roof by-law leaflet via: http://www.toronto.ca/greenroofs/pdf/greenroof_bylaw_brochure.pdf.

Status of implementation of green roofs:

- ❖ Per October 2009 133 green roofs were installed and another 72 are planned. Future expectations: 50-60 installations/year through the by-law and 10-12/year through the incentive program.
- ❖ Total roof area installed per October 2009: 36,517 m²
- ❖ Most green roofs are a sedum mix (they can overwinter and require less water in summer). Where buildings have access to the roofs, the green roof will be more diverse with plants and wild flowers.

Eglinton West Station



MEC store



City Hall



Recently it published a heat vulnerability assessment report which shows maps of surface temperatures across Toronto and ends with preliminary heat stress vulnerability maps for the general population and seniors specifically (Rinner et al., 2009). With support from Natural Resources Canada, Toronto Public Health is now testing advanced geospatial statistical techniques designed to locate pockets of vulnerable people, refining the maps to include information about population density, and determining a way to validate the approach. Before finalising the mapping tool and an associated map series, Toronto Public Health will also gather feedback on the prototype maps from

staff and volunteers who implement hot weather response across the city. To aid in short and long-term planning, maps will also be created which overlay vulnerability to heat with access to existing hot weather facilities and services. The work will also assess populations' access to cooling centres and green space. It is quite evident that the more affluent people live in the highly wooded areas (Gower, 2009). Public Health continues to collaborate with partners from other levels of Canadian government and researchers in Canada and the U.S. to explore ways of combining vulnerability mapping with land use mapping and future climate change scenarios.

In its section on community services and facilities the Toronto Official Plan pays attention to the adequate and equitable accessibility of the social infrastructure of the city through a network of neighbourhood community facilities. The section on parks and open spaces also makes some reference to the accessibility of green space. It states that parkland acquisition strategies should take into account the amount of existing parkland and the amount of publicly accessible open space among other criteria. This policy is supported with a map showing local parkland provision across Toronto (Toronto, 2007a).

One of TEO's environmental programmes, the 'Toronto Live Green' programme, offers opportunities for community projects to incorporate environmental measures in neighbourhoods. It has been suggested that this programme could be used for example to retrofit buildings with green roofs in hot spot areas, although this has not yet happened to date. Basement flooding is not related to income inequality, since it mostly affects suburban neighbourhoods. Generally these are middle-class areas, although these people should still be protected against property damage.

It can be concluded that environmental inequality as a result of climate change is primarily related to heat stress in Toronto because of the availability of considerable information. There might be other climate change impacts that influence inequality, but they are not known at this point in time. Public Health has been engaged in programmes to address the heat issue long before the municipality engaged in adaptation planning. Urban planning primarily considers access to green space in the TOP, and not yet specific adaptation related inequalities.

5.4.4. Key barriers and opportunities to the legal capacity

The legal capacity of spatial planning to contribute to adaptation governance by protecting and increasing the amount of green space only raised one significant barrier with respondents. In four interviews the dominance of private interests in development, facilitated by the Ontario Municipal Board was raised as a barrier, causing continuous pressure on green space in particular at the urban fringes of Toronto.

5.5. Managerial capacity

5.5.1. Integration of adaptation and green planning into spatial planning

Here the following three indicators are analysed: the extent to which spatial policy documents contain adaptation issues, goals and measures; the extent to which the urban planning process contains provisions to climate proof the city; and the extent to which green infrastructure planning is a mature and integrated part of overall city planning and used as an instrument for adaptation.

As was clear from section 5.3.2. planning for climate change is not the primary concern of the Federal and Ontario government other than conducting research. Only in 2008 did the Ontario government start up the adaptation expert panel. Hence planning and other policy documents at the provincial level do not yet contain explicit adaptation considerations. Contrary to this, the Canadian Institute of Planners, a professional body representing 7,000 planners in Canada, has issued a national policy paper on both climate change mitigation and adaptation. It acknowledges the role of planners in climate change and aims to guarantee that Canadian planners take climate change considerations into account and to raise awareness and increase knowledge levels among planners (CIP, 2009). At the Toronto municipal level, in the Toronto Official Plan (TOP) the words climate change or adaptation are never mentioned specifically, although many policy statements relate to adaptation.

For instance, TOP deals with the management of stormwater and land use planning for flood mitigation. Moreover, it mentions the use of innovative green spaces and other measures to reduce the urban heat island. Green roofs are mentioned a couple of times as a remediation of both storm water and heat stress issues. According to the Ontario Planning Act the TOP needs to be reviewed every five years. The environmental policy group of City Planning will be addressing adaptation policies specifically in the reviewing process, which is currently under way. One of the key recommendations in the Adaptation Strategy (a document unanimously endorsed by City Council) was for the Chief Planner of Toronto to ensure that explicit goals for adaptation of infrastructure and buildings be incorporated in the review of the TOP (Toronto, 2008b).

In the past the Ontario government designated TRCA as a regulatory body to be involved in planning processes through the Conservation Authorities Act (for instance Ontario regulation 166/06 made under this Act in 2006; TRCA, 2006). This was done to prevent development in the flood plain and its interference of watersheds in order to protect their ecological health and integrity (TRCA, 2007). In practice this means that TRCA is involved in formal site plan approvals in valley and stream corridors and wetlands in order to maintain their buffer function. The Ontario Municipal Act also regulates that municipalities consult TRCA on their zoning and official plans. TRCA has a separate planning and development department for these regulatory functions. At the municipal level inclusion of adaptation planning in planning processes has taken a substantial leap due to the Toronto Green Standard (TGS). Although not specifically labelled as adaptation, TGS guarantees that heat moderation and stormwater reduction considerations are taken into account in new and re-developments based on performance targets. For instance through treatment of stormwater on site, incorporation of green roofs and reservation of space to allow trees to grow. TGS is being implemented and secured via the site plan approval process that applies to each new building (D'Abramo, 2009). Therefore TGS is becoming a very important component of the planning process. What is more, the guidelines for stormwater management as defined in the Wet Weather Flow Master Plan, are also incorporated into TGS.

Green infrastructure planning is regarded as an important part of overall urban planning in Toronto for general amenity purposes and in relation to climate change. TOP has incorporated the Green Space System as a city-wide network of natural green spaces. Green space measures for climate proofing Toronto, such as green roofs, green parking lots, and tree planting are integrated into TGS and the adaptation strategy. Furthermore, a separate Parks, Forestry and Recreation division is responsible for the management of Toronto's natural areas and open spaces. The strategic plan of this division 'Our Common Grounds' aims to enhance the quality of life in Toronto, so that "Toronto will become known as the City within a Park" (Toronto, 2004, p. 20).

In sum, adaptation considerations are starting to become embedded in planning documents and in particular in planning processes at the municipal level, and green space plays an important role in adaptation planning.

5.5.2. Organisation of spatial, green and adaptation planning

This section deals with the extent of fragmentation of tasks and responsibilities for spatial, adaptation and green planning in the city; the horizontal coordination of spatial planning with other policy fields; the geographical coordination of spatial planning in the Greater Toronto Area; and the vertical coordination with other levels of government.

The responsibility for spatial planning in Toronto lies with the City Planning division. Co-ordination of adaptation planning is the responsibility of the Toronto Environment Office (TEO), which has assigned one full-time person to the issue of general environmental risk management. The staff person's main activity in the last several years however has focussed on adaptation or climate change risk management – which is an issue that clearly cuts across many organisational silos. The ownership and management of green space is more complicated. The Toronto and Region Conservation Authority (TRCA) owns much green space in Toronto in the form of conservation parks and valley lands along watercourses; they have a separate Parks & Culture division that manages

Conservation parks, although in Toronto the Park, Forestry and Recreation division manages the lands owned by TRCA. The city itself owns nearly 5,000 hectares of parkland, which is managed by the Parks, Forestry and Recreation division. It has a separate Urban Forestry Services section which manages the forestry programme and takes care of Toronto's trees planting and maintenance. Hence the separation of tasks and responsibilities for spatial and adaptation planning seems to entail a rather straightforward specialised approach according to which the responsibilities are clearly defined along divisional lines, while responsibility for green space planning and management is more fragmented.

Clear separation of responsibilities across specialised agents nevertheless requires horizontal coordination across these agents. And this is a real challenge in an enormous organisation of 40,000 civil servants. Silo-thinking was mentioned regularly as a barrier during the interviews. In theory TEO is quite important in coordinating environmental matters beyond the scope of city divisions; it was established in 2005 with the official mandate to do exactly that. In practice much cooperation depends on personal relationships, according to respondents. Nevertheless in an effort to structure coordination across divisions, TEO has set up an Executive Environment Team, consisting of the heads of all city divisions. The objective of this team is to make sure that they pool together on all kinds of issues. They meet on a monthly basis. As mentioned before, TEO also created an Adaptation Steering Group (ASG), consisting of around 15 mid-level staff of various City Organizations, plus their consultant from the Clean Air Partnership. In addition a smaller Working group was formed for adaptation, which included representatives from TEO, Water, Public Health, Communications, and the Clean Air Partnership. The smaller group met very frequently to deliver input from their respective divisions while the *Ahead of the Storm* was being developed, and were very successful in preparing the adaptation strategy. Unfortunately the larger Steering Group met only a few times and was less engaged with the strategy development process. Hence it has been difficult to keep the momentum for adaptation going after the Council adopted the strategy, thereby putting the actual implementation of the actions as defined in the strategy at risk (Penney, 2008). This is rather disappointing since the premier purpose of the strategy is to mainstream adaptation in all policies and programmes and the "recommended action number 1" of the strategy is that those divisions which have proposed short term adaptation actions "should make the business case for implementing these actions and seek appropriate approvals to ensure implementation" (Toronto, 2008a, p.21). TEO's adaptation officer has been trying to break this inertia by forming an Environmental Risk Management Committee in 2009 as the successor of ASG. This group has a mandate to assist in the management of all environmental risks that are relevant to multiple City organizations. This committee which is meant to develop a risk assessment tool that they hope to apply to climate change risks as well as other environmental risks, is trying to create a new, more hands on working group around adaptation planning for the city's infrastructure.

Next to TEO, the Environmental Policy Group of City Planning also plays a crucial role in coordinating environmental matters across divisions. A lot of input from other city divisions for instance, went into the creation of their TGS. Besides critique respondents also gave various examples of good cooperation; for instance the fact that Toronto Water gives funds to Urban Forestry to plant trees for water retention purposes and that they co-decide on the location of the trees; or the synchronisation of comments on planning applications among TRCA and the city bodies involved in site plan approvals. So on paper there are strong organisational structures in place to coordinate environmental matters, while in practice it comes down to the personalities involved, as indicated by many.

With a dominant central role for the provinces in Canada and their rather centralised governance system, it can be expected that vertical coordination between the Ontario government and the City of Toronto municipality is troublesome. This is the more so, since many Ontario governments have been conservative while Toronto governments have always been quite liberal, sometimes resulting in a clash of political cultures. The planning powers of Toronto are not different from other municipalities, in order to get a uniform playing field across the province; Ontario municipalities are

quite restricted in terms of how far they can go beyond what the Ontario Planning Act allows them. For instance, building design in Toronto is regulated by the building code of Ontario (Vancouver has a separate building code as a result of a special city charter, but attempts to create a Toronto charter have failed (Keil and Young, 2003)), which is at odds with parts of the Toronto Green Standard. Nowadays the relationship between Ontario and Toronto is quite cooperative and conflict free, thanks to the current liberal Ontario government. Both growth strategies towards intensification overlap. Changes to the Ontario Planning Act have been made to accommodate some of Toronto's planning issues. Direct contact between Toronto and the federal government is blocked by the province, so coordination among these levels of government takes place through the province.

Geographical coordination across the Greater Toronto Area other than through TRCA does not exist. Apart from the City of Toronto, GTA consists of 25 municipalities grouped into four regional governments. There is not one overall regional government responsible for the GTA, and consequently there is not one comprehensive integrated GTA planning policy. And again there are rather large differences between the liberal Toronto culture and the more conservative suburban culture in the regions around Toronto. The closest the province has come to harmonisation of planning policies for this region is through its Growth and Green Belt Plans and Acts, which have been put in place since 2004. While these contain Toronto within its boundaries, they allow Greenfield development (of farmland) in the suburban regions in the area between the city and the Green Belt. Several studies have been done on these rather unusual progressive Ontario plans (see for example Amborski, 2005 and Carter-Whitney, 2008), and both the scientific experts and several respondents tend to disagree on the extent of their (regulatory) capacity to restrict urban sprawl around Toronto. Nevertheless most people seem to acknowledge that these plans are a huge step forward.

In sum, horizontal coordination is constrained by compartmentalisation as a result of the immense size of the municipal organisation and its necessary break-down into manageable specialised units. Vertical and geographical coordination is primarily constrained by provincial governance structures, further aggravated by different political cultures among government bodies.

5.5.3. Use of management tools and strategies

This involves the analysis of management strategies and tools to promote the effectiveness of spatial planning in climate proofing Toronto, both in terms of policy development and in terms of implementation, as well as in terms of the promotion of multi-functional forms of land use, as a means to achieve both socio-economic and environmental targets.

Partnerships and in particular public-private partnerships have been a common governance feature in Canada, run in the neo-liberal spirit of entrepreneurship and efficiency (Allahwala et al., forthcoming). Since the 1980s partnerships have gained ground in almost every government policy field. In urban planning they play a role in the re-development of Brownfield sites, such as the East Don lands and the port area in Toronto. Around Pearson's international airport, TRCA is coordinating the development of the largest eco-industrial park in North America which is being built with leading edge businesses in a public-private partnership (Partners in Project Green, 2010). The adaptation strategy explicitly states that one of its goals is to "build on existing partnerships to engage the City urban area, comprising small and large businesses, residents and other stakeholders, in actions to provide protection from climate change"(Toronto, 2008a, p.5). Apart from partnerships, other organisational structures are employed to coordinate and cooperate across silos, such as the earlier mentioned general or special purpose steering groups and committees with high-level officers for policy development. Structures used for policy implementation are special purpose working groups with mid-level people and multi-divisional project teams with representatives from city divisions, often supplemented with external expert agencies. A very recent example for adaptation planning that is inherently cross-silo, is the Environmental Risk Management Committee, through which each relevant City organization eventually will be given support to assess their climate change risks. A second phase will be to assess the organization for general environmental risks .

The spatial planning concept 'Multi-functional land use' is meant to make efficient use of scarce space and to achieve smart growth policies. Creating green space for adaptation should not lead to inefficiencies in other areas, such as for example infrastructure, emissions etc. Mixed-use development', the term used in Canada, is promoted in Toronto's Official Plan (TOP) for the growth centres. In fact mixed use areas are one of five land use designations in TOP targeted to achieve higher densities. However, several respondents indicated that the process of thinking in terms of mixed use development is only just beginning. Early examples of the promotion of mixed use with incorporated adaptation measures are the policies on green roofs and green parking lots.

In conclusion, organisational structures such as partnerships, steering groups and project teams have become common approaches to breakdown silos and increase the managerial capacity. Multi-functional land use appears to be still in the early stages of development.

5.5.4. Key barriers and opportunities to the managerial capacity

According to respondents the key barrier to the managerial capacity is compartmentalisation (referred to as silo-thinking), as expressed in 7 out of 11 interviews. Another barrier is the lack of translation into action of adaptation mainstreaming into other divisions' policies, partly as a result of this silo-thinking. The analysis further suggests that the governance structures and diverging political cultures in the GTA pose serious limitations to the geographic coordination among municipalities, so that Toronto feels left alone in its struggle towards a more sustainable growth. The most important opportunities as perceived by respondents are the mainstreaming of adaptation into risk management systems, environmental impact assessment processes and building codes; and mixed use developments that integrate the natural and built environment, such as swales, green surface paving and restoration of natural river flows.

5.6. Political capacity

5.6.1. Accountability

Indicators of accountability which were analysed include the existence of an open and transparent planning process; and an active involvement of stakeholders and the public in urban planning processes.

Public participation is guaranteed in most Provincial Planning Acts. The Canadian planning system is considered to be collaborative and consensual; plans are developed with a high degree of public participation from business representatives and professional experts to voluntary groups and local residents (Wolfe, 2005). Toronto has established a Committee of Adjustment, consisting of citizens which considers applications for minor variances to the zoning by-law. Toronto has also appointed an advisory panel for design reviews, consisting of experts such as architects and urban designers which provide advice during the approval process of public developments. City Planning has a 'Community Planning' section which regularly consults representatives of the public and of other city departments on development projects and which deals with the applications of the Committee of Adjustment (Toronto, 2010b). Public consultation has been part of the creation of the TGS and approval of the TOP. There are a lot of checks and balances because of the legislative nature of the document. Moreover, there is an appeal process and people can go the Ontario Municipal Board (OMB). This body judges whether development proposals comply with the letter of the law and whether an application can be considered 'good planning'. It is an extra-jurisdictional authority; members are not elected, but appointed by the province. Therefore their accountability is rather low, which could be problematic considering their favourable attitude towards the development industry. A recent reform to the Ontario Planning Act has somewhat reduced the powers of the OMB versus municipal governments (MAH, 2010). It remains to be seen how much will change in practice.

TEO also arranged an extensive consultation process for the development of the adaptation strategy. Internal meetings with other city divisions were organised to actively gather their input, in particular with respect to short-term actions each division could take to improve their adaptive capacity. Input

was obtained from more than a dozen experts on two expert panels. One of the expert panels was held in the Council Chambers, and was open to the public and media. This event resulted in approximately 15 media stories. With the help of Toronto's Public Consultation Unit, the public at large was actively pursued through meetings and hearings in advance of finalising the strategy. In spring 2008 six public hearings were held directly after the publication of the 'Ahead of the Storm' glossy document which was created as a public consultation and education tool. All input from these hearings is documented in a report which is publicly accessible via TEO's website. On the whole, the City of Toronto appears to be committed to wide consultation processes both prior to and after publication of its planning and adaptation documents.

5.6.2. Political will

Here the extent of political support and how this support is achieved and contained are analysed. The political buy-in to climate change policy is very high in Toronto, with a predominant attention towards mitigation. This stems from the Mayor's involvement on the mitigation side as a result of his chairmanship of the C40 cities network on climate change. Several years ago adaptation planning was perceived as taking money away from or even giving up on mitigation. The extreme rain resulting in the urban flooding of 2005 is generally seen as the key driver for putting adaptation on the public agenda. Compared to the Mayor the City Council, consisting of 44 elected representatives from Toronto's wards, has a strong position. Both the Mayor and the Council are perceived to be very environmentally minded, or "green" as they say in Toronto. The Council has been the major driver behind initiatives such as the Toronto Green Standard (TGS), the Green Roof by-law and the commitment to double the tree canopy. City Council approved the adaptation strategy unanimously. High support from Council has been achieved by focusing on short-term actions and by employing a strategy of incremental change. The adaptation strategy puts a lot of emphasis on the activities each division can implement in the short term, thereby making the adaptation activities very visible and feasible in the eyes of the Council. The TGS is a good example of a step-by-step process of gaining political and societal buy-in. City Planning started with a voluntary standard in 2004. After gaining some years of experience the performance targets have gradually been raised and as of the beginning of 2010 the standard has become mandatory.

Likewise, TEO tries to maintain the momentum in several ways. First of all by trying to tie in adaptation measures with mitigation measures as much as possible, and by stressing the co-benefits of each adaptation measure. For instance, the adaptation strategy stresses the installation of green roofs and the doubling of the tree canopy as typical examples of measures that have both mitigation and adaptation benefits; it includes a diagram showing all measures that do both (Toronto, 2008a, p.38). Secondly, through the creation of the Toronto Urban Climate Change Network (TUCCN), which was established in 2008, and the Climate Change Science Advisory Committee (CCSAC), which was created in 2009. TUCCN is an expert network of governmental, NGO and university representatives, meant to provide advice on adaptation issues on a regular basis and keep adaptation on the radar screen of politicians. CCSAC contains representatives from federal, provincial and local government and three local universities, with the aim to develop a consensus on best available scientific information on future weather in Toronto. Finally, TEO is also working on a research programme to update local climate projections, the so-called Climate Driver Study, in the hope that this will put a new spin on adaptation planning as soon as results are known. All in all, the political will for adaptation planning is increasing, but is heavily competed by mitigation and thus needs to be actively fostered through continuous initiatives from city officers.

5.6.3. Leadership

Leadership is analysed by looking at the extent of top-down and bottom-up leadership, and involvement of external parties in pushing the adaptation agenda.

While on the one hand there is lack of policy, resources and leadership for adaptation from the provincial government, the City of Toronto on the other hand has shown remarkable leadership

among municipalities in Ontario, as demonstrated by developments such as the progressive nature of the TOP, the Wet Weather Flow Master Plan, and the recent Toronto Green Standard and Green Roof by-laws. The Mayor has been quite persistent in pushing the climate change agenda. However, his influence is rather modest; he is considered a Council member and therefore has one out of 45 votes in the Council. He has neither a budget nor a direct influence on the civil service. The Deputy Mayor and the 'Round Table on the Environment' (which is now disbanded), a participatory body for discussing environmental matters which he headed, were critical in pushing the Green Roof by-law. Bottom-up leadership has been driven by a few committed executive champions mainly at Public Health, City Planning, Toronto Water and TEO, supported by substantial leadership from external parties. TRCA has played an important role in promoting adaptation in the Greater Toronto Area, stemming from their knowledge and strong mandate to govern watersheds. More recently TRCA has been involved in many kinds of sustainability initiatives, often as driving force. The Clean Air Partnership has been crucial in the development of Toronto's adaptation strategy. Therefore Toronto was able to pull from various sources to gain its leadership status in North America on policy development for adaptation, although the leadership spirit seems to be waning now that it comes to actual implementation, as observed by several respondents.

5.6.4. Key barriers and opportunities to the political capacity

According to respondents a key barrier is the focus on mitigation from the political side, as was reported in three interviews. Not surprisingly win-win solutions, i.e. measures which combine adaptation and mitigation and/or other benefits, are seen as the most important opportunity to gain and maintain political will for adaptation planning. In particular green infrastructural measures are perceived as win-win solutions.

5.7. Resource capacity

5.7.1. Economic resources

This entails the analysis of the available budget and land for adaptation and green infrastructure planning.

The funding of public services has been a fundamental issue in Toronto since amalgamation at the end of the 1990s. At that time the Ontario provincial government sought to make governance systems more efficient by merging municipalities into larger entities, by downsizing budgets and by downloading the full cost of services like public transport and social housing onto the cities, while the provinces retained the power to dictate these service levels. This downloading of unfunded responsibility for services has been at the roots of many service delivery problems in Toronto (Hanna and Walton-Roberts, 2004). This situation is further aggravated by the current economic crisis. According to respondents there are considerable deficits in infrastructure, from waste and storm water to transport systems. Toronto Water, which gets its funding from water sales, for instance estimates that it will take up until 2017 just to clear the back log with current funds, let alone the money that is needed to deal with adaptation to climate change or the cleaning up of Lake Ontario which is required under the environmental regimes of the Great Lakes Basin. Nevertheless an amount of Can\$200 million is reserved for dealing with measures to prevent (basement) flooding, in order to take care of the first four priority areas in the city. Moreover, an adaptive approach is taken when rebuilding and renewing the storm water infrastructure. Toronto Water also contributes to the budget of Urban Forestry for tree planting in impervious pavements (\$2 million per year). TEO has some budget for adaptation: in 2009 the adaptation officer had \$350,000 at his disposal which was largely spent on the risk management programme; \$2.4 million for 2008-2013 is available for the green roof incentive programme; and a relatively small part of the TEO Live Green Toronto programme is going to adaptation measures. By comparison, in the Climate Change, Clean Air and Sustainability Action Plan of 2007 a commitment was made to spend over \$ 1 billion in five years on projects for greenhouse gas reductions (Toronto, 2008a). The estimated budget spent on climate

change is 10-15% of the overall city budget (MacDonald, 2009). The above makes clear that the majority of spending on climate change policy is by far dedicated to mitigation, as was confirmed in the interviews.

Green infrastructure funding is equally under serious strain. After amalgamation the provincial funds for green space were cut by half, while these funds needed to serve four times the area (Toronto, 2004). After the publication of the Parks, Recreation and Forestry Strategy in 2004 which highlighted the deplorable situation of Toronto's green space (Toronto, 2004), budgets have slowly increased again, for instance to increase the tree planting pace and to start a watering programme to maintain the newly planted trees. The Climate Change, Clean Air and Sustainability Action Plan has allocated a five year budget of \$24 million for tree planting to help reduce CO₂ emissions (Toronto, 2008a). Although some land resources are in the hands of the city and TRCA, most is in private hands. Fortunately TRCA owns a lot of land crucial for conservation of the natural heritage and water sheds, as well as hazard lands for flood alleviation.

Although the City of Toronto Act has given the municipality some degree of autonomy in acquiring sources of revenue in the form of taxes (Boudreau et al., 2009), it can be concluded that the economic resources for green infrastructure planning and even more so for adaptation planning appear to be rather constrained.

5.7.2. Human resources

Here the number of people involved in adaptation planning, their skills and know-how and the extent to which the organisational culture is conducive to change, are analysed.

Adaptation planning resides under TEO with one dedicated officer, who in turn works together with various officers from other city divisions who are involved in his adaptation programmes, such as for example the environmental risk assessment committee. The adaptation officer is clearly under-resourced to effectively manage, coordinate and chase people in the entire civil service; the task is too large for one single person to handle. Momentarily almost all of his time is spent on setting up the risk assessment programme. Consequently, the coordination and steering of the actual implementation of adaptation activities within other divisions has weakened. Next to this officer, there is one TEO person who spends around 25 percent of her time on the coordination of the green roof incentive programme. However, more than 75 percent of TEO personnel is linked to work on mitigation and energy reduction. Next to TEO, divisions like Toronto Water, City Planning, Parks, Forestry and Recreation and Public Health will also have several officers working part of their time on adaptation, although it will not always be clearly recognised as such.

In addition to the very limited number of human resources, the know-how and skills regarding adaptation planning as well as the organisational culture pose yet another limitation to the resource capacity. This is the more so when it comes to green infrastructural measures which are based on a natural ecosystems approach to adaptive management. With the exception of TRCA and Urban Forestry, most staff of other city divisions still lack the knowledge about how adaptation planning in general and through natural ecosystems in particular, could be integrated into their planning processes and routines. As several respondents said, there is still a huge gap in education and training of staff, because it is a challenge to get everybody up to speed in large municipal organisations like Toronto. A few respondents also mentioned the organisation culture as a potential stumbling block, in the sense that people do things of set way and are resistant to new things, in particular when they are surrounded by uncertainty, as is the case in adaptation issues. Several educational programmes are being developed to resolve this. In 2008 TEO ran an 'in reach' programme with staff of all city divisions that have some doing with adaptation, in an effort to engage them in adaptation and to disseminate information. City Planning has developed training sessions for knowledge dissemination on the TGS for development review staff and for capital project managers (who take care of the city's own buildings). TRCA has developed a 'Municipal Response Plan', in order to support GTA municipalities with training programmes, but equally to give

them a planning tool kit and policy guidelines, which can be integrated into municipal zoning and official plans.

Nevertheless it can be concluded that human resources are focussed on mitigation when it comes to climate change, clearly reflecting political priorities as discussed in section 5.6. Currently the lack of human resource skills and the lack of a culture conducive to adaptation planning and adaptive management pose serious limitations to the resource capacity. However these are gradually being redressed through educational programmes.

5.7.3. Knowledge resources

Indicators analysed are the level of technical and social scientific knowledge regarding adaption and green infrastructure planning, and support of external experts (epistemic community).

Although good climate science for Toronto is not yet fully available, this will be resolved by mid 2010 with the publication of the results of the Climate Driver study. TEO's risk assessment work will trigger other city divisions to gain knowledge on and identify the risks of adaptation issues in their respective fields. TEO's initiative to create the Toronto Urban Climate Change Network and the Climate Change Science Advisory Committee can be seen as another attempt to gain and disseminate knowledge on climate change. The Clean Air Partnership (CAP), which in fact operates as an agency at arm's length of the municipality of Toronto, is very knowledgeable on adaptation. It has published several reports with evaluations of adaptation strategies from Toronto and other cities (CAP, 2009a). CAP is also investing in knowledge building on the urban heat island (UHI) effect for Toronto (CAP, 2009b). Together with Natural Resources Canada they are running two programmes: one to measure the UHI in Toronto and to check satellite surface temperature measurements against air temperatures in different parts of the region (NRC, 2009); the other concerns the development of a geospatial decision support system to provide information to public health and planners in their work to reduce the impact of the UHI. Therefore a lot of information will soon be available on the spatial and temporal effects of Toronto's UHI and their impacts on vulnerable population groups. TRCA is recognised as a real authority in its knowledge regarding flood plain and ecosystems management. They have also become knowledgeable experts in the area of sustainable technologies, in particular with respect to the permeability of green infrastructural measures for storm water retention and flood alleviation. TRCA has initiated the 'STEP' programme (Sustainable Technologies Evaluation Program). This multi-agency initiative develops analytical data and tools to support and promote sustainable technologies. New technologies are monitored: for instance a performance study on green roofs is done in conjunction with York University. The gathered knowledge is provided to municipal staff who in their turn can feel comfortable in promoting these technologies with the development industry (TRCA, 2010). TRCA and York University are providing valuable leadership through efforts to establish a 'Consortium for Climate Change Action, Integration and Research', meant to better connect the research community with the decision makers in municipal and provincial governments. There is vision that this organisation could be an Ontario based consortium with participation from the governments, universities, private sector and the NGO community, located at the TRCA offices. The consortium will bring together all TRCA's initiatives linked to climate change: it will provide regional climate modelling data as well as physical and social science research; it will develop training programmes on both mitigation and adaptation; it will include the municipal response project that provides tools to deal with climate change; and it will integrate public-private development initiatives such as the Pearson Eco business Park project.

With respect to green infrastructural knowledge, it is worthwhile to note that Toronto Urban Forestry is about to finalise a 'UFORE' study (Urban Forest Effects Model). This study will give an accurate inventory of trees and forests in Toronto; it will develop statistics for the forests; it will also estimate the ecosystems services these trees deliver in terms of storm water management, pollution abatement and energy savings and will attach a monetary value to these services (UFORE, 2010). The city also has a 10-year old database that registers every tree in Toronto, in which both tree planting and tree cutting is tracked.

In sum, technical scientific knowledge in support of adaptation and green infrastructural planning is rapidly being built with all kinds of research programmes, with input from various external experts. Social scientific knowledge is still underdeveloped, although the Institute for Catastrophic Loss Reduction, a non-profit organisation doing research and education on disaster prevention funded by the insurance industry, is doing some work on public hazards perceptions and has recently published a handbook on basement flooding for home owners.

5.7.4. Key barriers and opportunities to the resource capacity

Lack of adequate economic resources and the existence of other political priorities in the division of funds was perceived to be a key barrier in six interviews. Lack of human resources was mentioned four times as a barrier: twice in terms of the number of people dedicated to adaptation planning; and twice in the sense of the lack of skills of staff to deal with new ways of working needed for adaptation planning. Programmes for the training and education of staff were seen as opportunities, as well as developing standard tool kits on adaptation for staff.

5.8. Learning capacity

5.8.1. Dealing with uncertainty

This section deals with the way uncertainty is treated, the extent of technical approaches used to increase the evidence base, and the extent of managerial approaches used to handle uncertainty. Adaptation is still predominantly perceived as a risk according to the respondents in Toronto. It is not as rewarding as mitigation, which delivers direct and measurable opportunities in terms of energy efficiency for instance. Adaptation, when spoken of in terms of an opportunity, is primarily seen as avoidance of incidence and therefore as an opportunity for cost avoidance. One respondent did stress the opportunities in terms of infrastructure development, job creation etc., but this was the exception to a general perception of risks associated with adaptation planning, exacerbated by both the uncertainty of climate change projections and the anticipated expensive and far reaching implications of adaptation planning. Therefore adaptation policy needs to be evidence based, so that uncertainty is reduced. The uncertainty with respect to predicted local weather patterns is addressed by means of the Climate Drivers Study. To further reduce uncertainty probability numbers will be attached to the climate projections. Other technical approaches used to increase the evidence base are impact assessments and cost-benefit analyses. For instance, already in 2004 a cost-benefit analysis was made for green roofs taking into account their effects on storm water, energy and CO₂ reduction, temperature moderation and pollution abatement, to support the incentive programme. Another more recent example is the cost benefit analysis performed for the TGS, to support its mandatory character.

Considering the focus on the risk side of adaptation, it is quite logical that one of the primary means chosen to manage uncertainty by the City of Toronto is via the environmental risk assessment approach which is currently being developed by TEO with climate change as the focal point. This approach is a key component in the development of a comprehensive long-term adaptation strategy for the city (Toronto, 2008a; see box 5.1.) and is in line with the policy directions on adaptation from the federal and provincial government (see section 5.3.2.). An Environmental Risk Management Committee (ERMC) has been formed to replace the former Adaptation Steering Group. ERMC consists of staff of various city divisions, who can give direct stakeholder input. Its current key priority is to help reduce risks associated with physical climate change impacts and provide leadership towards climate change adaptation. This group's mandate also includes general environmental risks. In addition a very informal volunteer External Advisory Panel on Climate Change Risk Management was created to provide advice to the TEO adaptation officer. This panel consists of professionals from various backgrounds (Toronto, 2009c, p.4).

The TEO adaptation officer issued is currently overseeing the work of a consulting firm which is developing a general environmental risk assessment process and tool, which first application will be

to the issue of climate change. This tool is specified to permit sensitivity analysis, which checks the sensitivity of city activities to various types and intensities of severe weather events, based on the results of the Climate Drivers Study. One of the first City divisions which will be used as subject for undergoing such a climate change risk assessment process is the Transportation Services Division which maintains the road, sidewalk and bridge infrastructure (Toronto, 2009c). The first results of this assessment on transportation infrastructure are expected by mid 2010.

In addition to this risk assessment process both TEO and TRCA are checking the possibility to mainstream adaptation into existing risk management systems, together with the Canadian Standard Association. Other new approaches to manage uncertainty, such as real life experimentation and pilot projects are also being undertaken, albeit still in a modest way.

Toronto Water experiments with new technologies that have not been proven yet. In terms of green infrastructure for instance, they have developed the 'Sustainable Sidewalk', together with City Planning and the Transportation Services Division. This pilot project is meant to make trees survive better in sidewalks by creating facilities for the tree to catch rainwater and by putting utilities off to the side. Toronto Water has also experimented with mandatory downspout disconnection programmes to reduce stormwater run-off in certain areas of the city, as a result of which downspout disconnection has now become mandatory in the city. Various studies with universities are done to monitor the performance of green roofs in terms of quantity and quality improvements of stormwater. City Planning has developed a special innovative section of the TGS with bird friendly development guidelines, with which they recently won a prize. This section is meant to reduce the deaths of migratory birds as a result of collisions with (high rise) buildings.

To conclude, adaptation and its associated uncertainty are primarily regarded as a risk and therefore a lot of emphasis is placed on risk management to manage uncertainty. The first major step in this respect is TEO's risk assessment approach, which aims to set up a processes and tools to manage risk. In addition technical approaches are employed to increase the evidence base.

5.8.2. Continuous learning processes

An analysis is made of the existence of infrastructure for the distribution and safeguarding of knowledge, for the exchange of experiences through internal and external networks, and the use of stakeholder dialogue for enhancing learning processes.

Imparting knowledge among such a large municipal organisation is a challenging task. TEO made several efforts around the publication of the adaptation strategy in 2008 to build infrastructure for dissemination of knowledge to the wider city staff, as well as to gather input from selected stakeholder groups. An adaptation reference collection with over 300 documents was composed for city staff on TEO's website, with a top 10 list to increase accessibility (Toronto, 2010c). However, since its conception the site has fallen into disrepair due to lack of staff time to maintain it. Webinars, seminars, presentations and training sessions were also extensively used to disseminate adaptation information to city staff as well as to a wider audience. The public consultation meetings just after the release of the adaptation strategy were meant to engage in stakeholder dialogues with various societal groups. Nevertheless, efforts were dropped again in 2009 when the time and focus of the adaptation officer was consumed with setting up the environmental risk management programme. It is expected that this programme will automatically reach a large number of City staff again, while further improvement of internal communications and a new staff training programme are set objectives for 2010.

In addition, several outside organisations have offered possibilities for training to City staff. The Clean Air Partnership (CAP) runs webinars on a regular basis which are accessible to City staff, the Federation of Canadian Municipalities has offered some adaptation related webinars, and city staff have also participated in webinars run by the Urban Leaders Adaptation Initiative in the USA. TEO can draw knowledge and experience from internal networks in the form of the Executive Environment Team and the newly created ERM, and from TRCA. Moreover, several external networks provide the possibility to draw knowledge and exchange know-how and experience. The

earlier mentioned TUCCN created by TEO is such a network of external experts. CAP has initiated a web-based network among Canadian municipalities, called 'Alliance for Resilient Cities', as a community of practice for sharing information on adaptation planning (CAP, 2010). Toronto is part of this network, which gives other municipalities the chance to learn from this leader in adaptation policy. For acquiring information from international peers, Toronto can turn to two networks. Firstly, the Clinton Climate Initiative and the C40 cities network group, which is chaired by Toronto's Mayor. Secondly, the Urban Leaders Adaptation Initiative, consisting of US cities (Toronto is the only Canadian participant).

Therefore Toronto has ample opportunity to draw upon a considerable pool of knowledge, experience and best practice examples from internal and external networks, while the dissemination and safeguarding of knowledge among the City's own staff appears to suffer from discontinuity as a result of lack of TEO resources.

5.8.3. Key barriers and opportunities to the learning capacity

Uncertainty regarding climate projections (and not so much regarding the impact and effectiveness of adaptation measures) was viewed as a barrier in four interviews, especially since it was felt that it was an excuse for decision-makers to make only incremental changes. The translation from generalised knowledge to very specific recommendations on what has to change in planning processes was mentioned by two respondents as another challenge. Learning from a network of peer cities was mentioned as the most important opportunity area.

5.9. Synthesis

It can be concluded that Toronto is a leader in policy development for adaptation to climate change. It is one of the first cities in the world to formulate a specific adaptation strategy, to mandate green roofs on all new large developments, and to have integrated adaptation goals into a new ambitious code for sustainable building, the Toronto Green Standard. A substantial role in climate proofing Toronto is awarded to green roofs and trees, in recognition of the ecosystems services of green infrastructure to retain water and to moderate heat. To date, this has not yet resulted in an expansion of green space. The number and surface area of installed green roofs is still rather modest. This is likely to change in the near future as the by-law on green roofs comes into effect. The expansion of the tree canopy appears to be gradually taking form with the ambitious tree planting programmes. Results are expected to be published by mid 2010 through the UFORE study.

Many policies and activities for adaptation planning have been initiated: some already for five years or longer, even before they were framed as adaptation policy; others in the last one to two years around the time of conception of the adaptation strategy. Most policies and activities are meant to serve a wider range of sustainability goals and adaptation is just one of them. For an overview of the most important policy developments, implemented activities and future policy intentions, see box 5.3. However, the actual implementation of these policies was expressed as a real concern by respondents. It remains to be seen how much of all these policies and future intentions will materialise in practice. As the responsible body for adaptation planning, the Toronto Environment Office has decided to put a lot of effort into running a risk assessment process in 2010. It is expected that this process will not only help in getting a good overview of the climate change risks and consequent scope of measures per City division, but will simultaneously (and maybe even more importantly) serve to raise awareness and know-how among City staff and get them into action mode, so that adaptation at one stage will become mainstreamed in their respective planning processes, which is the ultimate goal of the adaptation strategy.

Considering the early stage of policy development and implementation, this study cannot and is not meant to evaluate the effectiveness of these policies. Instead it aims to analyse the potential capacity of cities to govern adaptation planning, with a focus on the spatial planning policy field. There is a common recognition of the role of spatial planning in governing adaptation to climate change.

Box 5.3. Adaptation policy development and implementation in Toronto

Most important implemented adaptation policies (including those not labelled as such):

- ❖ *Hot Weather Response Plan and related Heat Health Alert System*
- ❖ *Wet Weather Flow Management Policy and related policies for stormwater retention*
- ❖ *Policy to double the tree canopy and related tree planting programmes*
- ❖ *Green Roof by-law mandating green roofs on all large developments (as of January 31st, 2010)*
- ❖ *Toronto Green Standard for all newly built dwellings (as of January 31st, 2010)*

Most important adaptation activities and research projects (executed or in execution phase):

- ❖ *Green Roof incentive programme*
- ❖ *TRCA's Greenland Acquisition Project and Municipal Response Plan*
- ❖ *Creation of the Toronto Urban Climate Change Network*
- ❖ *UHI study and Heat Vulnerability Assessment*
- ❖ *Climate Driver Study (expected by mid 2010)*
- ❖ *2010 Forest Inventory and Tree Canopy study by Toronto Urban Forestry (expected by mid 2010)*

Most important future policy intentions for adaptation:

- ❖ *Running of climate change risk assessment processes for all relevant city divisions, starting with the Transportation Services Division*
- ❖ *Development of a long-term and comprehensive adaptation strategy*

A framework of analysis has been developed, in which the governance capacity is broken down into five sub-capacities: the legal, managerial, political, resource and learning capacity (see chapter two for more details). This chapter has presented an analysis of these capacities, based on the adaptation policies, activities and policy intentions of the City of Toronto.

The *legal* capacity of the spatial planning policy field appears to be very well developed. In theory there are a considerable number of spatial policies and instruments in place that can protect existing green space. The same can be said for the creation of new green space, in particular through the new and unique Green Roof by-law. In practice existing green space remains under considerable development pressure, the more so since a lot of green space in the suburban areas is in private hands. It is expected that the *managerial* capacity of spatial planning to climate proof Toronto will substantially increase through the new mandatory Toronto Green Standard for all new buildings, which will become effective as of the beginning of 2010. It will ensure that adaptation considerations are taken into account in planning processes and applications. However, the critical managerial aspect of horizontal coordination is rather constrained by the phenomenon of compartmentalisation, which was the most commonly mentioned barrier in all interviews. Although compartmentalisation is the natural downside of specialisation of government departments needed to manage such large organisations as the municipality of Toronto, it is generally a disadvantage in dealing with a wicked problem such as adaptation. In the face of uncertainty, adaptation planning requires lateral and integrative thinking in order to develop difficult, non-evident and often contradictory solutions with the involvement of many actors with different value systems. Toronto is trying to resolve this through organisational structures which require cross-divisional coordination, such as steering committees, working groups and project teams; and by involving external partners through partnerships.

The *political* capacity appears quite developed thanks to strong top-down and bottom-up leadership, complemented with some highly capable external partners, such as TRCA and CAP. It has given Toronto its leadership status in climate change policy. However, there is a notable political priority for mitigation; there is a continuous competing agenda manifested by mitigation, and the obvious answer is to propose win-win solutions that address both, such as green infrastructural measures. The *resource* capacity faces significant barriers through the lack of economic, as well as human resources. As a result of the political priorities, the funds and staff for adaptation are very

constrained in comparison with mitigation. Furthermore the staff has still limited know-how and skills to deal with adaptation considerations. On the positive side, knowledge regarding adaptation is rapidly evolving, in particular technical scientific knowledge. The *learning* capacity still offers room for further development. Adaptation is seen as a risk, rather than an opportunity, and the uncertainty with respect to local climate impacts as a considerable barrier. Therefore the intention is to manage this uncertainty in the near future through an extensive environmental risk assessment process with a focus on climate change adaptation and mitigation. Learning processes are fostered through various internal and external networks, but there needs to be more attention for the maintenance of the infrastructure for knowledge dissemination among City staff.

Overall the potential capacity of the spatial planning policy field to govern adaptation planning in Toronto is moderate. It is able to protect existing green space, it offers significant potential to add green space through the new green roof by-law. The Toronto Green Standard is an important means to integrate adaptation goals into city planning processes, and planning processes appear to be transparent which promotes accountability. The other contributions to the governance capacity of Toronto, such as leadership and learning networks, appear to be more attributable to other than spatial institutions or considerations.

Based on the feedback of respondents (12 people in 11 interviews) and the analysis the most important barriers to the governance capacity in Toronto are as follows:

- Compartmentalisation among City divisions (managerial capacity)
- Lack of funds for adaptation (resource capacity)
- Uncertainty regarding local climate impacts (learning capacity)
- Political focus on mitigation (political capacity)
- Power of developers (legal capacity)
- Lack of staff to manage adaptation planning (resource capacity)
- Lack of know-how and skills among the wider city staff (resource capacity)

The key opportunities for increasing the governance capacity are:

- Mainstreaming of adaptation into environmental risk management systems (managerial capacity)
- Regional scale coordination (managerial capacity)
- Linking adaptation to mitigation and other co-benefits (political capacity)
- Educational programmes for staff (resource capacity)
- Increase of mixed-use development (managerial capacity)
- Learning from the experiences of other cities (learning capacity).

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6. Comparative Analysis

6.1. Introduction

Each city has its own tale to tell, as has become clear from the detailed descriptions in the previous chapters. For instance: Rotterdam is embracing adaptation to climate change as *the* opportunity to make the city more attractive, economically viable, and liveable. In London the GLA is mainstreaming adaptation into each and every policy document to make adaptation happen. Toronto is one of the first cities in the world to make a special law that requires green roofs on all new developments.

The aim of this chapter is to make a lateral comparison: to look for similarities and differences between the governance capacities and their opportunities and barriers in Rotterdam, London and Toronto, so that patterns might be found. Therefore the information provided will be of a more general nature. Firstly, the contextual similarities and differences will be analysed in terms of governance arrangements and policies for spatial planning, in so far as relevant for this research. It is not the intention here to make a comparison of spatial planning systems, which would be a research in its own right. Rather, some of the contextual differences could explain the differences in the governance capacities across the cities. Secondly, attention will be paid to the comparison of the content of the adaptation strategy and planned activities. Thirdly and most importantly the five sub-capacities will be compared in order to inform the conditions necessary for climate greening cities, which will be discussed in the next and final chapter of this thesis. Again this comparison is guided by the framework of analysis as presented in chapter two.

6.2. Governance arrangements and policies for spatial planning compared

6.2.1. Spatial governance arrangements

Each of the three cities are faced with different administrative systems. Rotterdam is a municipality functioning in a *decentralised* unitary state with the province of Zuid-Holland and the national government as higher government levels. London is a collection of 33 boroughs as local authorities, functioning in a *centralised* unitary state, with the Greater London Authority (GLA) and the UK national government as higher government levels. Toronto is a municipality within a *federalised* state which does not have constitutional rights, but lends its authority from the delegation of powers by the Province of Ontario as the most important government tier. Irrespective of these different multi-level governance arrangements, in all three cities the local level, i.e. the municipalities of Rotterdam and Toronto, and the boroughs of London, are responsible for the governance of spatial planning on the ground. They are the authorities responsible for the control of land use in their administrative jurisdictions; they prepare long-term visionary plans to guide urban planning; and they are responsible for development control. In doing so, they receive guidance from higher levels of government, which prepare strategic frameworks for lower government levels to abide by. Although it is said that English planning is rather discretionary by nature (due to absence of zoning plans and other rules that regulate land use prior to a planning decision, and the relatively strategic and broad character of policy guidance from the national government), the findings suggest that in the last decade English planning is bound much more as a result of the many national planning policy statements which have been issued in order to address all kinds of sustainability issues. In the case of the London boroughs the discretion of their planning officers is furthermore constrained by the strategic guidance from the GLA. The fact that in the UK sustainable development considerations are being integrated into the planning system, indicates towards a shift from a more traditional land-use planning towards a more comprehensive and integrated way of planning (a move towards spatial planning as the British say). The same can be said for planning in Ontario: there is a trend towards a more comprehensive way of planning, taking broader social, economic and environmental issues into account; a style of planning the Dutch have been famous for since the 1970s. In response to the neo-liberal movement and governance trend, public-private partnerships have become a popular

governance arrangement for spatial planning in all three countries, although the extent may vary. Public-private partnerships in the three cities are most often applied in case of larger development and regeneration projects (or integrated area development projects as they call it in the Netherlands).

Without being overly simplistic it can be said that, although faced with many contextual differences, the governance processes of spatial planning in these three cities are not extremely different, due to common trends towards decentralisation, towards the increased participation of non-state actors in planning processes, towards the integration of sustainable development principles in planning, and towards neo-liberalisation leading to the introduction of economic management principles in the public sector. Table 6.1. provides an overview of the main characteristics of the governance arrangements of spatial planning for the three cities.

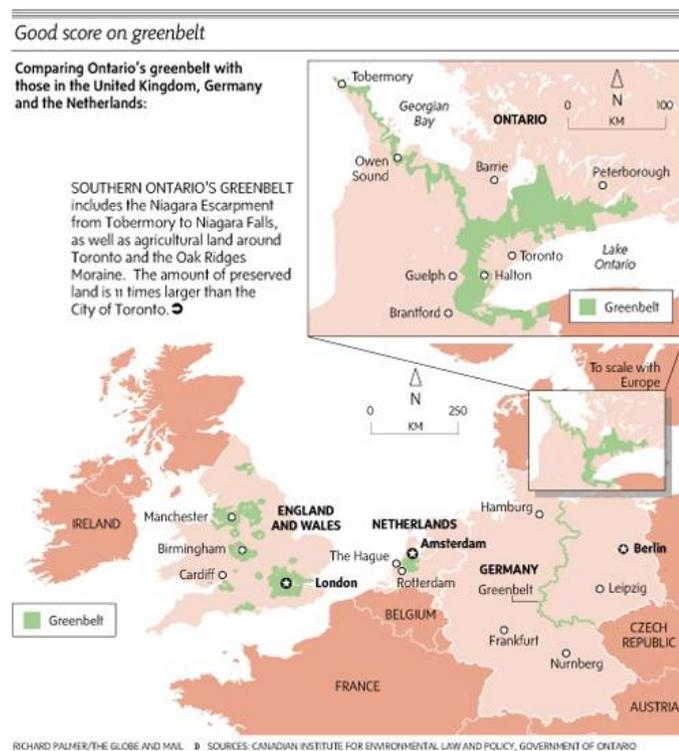
Characteristics	London, England	Rotterdam, the Netherlands	Toronto, Ontario
Administrative system	centralised unitary state	decentralised unitary state	federalised state
Government levels	national, regional (Greater London Authority), local (33 boroughs)	national, provincial, municipal	federal, provincial, municipal (although municipalities have no constitutional rights)
Spatial Planning Law	from UK national government Planning and Compulsory Purchase Act 2004	from Dutch national government Spatial Planning Act 2008	from Ontario provincial government Ontario Planning Act 1990 (last amendmend 2009)
Planning responsibility	Boroughs	Municipality of Rotterdam	City of Toronto, delegated by province
Main characteristics	no zoning plans rather generic policies which leave room for flexibility traditional focus on land use planning, since 2004 reform more integrative public-private partnerships	zoning plans rather strict policies to regulate land use prior to decision-making very comprehensive planning system public-private partnerships	zoning plans rather strict policies to regulate land use prior to decision-making traditional focus on land use planning, lately it is becoming more integrative public-private partnerships
Policy guidance from higher governments	National Planning Policy Statements on various topics Greater London Authority's London Plan	National Spatial Strategy 2004 National Structure Vision for the 'Randstad' Provincial Structure Vision	Provincial Policy Statement 2005

Table 6.1. overview of the main characteristics of spatial governance arrangements

6.2.2. Spatial policies

All three cities are subject to spatial policies from higher government levels, which oblige them to increase spatial densities and to respect their urban boundaries, in order to make the city more compact and to spare the country-side around them. Indeed, this was an important criterion for the case selection, as was mentioned in chapter one. Chapters three to five have illustrated that London, Rotterdam and Toronto are all contained by a combination of Smart Growth/Compact City and Greenbelt policies, making agricultural and ecologically sensitive land officially off limits to developers. The Toronto greenbelt, although established only in 2005 (the London greenbelt was established in 1938, the Dutch Green Heart in 1958), is the largest greenbelt in the world; it is eleven times the size of the City of Toronto (Carter-Whitney, 2008). See figure 6.1. for a map illustrating the relative size of the three greenbelts. These cities are faced with similar targets for intensification: in Ontario 40 percent of new development should be within cities boundaries; in the Netherlands this percentage is the same, but the province of Zuid-Holland even takes 80 percent as the target for its cities. In England the target is formulated slightly differently: a minimum of 50 percent of development should be achieved on previously developed land. The cities acknowledge these requirements in their respective spatial strategy documents. Each document has explicit objectives which aim to accommodate growth within the city's boundaries; each document also contains a map of urban green space that should be protected. Nevertheless, only the Dutch National Spatial Strategy and the Rotterdam City Vision openly acknowledge the fact that the compact city and greenbelt policies have led to a loss of urban green space. The Rotterdam City Vision addresses this by sacrificing some (neglected and monotonous) green, with the aim to upgrade the rest of urban green spaces.

Figure 6.1. Map with relative size of the greenbelts in the vicinity of London, Rotterdam and Toronto (source: Canadian Institute for Environmental Law and Policy)



6.3. Adaptation issues, strategies and activities compared

6.3.1. Climate change effects

It is very difficult to compare climate projections across the cities because they are based on different modelling systems, emission scenarios, baselines, probability factors, spatial and temporal scales. If one would ignore these differences, it would appear that Rotterdam is faced with the lowest expected average temperature increase (between 0.9 and 2.8°C), London with the medium (2.7°C) and Toronto with the highest increase (between 2.5 and 4°C) by the year 2050. It is nevertheless safe to say that all three will be facing a considerable temperature increase, which will be exacerbated by the urban heat island (UHI) effect. Although again the cities have applied different research methods to study the UHI effect, it is safe to assume that each of them is experiencing considerable higher temperatures than their surrounding country-side. Each city has also experienced a couple of extreme heat events in the last decade (Rotterdam and London in 2003 and 2006; Toronto in 2005 and 2007). In addition to higher temperatures, the cities are also faced with increased precipitation in winter, combined with more extreme storm events. As a consequence surface water flooding is a theme which dominates in all three cities. They are also vulnerable to river water flooding, as each of them lies in a river delta. Moreover, London and Rotterdam face additional flood risk from sea level rise due to their close proximity to the sea, while by contrast Toronto will be faced with lower water levels for Lake Ontario. Finally, also drought is a common feature in the three cities, as a result of a decrease in rainfall in summertime. These climate change effects in their turn have a range of similar impacts on the cities (on citizens' health, infrastructure, the economy, the environment etc.), although there may be large variances in exact local impacts among these cities and even within cities (among districts).

6.3.2. Adaptation policy at higher government levels

The UK, The Netherlands and Ontario have all had to deal with serious flood events in the past, which led them to consider adaptation strategies even before they were framed as such. With water management from rivers being a serious problem, both the UK and Dutch national government launched new adaptive management approaches by giving more space to water, in an attempt to retain water in wider river beds, wetlands etc. rather than trying to contain water within the rivers

through dikes and other infrastructural measures. The Ontario government re-destined flood plain areas as conservation areas and parks and appointed Regional Conservation Authorities to manage watersheds. Both the Dutch and UK government have in the meantime formulated a National Adaptation Strategy (NAS), respectively in 2007 and 2008. These documents still give only very broad guidelines to lower government levels, which are seen as the level for implementation of adaptation policy. Both NAS documents call for a mainstreaming of adaptation into other sectoral policies, rather than the creation of a new policy field. Both put considerable emphasis on the creation of partnerships as governance arrangement for adaptation planning and implementation. Furthermore, they also have in common that they consider spatial planning to be a key policy sector for handling adaptation to climate change. The Dutch NAS is very focussed on water related issues and is even more strongly pronounced about the spatial dimension of adaptation (the name of the NAS 'Make space for climate!' speaks for itself). Neither the Canadian federal government nor the Ontario provincial government have as of yet launched a national or Ontario adaptation strategy. The Ontario Expert Panel on Climate Change Adaptation created by the Ontario government, has only just released a report with recommendations, which is meant to inform a future adaptation strategy. Therefore, both London and Rotterdam receive more policy direction and support for adaptation planning from higher government levels than Toronto. Having said that, the Netherlands, UK, Canada and Ontario governments have in common that they all put considerable efforts into the provision of scientific support. Large research programmes have been set up, mostly to advance in climate science, i.e. better modelling of climate projections and their impacts, but also increasingly to develop applied science for adaptation planning, i.e. increasing resilience to the impacts.

6.3.3. Adaptation policy at the city level

Rotterdam, London and Toronto have been putting considerable efforts into adaptation planning, as this was one of the criteria for the strategic sampling of the case studies. Coincidentally they all launched their (draft) adaptation strategy at the same time around spring-summer 2008. But even before the launch of these strategies, they were already engaged in adaptation planning 'avant la lettre'. Water issues being the primary source of inconvenience, water management has dominated the agenda prior to the publication of the adaptation strategy. Separate water strategies and integrated water management programmes have been developed in each city, which cover issues such as expansion of water storage capacity, storm water management, watershed management and supply of drinking water. In addition to water management, public health management has played a major role in Toronto, in particular in relation to heat stress with vulnerable population groups. In London the creation of a London Climate Change Partnership already in 2002, has helped to raise awareness and increase knowledge for adaptation planning, in particular regarding the retrofitting of homes to make them more climate resilient.

Both London and Toronto have placed the responsibility for adaptation planning with their respective environmental departments, which indicates that adaptation is first and foremost regarded as an environmental issue. Hence, these cities appear to treat adaptation primarily as a threat, as can also be deduced from the content analysis of the adaptation strategies (although the London strategy does to some extent discuss the opportunities climate change can generate). In Rotterdam adaptation used to be the responsibility of the water management department of the municipality, but recently it was decided to form a separate climate office for both mitigation and adaptation with a relatively large staff. The main reason for this approach is that both mitigation and adaptation to climate change are primarily viewed as opportunities to create a safe, economically strong and attractive city, and to become an expert in climate proofing cities in delta regions.

A common theme in the adaptation strategies is the mainstreaming of adaptation into other policy areas of the city, although in Rotterdam the focus lies with spatial planning processes, while in London and Toronto the role of spatial planning is acknowledged but seen as one of many more important policy fields for adaptation planning. The role of green space varies from city to city. It is one of the main adaptation measures in London, and therefore a special elaborate urban greening

programme has been defined, in particular in order to mitigate heat stress. In Toronto green space is also relatively important for moderating heat stress, with a considerable expansion of the tree canopy, expansion of parkland naturalisation and an extensive policy programme for green roofs. The role of green space in Rotterdam has so far been very limited, reflecting the focus on water management issues, rather than heat issues. In Rotterdam the building on water (floating houses) and water plazas dominate the adaptation programme. The above illustrates that there are some common themes, but also some notable differences in the adaptation strategies of Rotterdam, London and Toronto. Table 6.2. gives a summary of the main characteristics of the adaptation strategy per city.

Characteristic	London	Rotterdam	Toronto
Adaptation strategy	elaborate document, 1 st draft August 2008, 2 nd draft February 2010	concise document, May 2008 plus a separate adaptation programme for 2009	elaborate document, April 2008
View on adaptation	both a threat and an opportunity	primarily an opportunity	primarily a threat
Important adaptation themes	surface water flooding, urban greening programme, mainstream adaptation across GLA sectors	water, become expert of climate proof deltas, mainstream adaptation into spatial planning processes	surface water flooding, heat stress, mainstream adaptation into Toronto policies & programmes
Responsibility for adaptation	GLA environment department	separate adaptation group	Toronto environment office
Role of green space	very extensive	limited	extensive

Table 6.2. Overview of the main characteristics of the adaptation strategy per city

6.4. Legal capacity compared

6.4.1. Regulative institutions to protect existing urban green space

Higher government levels of The UK (national), The Netherlands (national and provincial), and Canada/Ontario (federal and provincial) are predominantly occupied with the protection of green space in the country-side. Only the UK government has issued a specific policy on open (green) space, which requires local authorities to restrict development of open space unless it is clearly shown to be surplus. Other than that, *urban* green space is delegated by higher government levels and considered to be a matter of local governance. The first and most common means to protect existing urban green space, is by incorporating larger parks, district parks, recreational green space and other valuable public open green spaces in local strategic spatial plans, i.e. the Rotterdam City Vision, the London Plan and Local Development Frameworks of the London boroughs, and the Toronto Official Plan, often complemented with a visual map of the urban green space network. These spatial plans are considered to be powerful spatial/legal instruments in their respective jurisdictions and therefore offer considerable protection. Additionally Rotterdam has zoning plans and Toronto has zoning by-laws in place as instruments for the protection of public and private green space by giving them specific designations, while the boroughs in London have the possibility to develop local by-laws for the protection of certain types of green spaces. The types of green space that appear to be least well protected in the urban environment are cultural and recreational facilities (Toronto), sports/playing fields (Rotterdam and London), and allotments (Rotterdam). In addition to green space, trees are also subject to protection. Firstly, all three cities have some form of strategic guidance document on trees, forests and/or woodlands. Secondly, trees are protected by special laws that restrict cutting or require cutting permission. Toronto is most elaborate in this respect: it has by-laws for street trees, park trees, trees in ravines and trees on private property.

In conclusion, in each city the protection of urban green space is in the hands of local authorities, which have a range of strong spatial and other legal instruments at their disposal to realise this. Nevertheless, in each city respondents mentioned the continuing development pressure on urban green space, in particular private green space which is more difficult to control (Toronto and

London), while in Rotterdam, where a lot of land is still public, the selling or development of public open space offers considerable economic benefits to the municipality and thus represents a threat to existing urban green space.

6.4.2. Regulative institutions to create new urban green space

National (The UK and The Netherlands) and provincial (Ontario) spatial regulations in the respective spatial planning acts are in place which empower local governments to demand either land or money for the acquisition of land from developers in case of new or re-development projects. This is a question of negotiations between planning officers and developers, something which traditionally fits the UK planning system very well, while it is relatively new in the Netherlands. The UK regulation allows for more discretion, while for instance in Toronto percentages of land that can be claimed are rather fixed. In addition each city has another regulation or policy at its disposal to stimulate the creation of new green space. In London the Mayor uses his statutory powers by means of the London Plan to set targets for an increase in the amount of green space for the central London area, specifically for adaptation purposes. The Mayor's policy consequently informs the spatial policies of the boroughs which will need to act on that policy. Moreover, Mayor Johnson has committed himself to planting trees and enhancing parks, funded from his own budget. Rotterdam has an additional national regulation at its disposal, stemming from national water policy, which is meant to create additional surface water area, and is often implemented through a combination of water and green space. The municipality of Toronto and the Toronto and Region Conservation Authority are very active in tree planting as a means to enhance green space due to the 'double the tree canopy' policy, as a result of which around 100,000 trees are planted in the city each year.

Furthermore, these cities are also active in adding new green to existing space through for instance green roofs (all), green cable car ways (Rotterdam), and green parking lots (Toronto). In particular green roofs are very much promoted, although in Rotterdam not yet through (spatial) regulatory provisions but through an incentive programme. London has the longest history of green roof policies, originally stemming from nature conservation law but nowadays complemented with a specific spatial policy in the London Plan for adaptation purposes. Toronto has just recently taken the step of developing a specific by-law which makes green roofs mandatory for every large new or re-development project.

In sum, all three cities have spatial regulations and policies at their disposal to create new green space. These regulations tend to lead to negotiation processes with developers, who can be very powerful due to their land positions. The amount of regeneration and development projects in each of the cities offers considerable potential for the creation of new green space.

6.4.3. Environmental equity

Like most larger cities in the world London, Rotterdam and Toronto have a diversity of population groups and are faced with substantial socio-economic disparities. Notably in London and in Toronto much attention is paid to health inequalities as a result of these disparities, and these health inequalities are expected to get worse due to the impacts of climate change. Detailed geo-spatial information regarding the access to green space is available in each city thanks to GIS type of information systems. London and Toronto have recognised and acknowledged access to green space to be an important factor in the exposure of certain citizens to heat stress and the occurrence of the urban heat island (UHI), while Rotterdam is still in the research and scoping phase of the UHI effect and the role of green space in remediating heat stress. Information regarding the exposure to flood risk of vulnerable populations is still scarce. Only London has published a map of 'high social flood vulnerability' in its adaptation strategy.

Since information regarding access to green space, heat stress and their interrelationship is becoming increasingly available, policies to redress unequal situations are also gradually being developed. London appears to be making a head start with this: the Greater London Authority is taking the first steps in redistributing green space, since it is targeting its urban greening programme specifically

towards areas of multiple deprivation in the central London area, which have a lack of green space and where the urban heat island effect occurs most intensively. It is using the opportunity which the regeneration of these areas offers, to incorporate green adaptation measures among other things. To date no redistribution mechanisms for addressing inequalities in flood risk have been developed in any of the three cities.

In other words, the inequalities associated with flood risk and heat stress are gradually being recognised as information becomes available, while policies to remediate these still need to be developed. London is most advanced in addressing environmental equity issues as a result of climate change.

6.4.4. Key barriers and opportunities

In neither of the three cities did the legal capacity raise dominant barriers with respondents, and the legal capacity was generally found to be in order. Some concerns were raised regarding the power of the development industry in dictating the development agenda. No significant opportunities were mentioned either, apart from the fact that the large regeneration projects in each city offer considerable potential for expanding green space and incorporating green to existing space, most notably green roofs.

6.4.5. Synthesis of legal capacity

When judged on the basis of the presence of adequate regulative institutions in London, Rotterdam and Toronto and the feedback of the respondents, the legal capacity appears to be a key asset of the governance capacity of the spatial planning policy field to climate green urban areas. Each of the three researched cities has ample formal power of authorisation to protect and enhance urban green space through all kinds of spatial regulations, policies and instruments, either devolved to them from higher government levels or created by the local authorities themselves. The legal provisions for the protection of existing green space are quite stringent, while the legal provisions for the creation of new green space offer sufficient flexibility to negotiate deals with developers and to aim for custom made solutions per development or regeneration project.

Regarding the environmental equity situation in adaptation issues such as flood risk and heat stress it should be noted that the process of addressing this is just beginning and very much dependent on adequate information provision regarding the exposure of vulnerable population groups. These cities are still a long way away from being just and fair in adaptation matters, although there are clear signs of policy intentions in that direction. Table 6.3. gives a summary of the comparison of the legal capacity.

Critical aspect	London	Rotterdam	Toronto
Spatial instruments for the protection of existing green space:			
Parks, recreational and natural heritage areas	yes	yes	yes
Trees	yes	yes	yes
Private green space	no	yes (zoning plans)	yes (zoning plans)
Spatial instruments for the creation of new green space:			
Land for new green space	yes	yes	yes
Charge for new acquisition of green space/ enhancing existing space	yes	yes	yes
Green Roof policy	separate policy in London Plan	no spatial policy but incentive programme	specific by-law and incentive programme
Environmental Equity:			
Information re access to green space	yes	yes	yes
Information re heat stress	yes	very limited	yes
Information re flood risk	yes	no	no
Redistribution mechanisms for heat stress	yes	no	very limited
Redistribution mechanisms for flood risk	no	no	no

Table 6.3. overview of the legal capacity

6.5. Managerial capacity compared

6.5.1. Integration of adaptation and green planning into spatial planning

The incorporation of adaptation issues, goals and measures in spatial planning *documents* is most elaborate in the UK and London; most relevant national and Greater London Authority spatial documents already explicitly contain a broad spectrum of adaptation concerns. This reflects the dominance of climate policy on the UK national agenda, which trickles down to lower levels of government as a result of the rather hierarchical steering of spatial planning in the UK. In the Netherlands and Rotterdam the incorporation of adaptation concerns in planning documents is still in its early stages and predominantly focused on water related adaptation issues, as a result of strategic guidance on one of the most prevalent risks in Dutch society (flood risk). While Ontario has not yet provided any specific guidance on adaptation planning in its planning documents or otherwise, Toronto has indeed incorporated adaptation concerns into its own spatial plan due to past extreme events, although not yet framing it explicitly as such. Integration of adaptation concerns into spatial planning *processes* has been secured for water related adaptation issues, since (surface water) flooding is such an important risk for all three cities. The UK and Dutch national, and Ontario provincial governments have effectuated this by making the bodies responsible for water management statutory consultees in planning documents and application processes. Another common pattern across the three cities with respect to the incorporation of adaptation into spatial planning processes, is the development of building guidelines for adaptation. Rotterdam is currently busy with the development of a special building standard for adaptation in parallel with its already created building standard for mitigation (The Rotterdam Adaptation Strategy method). Along similar lines Toronto has just developed its own Toronto Green Standard which integrates adaptation concerns into overall sustainable building processes. Local authorities in London have the possibility to develop supplementary planning guidance documents for the sustainable design of buildings, in which they can incorporate adaptation concerns. In addition, the UK government has developed several other tools/guidelines in order to stimulate the integration of adaptation concerns into spatial planning processes of local authorities in a rather top-down manner.

Integration of *green* planning into spatial planning documents and processes is quite elaborate in both London and Toronto, where the role of green infrastructure as general amenity in the sustainable development of the city is widely recognised. In Rotterdam green infrastructure planning receives less specific attention; it is generally planned as part of the public realm. Both London and Toronto recognise the role of green infrastructure in adaptation planning, and this then translates into greening programmes for adaptation, ranging from very extensive in London to extensive in Toronto, while in Rotterdam the role of green infrastructure is still limited to green roofs.

Thus the incorporation of both adaptation and green planning, as an important means to achieve adaptation planning, is gradually being realised albeit at different rates; in the case of London with a quite central role for the UK national government, while in Rotterdam and Toronto it is more in the hands of the local authorities.

6.5.2. Organisation of spatial, green and adaptation planning

Institutional fragmentation is an inescapable consequence of specialisation, but at the same time a key area of concern for a wicked problem such as adaptation, which requires an integrated approach across relevant policy fields. As was illustrated in the case studies in chapters three to five, fragmentation appears to be omnipresent in urban governance systems and occurs in many ways. Tasks and responsibilities can be split across divisions and even across different sections within divisions, across geographical jurisdictions, and across different government tiers. Fragmentation seems to be most fierce in The UK and London, where it is a dominant institutional characteristic of spatial planning and even more of green infrastructure planning, although to a lesser extent fragmentation also occurs in Rotterdam, and least in Toronto. In light of this manifest fragmentation issue, coordination and cooperation become very important aspects in order to achieve an

integrated approach. First of all, coordination should happen across and within policy divisions. In practice this horizontal coordination is seriously hampered by compartmentalisation, or in other words silo-thinking. This inability or unwillingness to think and act laterally across one's own scope of responsibility was evident in all three cities. Secondly, coordination should be sought across different tiers of government. This vertical coordination is also hampered, in particular in London and to a lesser extent in Toronto and Rotterdam, as a result of political sensitivities between government layers. Thirdly, coordination is necessary across different geographical jurisdictions. And again this type of coordination is hampered in London by political sensitivities, and in Toronto due to the absence of a regional coordination body. By contrast, the Rotterdam region has a specific body to do this, which has well established relationships among the concerned municipalities.

In sum, in every way coordination is frustrated by both fragmentation and compartmentalisation.

6.5.3. Use of management tools and strategies

Just as in the business world large bureaucratic government organisations make use of management strategies to make their governance processes more effective and efficient, and to cut across vertical chains of command so as to promote the interdisciplinary coordination so much needed for finding integral solutions for wicked problems. Public-private partnerships, one of the key concepts of New Public Management, are a common strategy in each city in spatial planning processes, in particular in case of regeneration and development projects. Moreover, both in London and in Toronto partnerships with external bodies are promoted in almost any policy field, and are extensively used in green planning and adaptation planning, while in Rotterdam its use beyond spatial planning is still less pronounced, and not yet part of the adaptation planning process. The focus in Rotterdam is more on the application of project management structures and techniques within the own municipal organisation, as well as the creation of a special group of officers with an integrating role in the form of the Rotterdam Climate Proof team. In Toronto inter-municipal coordination and cooperation is stimulated through working groups, task forces and executive committees.

The spatial planning concept of multi-functional land use as *the* solution to merge the compact and the green city and to be effective and efficient in the use of scarce land in urban areas, is a tool widely used in The Netherlands and in Rotterdam, where multi-functional forms of land use are experimented with on a regular basis. Both in London and in Toronto the application of multi-functional land use forms is still in its infancy and in light of this research limited to the application of green roofs (both) and permeable parking lots (Toronto).

Thus the use management tools and strategies from the business world have become very common, although there are notable differences in the selection of these tools and strategies per city.

6.5.4. Key barriers and opportunities to the managerial capacity

In all three cities the managerial capacity raised significant barriers; in fact the most pronounced and most common barriers were evident in the managerial capacity, although there are differences as to the fierceness of each barrier per city. Fragmentation of tasks and responsibilities is viewed as the most important barrier in London, while in Rotterdam and Toronto this phenomenon is less fierce. In these cities compartmentalisation is the first and foremost barrier, while in London this barrier is present but overshadowed by even more pressing issues, such as the lack of geographical integration as a result of the two-tier governance structure.

Fortunately the managerial capacity also encompasses opportunities. The integration of adaptation considerations into all kinds of spatial planning processes was seen as a big opportunity; for instance in the public-private partnerships for regeneration projects; in the various building codes that have been or are being developed; in existing risk management and environmental impact assessment processes; and in projects around multi-functional land use.

6.5.5. *Synthesis of managerial capacity*

It is quite evident that the managerial capacity to govern the process of climate greening urban areas is seriously constrained by the complexity of today's governance structures. The existential issues of fragmentation and compartmentalisation as the unintended negative consequences of specialisation are not exclusive to adaptation issues, but touch every complex governance issue urban areas are faced with. Therefore the continuous dilemma between specialisation and integration will most likely not be solved just for the sake of adaptation planning alone. The pressure to find solutions will probably be dependent on the degree to which other important governance issues are affected too. This raises the question whether the integration of adaptation across policy fields and its accompanying city wide adaptation strategies which stretch beyond the boundaries of sectoral policies are the best governance mode for adaptation planning. One could challenge this dogma of mainstreaming, by analysing the suitability of more sectoral approaches to replace or complement the mainstreaming approach; so to follow sectoral lines rather than resist them. One could adopt an approach in which each sector makes its specific adaptation policies in order to make that sector climate resilient. The most relevant sectors would be urban, infrastructure, water, green and public health planning, and other sectors where the impacts of climate change are felt. One could also think of the creation of a dedicated policy group/sector for adaptation and/or climate policy (similar to Rotterdam). This could be an effective strategy in the phase of policy preparation and making. In that sense it would be interesting to evaluate the effectiveness of the Rotterdam Climate Proof group in five years time. Is this governance mode of a rather specialised sectoral group of people more effective than the mainstreaming of adaptation? The general advantages of such a dedicated team are expected to be the presence of clear, detailed and accountable targets and mandates geared towards adaptation, and more focus for and specialisation of adaptation issues. In the case of RCP an additional advantage is their place in the organisation directly under the municipal executive office, which lends them considerable political power. The expected disadvantages are obviously more distance from related policy fields, which could lead to these other policy groups posing barriers to protect their turf. Moreover, a separate policy group could result in too much orientation on the content, and not enough process orientation (management skills that enhance coordination across policy sectors); and lack of knowledge of related policy fields.

Table 6.4. provides an overview of the comparison of the managerial capacity across the cities.

Critical aspect	London	Rotterdam	Toronto
Integration of adaptation and green planning:			
Adaptation concerns into spatial planning documents	national: yes; regional (GLA): yes; local: still limited	national: no, separate document provincial: yes, focused on water local: no, only in Waterplan2	federal: no provincial: no local: yes, but not explicitly
Adaptation planning into spatial planning processes	national: extensive amount of tools from national government, both for water and building standards; no local initiatives	national: focus on water; local: dedicated adaptation team and development of a building standard	national: focus on water; local: development of the Toronto Green Standard as a sort of building code
Green planning important part of spatial planning	yes, extensive	yes, but less explicit. No overall green policy in place.	yes, extensive
Green infrastructure as an important adaptation measure	yes, separate urban greening programme for adaptation	no, with the exception of green roofs	yes, rather extensive
Organisation of spatial, green and adaptation planning:			
Extent of fragmentation across and within bodies	spatial: rather fragmented across bodies green: extremely fragmented adaptation: geographical fragmentation across boroughs	spatial: fragmented across municipal bodies green: very fragmented adaptation: one dedicated municipal dept.	spatial: concentrated in 1 division, but internally fragmented green: limited fragmentation adaptation: one division responsible (environment office)
Vertical coordination	troublesome due to politically sensitive relations	troublesome; Rotterdam has possibility of direct contact with national government	troublesome due to political sensitivities, but currently quite good relationships
Horizontal coordination	constrained by compartmentalisation	constrained by compartmentalisation	constrained by compartmentalisation
Geographical coordination	troublesome due to politically sensitive relations among boroughs and with the GLA	quite good coordination due to special regional body of the City Region	difficult due to the absence of a regional body. TRCA coordinates water sheds and natural heritage
Use of management tools and strategies			
Tools to increase the effectiveness and legitimacy of policies	very extensive use of partnerships in every policy field and across policy fields including for spatial, green and adaptation planning	limited use of partnerships in spatial planning, extensive use of project management type of tools	extensive use of partnerships in every policy field and across policy fields; extensive use of steering and working groups, steering committees
Extent of promotion of multi-functional forms of land use in general and for adaptation	still rather limited, although it is recognised as an omission, focus on green roofs	extensive use of multi-functional forms of land use; many pilot projects to gain experience	still rather limited, focus on green roofs and permeable paving
Barriers (in order of significance)			
	Fragmentation Two-tier government system Compartmentalisation	Compartmentalisation Fragmentation Lack of organisational structures for mainstreaming adaptation	Compartmentalisation Lack of translation into action Lack of geographical coordination
Opportunities			
	Using existing Green space more efficiently More inclusive integration of adaptation in regeneration projects	Mainstreaming adaptation into all kinds of processes, including building codes	Mainstreaming adaptation into risk management type of processes and building codes Multi-functional land use
Key strategies used to overcome the barriers			
	Partnerships Mainstreaming of adaptation into all relevant strategic policy documents	Separate Rotterdam Climate Proof team Project management structures and tools	Using more formal regulatory institutions to enforce adaptation into development projects, such as the Toronto Green Standard and the Green Roof by-law

Table 6.4. overview of the managerial capacity

6.6. Political capacity compared

6.6.1. Accountability

The extent of involvement of stakeholders and the public at large, as well as the transparency and documentation regarding the processes of public policy making are regulated by national (The UK and The Netherlands) and provincial (Ontario) law for each city; for spatial planning processes this is regulated in the respective Planning Acts. These Acts prescribe when and how public consultation should take place, who is ultimately responsible for making policy decisions and which information should be made accessible to the public. On top of this, local authorities can also more actively stimulate public involvement for example by involving relevant citizens and other stakeholders in the act of making policy rather than consulting them once the policy has been made. Although this is not yet common practice, it appears to be on trend in Toronto and Rotterdam in order to make policy decisions more legitimate and to increase societal support. Nevertheless it can be said that the accountability process for spatial and adaptation planning appears to be largely a matter of control by councillors, who deliver the political checks and balances as a result of the (legal) complexity involved in these matters. An effective way for citizens to have their voices heard is by pressurising these politicians.

6.6.2. Political will

In general the political will for climate policy is high, although both London and Toronto appear to have a bias towards mitigation rather than adaptation policy. The financial impact of the flood of 2005 was probably the real key driver for the development of adaptation policy in Toronto. Actors in each city have recognised the potential danger of short-termism of politics: one term you have support, the next term it might be gone. Therefore they have employed different strategies to keep adaptation planning on the political agenda. While the linking with mitigation so as to create win-win solutions is rather obvious, cities have also been using the opportunities of the visibility of partnerships and independent committees, as well as the newsworthiness of new climate projections for keeping adaptation high on the political agenda. Another example is the deliberate focus on short-term and manageable adaptation actions and projects, and the use of an incremental approach in case of rather radical measures, as was done for instance to facilitate the introduction of the Toronto Green Standard. In other words, all three cities are very creative in finding ways to maintain high political support, although it appears that Rotterdam manages best at doing this. This could be due to the fact that this city tends to focus on the opportunity rather than on the risk side of adaptation (this will be further discussed in section 6.8.).

6.6.3. Leadership

It is clear from the case studies that the three cities have achieved their frontrunner status as a result of the existence of considerable top-down, bottom-up and external parties leadership occurring within the time frame of the last ten to five years. In each city the Mayor has played a crucial role as visible authority, although there is a considerable difference in the powers among these Mayors (the Mayor of London is much more powerful than those of Toronto and Rotterdam). In Toronto this was compensated with a very strong and 'green' Council, while in Rotterdam one of the aldermen played a crucial role in the acceptance of adaptation measures. Bottom-up leadership was present in each city in the form of several dedicated policy officers, whose influence appears to have been most notable in Rotterdam. Each city also had the opportunity to utilise external experts and consultants to push the adaptation agenda. This cocktail of leaders, their high profiles and their skills resulted in considerable adaptation efforts, culminating into the creation of a city-wide adaptation strategy. Nevertheless, whereas in Rotterdam adaptation planning seems to be a conscious political choice of its leaders, in London and Toronto adaptation planning appears to be riding on the back of climate policy in general and a 'spin-off' of mitigation efforts, rather than a conscious political choice.

6.6.4. Key barriers and opportunities to the political capacity

Although the political capacity appears to be a major asset in these cities, a few barriers were nevertheless raised. In London the political tensions between the Mayor and the boroughs and among boroughs are viewed as a potential constraint. In Rotterdam the short-termism of politics is regarded as a threat, certainly in light of the municipal elections of March 2010. In Toronto the inclination of politicians towards mitigation is mentioned as a barrier. In terms of opportunities respondents are rather unanimous; i.e. the linking of adaptation with another important governance issue and in particular with mitigation. In Toronto and London green infrastructural measures are regarded as the ideal win-win solutions for both mitigation and adaptation concerns.

6.6.5. Synthesis

The political capacity is quite strong in London, Rotterdam and Toronto, although it is not exclusively a result of the spatial planning policy field. Spatial planning regulations offer considerable potential in terms of accountability. Political will and in particular leadership are delivered by a combination of factors and actors from the wider policy and political arena. Spatial planning plays a considerable role in delivering leadership in London, but this is because of the planning powers of the Mayor rather than the capacity of the policy field itself. Differences in capacities between the three cities are only nuances; they are quite alike in terms of political capacity, although in Rotterdam there is slightly more support for adaptation planning specifically. In contrast to the barriers constraining the managerial capacity, most barriers regarding the political capacity appear to be less difficult to change for the better and appear to be within the powers of the local authorities. These cities have demonstrated that there are all kinds of strategies to get and maintain political buy-in for adaptation despite barriers such as the short-termism of politicians and their inclination towards mitigation policies. Political buy-in, supported by a considerable amount of leadership, appears to set these cities apart from other cities, and most likely explains their status of frontrunners in adaptation. This suggests that they could provide valuable lessons for other cities in terms of building political capacity. Table 6.5. gives an overview of the comparison of the political capacity across the cities.

Critical aspect	London	Rotterdam	Toronto
Accountability:			
Extent of transparency of policy making processes	Passive openness as required by law	Passive openness as required by law	Passive openness as required by law
Active involvement of stakeholders and public in spatial planning processes	Wide consultation process, generally after policy making	Wide consultation process, mostly after but increasingly prior to policy making	Wide consultation process, both prior to and after policy making
Political support:			
Extent of political support	High for climate policy but focussed on mitigation	High for both mitigation and adaptation	High for climate policy but focussed on mitigation; 2005 flood was a key driver
Means to achieve and contain support	Link with mitigation to create win-win solutions	Inspiring vision for Rotterdam as a Water&Climate City	Link with mitigation to create win-win solutions
	London Climate Change Partnership	Breakdown of vision into sizeable projects	Toronto Urban Climate Change Network
	Use momentum of new UKCP09 climate projections	Demonstrating economic spin-off of adaptation planning	Climate driver study
		Independent Advisory Committee of respected experts/consultants	Focus on short-term actions
		Incremental approach to Toronto Green Standard	
Leadership:			
Top-down leadership	Two consecutive Mayors who are very strong on climate policy	Mayor Opstelten (previous Mayor) and Alderman Bolsius	Mayor and Deputy Mayor
Bottom-up leadership	Dedicated GLA officers and a few officers in the boroughs	A few very passionate policy officers with a huge network within the municipality	A few committed policy officers
External partners pushing the adaptation agenda	Most notably the Environment Agency and Living Roofs in the promotion of green roofs	International Advisory Board, with special role for Mr. Lubbers	'Round Table of the Environment', Toronto and Region Conservation Authority, and Clean Air Partnership
Key barriers:	Lack of political buy-in by boroughs	Short-termism of politics	Focus on mitigation from the political side
	Political tensions between the Mayor and the boroughs		
Key opportunities:	Linking mitigation & adaptation	Linking mitigation & adaptation	Linking mitigation & adaptation
		Use political support for the upgrading of the public realm	

Table 6.5. overview of the political capacity

6.7. Resource capacity compared

6.7.1. Economic resources

In general the economic resources in the form of budgets and land, in order to climate green cities are very scarce due to the priority setting of both higher and lower levels of government. Higher government levels generally do not provide separate funding for the acquisition and maintenance of green space, and land is anyhow very expensive in urban areas. Lower government levels generally give rather low priority to green planning, while most of their resources for climate change policy go to mitigation measures, thus reflecting the focus of political support as discussed in the previous section on political capacity. Rotterdam is in a luxurious position compared to London and Toronto; a considerable municipal budget has been made available for adaptation planning and the municipality still owns large parcels of land which it can use for climate greening purposes. Moreover, there are considerable provincial funds for the acquisition of green space in the direct surroundings of Rotterdam. It can be concluded that the availability of economic resources seems to be a reflection of the extent of political support for adaptation planning.

6.7.2. Human resources

Both quantitative (number of people) and qualitative (skills and know-how) human resources are under-resourced for climate greening London, Rotterdam and Toronto. Again Rotterdam is relatively well-off quantitatively speaking, with six dedicated officers for adaptation, although it is by far the smallest of the three cities in terms of the size of the municipal civil service. The skills and know-how for adaptation planning in general and climate greening in particular are largely lacking; in fact almost all respondents indicated that they were still at the beginning of a huge learning curve. Therefore it is acknowledged that extensive staff training programmes are needed both now and well into the future. Each city is also faced with a civil service apparatus as 'bureaucratic monster': the cultures of divisions are sectorally defined, and the way of doing things is hierarchical and fixed by procedures, reinforced by silo thinking. The culture of the civil service apparatus is hampering the integral and lateral thinking, claimed to be needed for adaptation planning by scientists and policy makers alike. Thus the capacity in terms of human resources is still a long way from being ideal for climate greening urban areas.

6.7.3. Knowledge resources

Knowledge for adaptation planning is rapidly building, thanks to the many research programmes, tools and databases that have been or are being developed. Both national governments and local authorities seem to understand the urgent need for addressing knowledge gaps, although most programmes are geared towards acquiring technical (natural scientific), rather than social scientific knowledge. Extensive support is given by external experts, scientists and consultants, often in the form of networks, partnerships, research institutes and NGO support programmes. Therefore it can be said that knowledge resources are most developed in this sub-capacity.

6.7.4. Key barriers and opportunities

Lack of economic resources was mentioned as a key barrier in both London and Toronto, while lack of know-how of (spatial planning) staff on adaptation was mentioned in all three cities. Lack of lateral management skills of staff, that effectively deal with the integral character of adaptation planning and that can counteract compartmentalisation, was also mentioned as an important constraint to the resource capacity. In Rotterdam, the lack of skills of spatial planning officers to deal with private developers was mentioned in light of the shift of spatial planning towards a governance approach. The most important opportunity to raise the resource capacity lies with the education and training of staff to build know-how and skills for adaptation planning, according to several respondents in each city.

6.7.5. Synthesis

The resource capacity, when expressed in terms of available budget, land and number of people, appears to be a one-on-one reflection of a conscious political choice for giving a low priority to adaptation planning; what is high on the political agenda, that is where the money goes. Hence the resource capacity is high in Rotterdam, certainly in relation to the size of the city, and low in the other two cities. Fortunately technical knowledge resources for adaptation planning are rapidly building in all three cities, supported by an extensive network of external experts, providing an epistemic community. A serious limitation to the resource capacity in all three cities is formed by the lack of organisational skills of staff to act and think laterally, further aggravated by a bureaucratic, hierarchic civic culture, divided into different sub-divisional cultures. When asked about the key barriers to the governance capacity for climate greening their city, “lack of resources” was often one of the first things mentioned by respondents. However, this does not necessarily reflect the importance of this barrier. Rather it is the ‘presenting barrier’: the obvious easy answer to the question, while there are other more complex barriers that might be more important and/or more difficult to deal with. Because the good thing about most of the barriers to the resource capacity, is that they are relatively easy to fix once the priority for adaptation planning is raised: by increasing budgets, by hiring people, by training staff, by extending research programmes etc. This in stark contrast to the barriers to the managerial capacity, which pose much more fundamental challenges in the urban governance of adaptation. Table 6.6 provides an overview of the resource capacity.

critical aspect	London	Rotterdam	Toronto
Economic resources:			
Available budget	very limited government funding for green or adaptation planning; boroughs budgets very low due to priority setting	considerable municipal budget for adaptation	limited municipal budget; most funds go to mitigation measures; some funds available for a.o. green roof incentive programme
Available land	land is too expensive to acquire and to maintain	Rotterdam stills own much land it can sell off to fund green space provisions	most land is in private hands, although TRCA owns some crucial parts
Human resources:			
Number of people involved in adaptation planning	only 1 dedicated adaptation officer after serious downsizing of GLA environment group	six dedicated adaptation officers	only 1 dedicated adaptation officer
Skills & know-how	GLA expertise on climate change is high; lack of skills for integrated planning	know-how focused on water management issues	lack of know-how on eco-systems and adaptive management
Organisational culture	protectionist culture of professional institutes maintaining silos, especially in green planning	municipal culture counteractive to lateral thinking; clash of cultures of the three physical divisions	municipal culture counteractive to change, very standardised way of working
Knowledge resources:			
Technical and social knowledge	many research programmes, databases and tools focusing on technical knowledge re local climate impacts	many research programmes, focusing on building knowledge re water management	many research programmes, tools and databases re climate impacts and sustainable technologies
Support of external experts	Extensive support from eg. UKCIP and LCCP	Extensive support from KfC	Extensive support from CAP, TRCA, TUCCN,
Key barriers:			
	Lack of budget for the urban greening programme	Lack of knowledge in spatial planning re adaptation	Lack of economic resources due to other political priorities
	Lack of knowledge of planning officers on adaptation	Lack of skills to think laterally	Lack of staff dealing with adaptation
	Lack of organisational skills to think and act laterally	Lack of skills to negotiate with private developers	Lack of management skills in dealing with adaptation
Key opportunities:			
	Training programmes for staff for know-how on adaptation and for new management skills		Education and training programmes for staff
			Development of standard tool kits on adaptation for staff

Table 6.6. overview of the resource capacity

6.8. Learning capacity compared

6.8.1. Dealing with uncertainty

As became clear from the literature review, uncertainty is a key feature of adaptation to climate change, and uncertainty regarding local impacts regarded as a key constraint. The research confirms these findings from literature: in each city uncertainty was acknowledged by respondents as a very real and important barrier. Nevertheless, there is one remarkable difference: in Rotterdam uncertainty is seized as an opportunity for turning the city into a living experiment for testing out new and innovative adaptation measures, while in London and Toronto uncertainty is regarded and treated as a risk that must be contained. Each city employs both traditional technical and new managerial approaches to handle uncertainty, but there are slight differences in emphasis. In London and Toronto there is more focus on the risk side: in London by means of technical instruments such as climate projections, impact assessments and regular policy reviews so as to increase the evidence base; in Toronto by means of instruments such as risk assessment processes so as to 'manage' uncertainty (take calculated risks). In line with its perception of uncertainty as an opportunity, the focus in Rotterdam is on conducting pilots and experiments, although they are primarily related to water management and not so much to green infrastructure as a means to do this. Thus, while uncertainty is a prevailing issue in all three cities, Rotterdam has chosen a rather different coping strategy.

6.8.2. Continuous learning processes

The infrastructure for the continuous support of knowledge dissemination among city staff and stakeholder groups appears to be most developed in London, where one has ample access to all kinds of databases and other tools provided both by national government, professional institutes and local authorities. In Toronto the foundation for such infrastructure was laid down around the launch of the adaptation strategy but neglected ever since, while in Rotterdam such infrastructure is still largely absent and missed, as repeatedly mentioned by respondents. More or less the same pattern can be distilled with respect to internal and external networks. London has ample opportunities to gain and share knowledge and best practices through networks offered by the numerous partnerships that have been formed, while in Toronto and in particular in Rotterdam networks are less developed. Each city has access to the C40 transnational network of cities and respondents in each city viewed this as one of the best opportunities to learn from peer cities. Rotterdam has even created a sub-group of delta cities within the C40 group with which it aims to share delta specific climate adaptation issues. So, the three cities are at different stages of development of continuous learning processes with London being slightly in the lead.

6.8.3. Key barriers and opportunities

Not surprisingly uncertainty, both with respect to local climate impacts and the effectiveness and financial implications of adaptation interventions, is perceived to be a serious barrier to the governance capacity according to respondents. In Rotterdam the lack of a robust knowledge infrastructure was also mentioned regularly, while in Toronto several respondents mentioned the translation from generic knowledge to real and practical planning processes to be a real challenge, as was experienced with the development of the Toronto Green Standard. Respondents in the three cities agreed upon the most important opportunity being the sharing of knowledge and experiences in all kinds of networks, and in particular with peer cities around the world.

6.8.4. Synthesis

In line with the literature on adaptive capacity (see chapter two) the learning capacity is indeed an important aspect of adaptation to climate change, based on the experiences in these three cities. Although it is not yet well developed, it appears to be a capacity that is entirely within the reach, power and authority of local governments and their partners. In other words, it seems to be a

capacity that is very crucial, accessible and manageable at the local level, which perhaps makes it one of the most influenceable and impactful sub-capacities at the local level. The learning capacity still offers much potential for growth in these three cities, each in their own way: London and especially Toronto by acknowledging and exploiting the opportunity side of uncertainty and of adaptation planning; Rotterdam by providing the infrastructure for continuous learning processes, certainly to ensure that all the experiences gained from experimentation are preserved within the relevant actors and stakeholders. Table 6.7. provides an overview of the learning capacity in the three cities.

critical aspect	London	Rotterdam	Toronto
Dealing with uncertainty:			
Uncertainty acknowledged	yes, reluctantly	yes, and embraced	yes, reluctantly
Uncertainty categorised	primarily as a big risk	primarily as an opportunity	primarily as a big risk or at best an opportunity for cost avoidance
Technical approaches	UKCIP projections and tools, impact assessments, regular reviews of policies and plans	RCP toolkit, cost-benefit analyses	Climate Driver Study, cost-benefit analyses
Managerial approaches	scenario building for both impacts and policy responses; real life experiments together with universities	real life experimentation as key element of the adaptation programme; City Harbour as key development area for innovative solutions	extensive environmental risk assessment process focusing on climate change; mainstreaming of adaptation into existing risk management processes
Continuous learning processes:			
Infrastructure	databases, regular workshops and training sessions on climate change for various audiences	very limited and perceived as an important barrier	foundation for solid infrastructure created in 2008, but neglected ever since
Internal and external networks	many internal and external networks as a result of the numerous partnerships; C40 transnational network	mostly external networks; active within the C40 network by setting up a Connecting Delta Cities sub-group	some internal networks; external networks through CAP and TRCA; C40 transnational network of which Toronto's Mayor is the chair
Stakeholder dialogue	automatically guaranteed through partnerships; separate stakeholder dialogue sessions for adaptation organised by the GLA	mostly with water boards and with external experts	various internal and external stakeholder dialogue sessions were held around the creation and publication of the adaptation strategy; nowadays mostly by means of the TUCCN
Key barriers:	uncertainties regarding adaptation interventions	uncertainties regarding costs and benefits of adaptation measures, in particular for green roofs	uncertainties regarding local climate impacts, and their use as an excuse to make only incremental changes
		limited internal infrastructure for knowledge generation and dissemination	translation from general knowledge to very specific recommendations in planning processes
Key opportunities:	networks of various stakeholder constellations	sharing of knowledge and best practices in all kinds of networks	learning from a network of peer cities

Table 6.7. Overview of the learning capacity

7. Conclusions

7.1. Introduction

Adaptation planning has become more and more popular in the policy arena as the impacts of climate change have become increasingly felt. This is the more so in urban areas: these areas are often located in river deltas close to the sea and therefore more vulnerable to flood risk, and they are faced with the urban heat island effect due to intensive urbanisation and therefore more vulnerable to heat stress. It is generally accepted in both academic and political circles that adaptation to climate change is a ‘wicked’ problem that needs a governance approach, in which all sectors in society (state, market and civil society) are involved. Moreover, spatial planning is generally regarded as an essential cross-sectoral policy field for the realisation of adaptation planning because its policies can affect resilience to the impacts of climate change due to their effect on land use and spatial configurations. Based on these assumptions, this research has attempted to contribute to gaining insight into the governance conditions needed for the spatial planning policy field to ‘climate green’ urban areas, by analysing and comparing three frontrunner cities in adaptation planning. ‘Climate greening’ is a new term created to describe the process of adaptation to climate change by means of green space as an important no-regret measure. The central research question was:

Which conditions contribute to the governance capacity of the spatial planning policy field for climate greening cities?

The sub-questions, which build up to this central question, were as follows:

- What are critical aspects of the governance capacity of the spatial planning policy field for climate greening cities? (chapter 2)
- Based on these critical aspects, what is the extent of governance capacity of the spatial planning policy field for climate greening London, Rotterdam and Toronto, and what are the main barriers and opportunities to this governance capacity? (chapter 3 to 5)
- What are the similarities and differences in the governance capacities and their barriers and opportunities among these cities? (chapter 6)
- What can be learnt from this comparison and which critical aspects can be relatively easily improved in London, Rotterdam and Toronto so as to enhance the governance capacity? (chapter 7)

By addressing this last sub-question this chapter sets out to provide the main common patterns in the governance capacity, to discuss the relevance of the two basic assumptions (the governance approach and the integral role of spatial planning), and to answer the central research question. The thesis will be ended with a discussion regarding the research methods and results, and some recommendations for further research.

7.2. Overall synthesis of the governance capacity

7.2.1. Extent of governance capacity

The findings in London, Rotterdam and Toronto show the legal and political capacity to be the strongest sub-capacities, i.e. their capacity levels are the highest of all five sub-capacities. The legal capacity is very strong because of the strong regulatory regimes for the protection and enhancement of green space, the political capacity is strong because of the combined strong accountability and leadership. The strength of the managerial capacity is moderate. On the one hand the integration of adaptation concerns into spatial planning documents and processes is already quite advanced, on the other hand the horizontal, vertical and geographical coordination of adaptation planning is seriously constrained by the presence of compartmentalisation and fragmentation. The resource capacity is still quite weak: while knowledge resources are quite well developed thanks to the presence of an

epistemic community, the economic and human resources are still rather limited. The learning capacity is also still rather weak and underdeveloped, because the opportunities attached to dealing with uncertainty are not yet exploited and the infrastructure for the support of a continuous learning process should be further enhanced. Table 7.1. gives an overview of the capacity level per critical aspect and per sub-capacity, based on an equal weighting of the underlying indicators per critical aspect as well as the average of the three cities. Appendix 4 provides a detailed assessment of the indicators. The average of the cities was used since there are hardly any significant differences among the cities. Only Rotterdam scores significantly higher in economic resource capacity. On the whole the governance capacity in these three cities is slightly stronger than average if all critical aspects and sub-capacities are given the same weight. This very promising score is to be expected from cities which are leading the field of adaptation planning.

Capacity/critical aspect	Strength
Legal capacity: Strong	
Protection of existing green space	Strong
Creation of new green space	Strong
Environmental equity	Medium
Managerial capacity: Medium	
Integration of adaptation	Medium-Strong
Organisation of spatial, green & adaptation planning	Weak
Management strategies & tools	Medium
Political capacity: Strong	
Accountability	Strong
Political will	Medium-Strong
Leadership	Strong
Resource capacity: Weak-Medium	
Economic resources	Weak-Medium
Human resources	Weak-Medium
Knowledge resources	Medium
Learning capacity: Weak-Medium	
Dealing with uncertainty	Weak-Medium
Continuous learning processes	Medium

Table 7.1 Strength of capacity based on ratings per critical aspect

7.2.2. Patterns in barriers and opportunities

There are a number of commonalities in the barriers and opportunities which stand out. Compartmentalisation was perceived to be a key barrier in each city in 17 (out of 33) interviews. It gives an indication as to the fierceness of the barrier as well as its detrimental effect on the integration of adaptation into relevant policy fields. Apparently the 'mainstreaming' of adaptation is not an easy task to do, despite the ambitions of policy makers. Uncertainty was also mentioned as a key barrier in every city, in total in 12 interviews. It is a fact of life when it comes to adaptation. A third common barrier is horizontal and vertical fragmentation, which is experienced in all three cities, and mentioned in 11 interviews. If one would add geographical fragmentation which was experienced in two out of three cities, this barrier would even be the biggest (in total 18 respondents). Fragmentation is the most difficult barrier to solve, since it touches upon the complex organisational structures of urban governance systems, which have been put in place for very good reasons other than adaptation planning. So instead of trying to remove this barrier (which would be a mission impossible), these cities are using all kinds of managerial approaches in order to promote

coordination and cooperation among all parties involved. Two of these common barriers are reconfirmed in the still limited but rapidly growing body of literature on the governance of adaptation. Institutional fragmentation is mentioned as a key constraint in Heinrichs et al. (2009), based on case study research of 8 cities in developing countries; in McCarney (2009) based on a case study research of London and New York, in Trohanis et al. (2009) based on case study research in five cities in developing countries, Penny and Wieditz (2007) based on six metropolitan regions in western democratic countries and in Lindley et al (2007) based on a case study of the Greater Manchester conurbation. Another key constraint found in literature is the uncertainty regarding impacts, the extent of adaptation required and the economics of adaptation measures (Adger et al., 2009; Nieuwaal et al., 2009; Füssel, 2007; Espace, 2007; Penney & Wieditz, 2007; Wilson 2006). There are also two opportunity areas common across all three cities. The first one is the linking of adaptation with other important governance themes, in particular with mitigation measures. Green infrastructural measures are seen as creating such win-win solutions. The second one is the integration of adaptation concerns into all relevant spatial planning processes, building standards, risk and environmental impact assessments and multi-functional forms of land. In particular the last one is felt to be rather underutilised: for instance the potential square metres of roofs alone was seen as a huge opportunity for climate greening the city.

7.2.3. Differences per city

Apart from common developments across the three cities, there are also some differences. It is not the intention here to place any judgments on these differences. Rather an effort is made to understand whether these differences could be explained by the existence of contextual differences, such as (spatial planning) governance arrangements, or political, cultural or historic contexts.

Regarding London, there are a two things worth mentioning. First of all, London stands out with its efforts to mainstream adaptation throughout the London Plan and other strategic Greater London Authority (GLA) policy documents. Thus it pushes adaptation considerations into the political agenda of the boroughs in a rather top-down manner, which is probably a necessity considering the two-tier and otherwise fragmented governance structure in London. In particular the London Plan has the statutory power to enforce adaptation into the spatial planning documents of the local authorities, and the GLA is using the power of this document to the max. Secondly London is, very much influenced by the neo-liberal spirit which has been dominant in The UK since the 1980s, employing public-partnerships for adaptation planning in every possible way.

Rotterdam is rather unique in the sense that adaptation is treated as an opportunity instead of a threat, and that they deal with the uncertainty of adaptation in the same way; by focusing on the chances this creates for 'learning by doing'. The knowledge generation as a result of this experimentation and its expected economic spin-off probably explain why Rotterdam has managed to secure more economic resources to support adaptation planning. The art of experimentation fits the 'hands on' culture of Rotterdam very well. Moreover, they have installed a dedicated team of six officers for adaptation planning, which is supposed to be in function until adaptation is mainstreamed across all relevant policy sectors and municipal divisions. This appears to be a reflection of the higher explicit political support for adaptation planning.

Toronto is striking because of its efforts to make maximum use of the limited power the municipality has been awarded by the Province of Ontario through the new City of Toronto Act to set requirements for sustainable development on all newly developed buildings. The Green Roof by-law is the first of its kind in North America, requiring green roofs on all new developments; the Toronto Green Standard is a newly created building standard that incorporates all kinds of sustainable design elements, including adaptation measures. In addition Toronto seems to be very keen on utilising risk assessment techniques for adaptation planning. This is in line with one of the key recommendations from the federal and provincial governments regarding adaptation, i.e. to take a risk management approach to adaptation.

7.2.4. Governance versus government of adaptation

Climate (change) can be regarded as a common public good, since it is impossible to exclude others from using the good. Hardin (1968, p.1243) wrote a famous article about the “The Tragedy of the Commons”, in which the overexploitation of common goods is described to be the result of the conflict between long-term and short-term interests and the lack of capacity of individual actors to fix the problem, although they do have this capacity collectively. Likewise, adaptation planning is a dilemma between strong short-term interests (eg. avoidance of costs of taking adaptation measures now; using the available space for socio-economic interests instead of for climate greening) and weak long-term interests (a future climate resilient environment). Furthermore, adaptation planning is difficult to realise on an individual basis: for instance other than installing an air conditioner to combat heat stress, individuals cannot influence the urban heat island effect, provide coolness and shade through green space or build a dike to protect themselves against floods. Therefore a public good is very often the focus of public policy making, and this is confirmed by the findings of this research. In London, Rotterdam and Toronto adaptation planning is still very new and primarily initiated, prepared and implemented by (local) government authorities. Non-state actors are only involved to a limited extent. Stakeholders from private parties and civil society participate in two ways: firstly through consultation processes for adaptation policy documents, oftentimes pro-actively stimulated through the organisation of stakeholder events; and secondly through adaptation partnerships/networks created for the purpose of conducting research, disseminating information, and giving advice and guidance in order to inform adaptation policies. London is most ahead in this respect: with the installation of a public-private partnership for adaptation planning purposes already installed in 2002, London gives a considerable role to non-state actors in the policy preparation phase. These forms of consultations of non-state actors can be regarded as a “degree of tokenism” on Arnstein’s (1969, p. 218) ladder of citizen participation, since it is unclear how and to what extent the ideas of non-state actors are taken into account and since decision makers still judge the feasibility of their advice. Or as Arnstein (1969, p.211) wrote, participation could thus manifest itself as a “window-dressing ritual”. Nevertheless, in their adaptation strategies all three cities have displayed intentions to employ a true governance approach, in which public-private partnerships are an important means to enhance public participation and in which planning and decision making responsibilities can be shared (a “degree of citizen power” according to Arnstein’s ladder). There are also some first signs of adaptation activities initiated by non-state actors from the insurance industry in the UK.

Based on these three leaders adaptation planning still appears to be primarily a government affair, but there are deliberate intentions to aim for a governance approach. It remains to be seen how and to what extent non-state actors will be involved in the entire policy cycle, including the implementation phase. It is simply too early to tell.

7.2.5. The role of spatial planning in adaptation planning

In each of the cities the spatial planning policy field has contributed first and foremost to the legal capacity, by having spatial policies and regulations in place for the protection and enhancement of green space. As a special form of the legal control model spatial regulations seem to be strong and consistent over time. A second major contribution of spatial planning is the capacity to incorporate adaptation measures in existing planning processes and building codes for sustainable design, as witnessed most prominently in the Toronto Green Standard. Through their extensive influence on urban renewal programmes they can substantially raise the managerial capacity. Thirdly, the spatial concept of multi-functional land use is very promising to integrate adaptation measures. With increasing populations and hence increasing densities in urban areas, multifunctional forms of land use are the solution to create a compact, green and climate resilient city. A fourth important contribution of spatial planning is the provision of geospatial information and databases, which can inform adaptation policies. Fifthly, the checks and balances in spatial planning processes considerably raise the transparency and accountability of public policy making, thus contributing to the political

capacity. Finally, spatial planning can deliver a number of resources in the form of land for climate greening, but also know-how of planning staff, and social-scientific knowledge related to urban planning. While the above contributions have been witnessed in all three cities, London has the additional advantage that the Mayor has considerable spatial planning powers, which has an additional positive effect on the political capacity of London.

There are also limitations to what spatial planning can do for adaptation to climate change. For instance, it cannot be expected to overcome compartmentalisation and fragmentation, just because it is supposed to be a cross-sectoral policy field. However, the management structures and tools that have been set up for spatial planning to promote interdisciplinary coordination can also be used for adaptation planning. For instance the public-private partnerships so popular in regeneration projects can also promote a climate resilient rebuilding of the urban environment. Another limitation of spatial planning is its very modest contribution to the political and learning capacity. Political will and leadership for instance cannot be expected to be generated exclusively by spatial planning actors. A large commitment from a broader policy spectrum is needed to raise these capacities. On the whole spatial planning is able to have a notable influence on the adaptation agenda, in particular on new and re-developments. On the other hand most urban environments are already largely built up. Therefore more emphasis should be paid to the potential role of spatial planning in retrofitting the existing building stock. Nevertheless, it appears that adaptation planning cannot rely exclusively on spatial planning; the active engagement of other policy fields is needed too. Table 7.2. summarises the main contributions and limitations to the dominant role claimed for spatial planning, derived from this research.

Contributions	Limitations
Strength of spatial regulations and policies	Limited influence on retrofitting of existing building stock
Strong influence on new and redevelopment through the integration of adaptation into planning processes and building standards	Integrative comprehensive character of spatial planning cannot overcome fragmentation and compartmentalisation
Spatial concept of multifunctional land use can be used to make the city climate resilient, compact and green	Critical aspects such as leadership, political will, handling uncertainty and continuous learning require involvement of actors from other policy fields
Provision of geospatial information to inform policies	
Checks and balances in spatial planning processes	
Provision of land resources, staff resources and knowledge resources	

Table 7.2. Contributions and limitations to the role of spatial planning in adaptation

7.2.6. The role of green space

The role of green space in mitigating the effects of climate change is acknowledged and applied in each city. The installation of green roofs is the most popular measure. In addition both London and Toronto use a wider range of green spaces, in particular with respect to trees. Although their role is widely endorsed, green infrastructural programmes are never exclusively developed for adaptation purposes; they serve a much wider range of ecosystems services. Moreover, their role should not be overestimated. It is realised in these cities that green space provisions can never completely solve adaptation issues such as floods and heat stress. They are just one measure that contribute to the solution, complementing other technical infrastructural measures.

7.3. Governance conditions for climate greening cities

Based on commonalities in critical aspects across the cities, general governance conditions have been deducted for adapting urban areas to climate change. In other words, if all these conditions are fulfilled the governance capacity should lead to the successful governance of adaptation to climate change in cities, which in turn determines the ultimate effectiveness of adaptation policy and green infrastructural measures. In line with the structure of the framework of analysis these conditions are once again organised per sub-capacity, although this is not representing any order of significance. Each condition is important in its own right.

Regarding the *legal* capacity, adequate protection of existing green space is a necessary precondition for climate greening cities, so that the urban environment does not become more impervious. The range of regulative institutions and spatial policies should cover a wide range of different types of green space and trees, if possible including sport/playing fields and private green space. Spatial regulative institutions that aim to increase the capacity of planning officers to demand land or money from developers in case of new or redevelopment, also make the urban landscape more pervious. Hence one can profit from the huge opportunity offered by the autonomous process of urban renewal. This can be done through spatial planning law, reinforced by local statements in the strategic spatial planning document. Regulations for the provision of green roofs might be even more acceptable by developers, since they do not sacrifice valuable land. Moreover, by making green roofs accessible to the public, they can contribute to the general amenity value of urban areas. Environmental equity requires the adequate geospatial information of vulnerable population groups, thus informing policies aimed to reduce inequities regarding exposure to heat stress and flood risk.

Legal conditions:

- *Adequate protection of existing green space*
- *Adequate provisions to create new green space*
- *Adequate geospatial information provision to inform redistribution policies that promote environmental equity*

In terms of the *managerial* capacity, adaptation concerns in the widest sense, so not only water, should be included in the checks and balances of local planning processes. In London, Rotterdam and Toronto this can be done through existing governance arrangements for water issues by extending the range of adaptation themes statutory consultees have in controlling planning processes. These statutory consultees should have the authority to inhibit planning processes in case of serious conflict with adaptation interests. In cities where such governance arrangements do not yet exist, some form of control over planning processes should be set up. Another important approach is to include adaptation concerns into national and/or local codes or standards for the design and construction of buildings, or even better by developing a special standard for adaptive building. Furthermore, if one keeps to mainstreaming adaptation across policy fields instead of a sectoral approach, managerial conditions must ensure as much as possible the horizontal, vertical and geographical coordination across policy fields, government levels and geographic jurisdictions. This can be done for instance by using existing coordination mechanisms of spatial planning and environmental planning. In addition it is recommended to create new consultation structures for adaptation (specific adaptation committees, steering groups, project teams etc.) Last but not least, multi-functional land use is *the* ultimate condition for both a compact and a green city and policy makers should encourage this effective management of precious space much more than is currently done. Simply planning green spaces for adaptation without a multi-functional approach only increases inefficiency in terms of infrastructure, emissions etc.

Managerial conditions:

- *Statutory consultees to control the integration of adaptation into spatial planning processes*
- *Integration of adaptation concerns into existing codes for sustainable building*
- *Application of a combination of management techniques (suited to the local governance context) to promote horizontal, vertical and geographical coordination*
- *Promotion of a multi-functional land use approach which includes adaptation measures*

With respect to the *political* capacity both internal and external stakeholder and public involvement needs to be ensured if one wants to have a true governance approach to adaptation planning. Preferably involvement should be extended into the policy preparation phase with some power to

co-decide, so as to make the planning process more legitimate. Regarding political will it is important that adaptation planning is explicitly endorsed as an important and integral part of climate policy. Buy-in for adaptation planning can be raised by focusing on the opportunity side of adaptation (business and job opportunities; becoming adaptation expert). Furthermore one should seek win-win solutions as much as possible: target adaptation interventions which have multiple benefits for society. The best way to create momentum is by having three kinds of leadership present at the same time: top-down leadership in the form of visible high-level politicians or executive champions, bottom-up leadership in the form of passionate policy officers and other stakeholders with a wide network of relations across policy fields, and external leadership in the form of experts, consultants, scientists or NGOs which provide knowledge and credibility.

Political conditions:

- *Real stakeholder and public involvement in adaptation planning*
- *Explicit political support for adaptation as full-fledged part of climate policy*
- *Creation of win-win solutions with multiple benefits for society*
- *Fostering of three types of leadership that mutually strengthen each other*

Since economic resources appear to be largely dependent on the level of political support, the *resource* capacity will automatically profit from improvement of the political conditions. Although very difficult, one could try to monetise the societal value of green space for adaptation and other purposes, so that adaptation measures are not only seen as expenses but also as benefits. Considering the early stage of adaptation planning and its learning curve the continuous investment in the building of know-how and skills of human resources involved in adaptation planning is very critical; hence this requires ongoing training and education programmes for staff and the wider stakeholder group. Gaining knowledge in climate science to inform policy making remains important, but more attention should be paid to the development of social scientific knowledge as adaptation planning becomes more mature.

Resource conditions:

- *Improvement of political support so that adaptation planning gets adequate resource allocated*
- *Training programmes as investment in the know-how and skills of human resources*
- *Investments into building technical and social scientific knowledge*

The following conditions are important for the *learning* capacity. While the uncertainties around adaptation planning need to be contained both by technical and managerial techniques, the shift of attention can focus to embracing uncertainty as an opportunity to ‘learn by doing’: make maximum use of the learning potential of experimentation through pilot projects (together with universities and other research institutes) and research and development programmes for innovative adaptation measures (together with market parties). The promotion of continuous learning processes can be fostered through organisational (partnerships, networks, forums, workshops etc.) and technical (databases, intra- and internet, toolkits etc.) infrastructures and the creation of networks among peer cities.

Learning conditions:

- *Containment of uncertainty through both technical and managerial techniques*
- *Mental space for learning by doing through pilots and innovations*
- *Organisational and technical infrastructures for continuous learning*
- *Exchange of information, experiences and best practices in networks*

7.4. Growth potential of sub-capacities

Since in section 7.2.1. a sense of the strength of each sub-capacity and its contribution to the overall governance capacity has been obtained, it might be interesting to question which strings should be pulled to raise the level of governance capacity. This section will look into the growth potential of the sub-capacities. This growth potential is deducted from a 'strength-actionability matrix' created for this purpose. This matrix is not meant to deliver exact science, but a crude tool meant to give a first idea of the low hanging fruit, i.e. which critical aspects could deliver the greatest potential for enhancement of the governance capacity and should be considered first. The horizontal axe shows the relative strength of the critical aspect, as has been summarised in table 7.1 and elaborated upon in appendix 4. The assumption is that a weak aspect indicates towards a high potential for growth, whereas a strong aspect leaves little room for further improvement, hence has little growth potential. This score is based on an equal weighting of the underlying indicators as well as of the three cities. As has become clear in chapters three to five there are no major differences in the levels of sub-capacities across the cities. Therefore one matrix has been made, which represents all three case studies. The vertical axe shows the 'actionability' factor, i.e. to which extent governance actors at the local level are able to take action on this critical aspect. It is measured by several indicators:

- Extent of actions that can be employed to ameliorate this aspect, based on the experiences of the three case studies (assumption is that the more actions have been initiated, the higher the potential is to improve this aspect)
- Extent of opportunities, i.e. chances for increasing the governance capacity, as mentioned by the respondents (assumption is that the more opportunity areas are mentioned by actors and stakeholders themselves, the higher the chance is that action will be taken)
- Extent of ability of local authorities to gear these remedial actions towards adaptation (assumption is that more focus on adaptation leads to better results, i.e. higher capacity)
- Extent to which this critical aspect can be handled by the local authorities without being dependent on or interfered by higher government levels (assumption is that the more independent the local authorities are, the more they are able to initiate the action)
- Extent to which these actions can be realised within time and budget constraints (assumption is that the more time and resources are needed, the less likely these actions will be realised).

Again, all five indicators have received equal weighting. This actionability assessment is in part based on the analysis of the three cities, and in part on estimations derived from literature. Appendix 5 elaborates upon the assessment of the actionability factor per critical aspect. By ranking the critical aspects on these two axes, one obtains insight into which critical aspects could make a difference relatively easily in the three frontrunner cities of London, Rotterdam and Toronto. The matrix as shown in figure 7.1. gives such an overview, based on the judgment of the findings of this research⁵. The orange zone in the upper left corner of the matrix indicates the zone with the highest growth potential, i.e. those aspects which are still relatively weak, but are relatively easy to strengthen and take action upon by local authorities. What becomes clear from making such a matrix, is that the following critical aspects provide most potential for raising the governance capacity for adaptation to climate change in London, Rotterdam and Toronto in the short to medium term, informed by the governance conditions from section 7.3. as to how they can be improved:

- environmental equity, by making maximum use of geospatial technologies and other spatial information to identify vulnerable population groups and take remedial action accordingly;
- management tools and strategies, by exploiting the potential of multifunctional forms of land use;
- human resources, by continuously investing in training programmes for staff and other stakeholders in adaptation planning;

⁵ It would be great if policy makers in each city would make their own assessment of the actionability factor, since they are the experts in their local contexts. This would be a nice exercise to complement this research.

- knowledge resources, by investing in particular in building social scientific knowledge (e.g. re policy interventions, effectiveness of different governance arrangements for adaptation planning etc.) in addition to maintaining an adequate technical research programme;
- dealing with uncertainty, by conducting pilot projects and innovative experiments; by becoming knowledge expert in adaptation planning and exploit its economic advantages;
- continuous learning processes, by providing and maintaining the infrastructure for these processes and making maximum use of all available actor and stakeholder networks; by using stakeholder dialogue to enhance the learning process.

Furthermore the following aspects show some room for growth:

- integration, by extending the integration of adaptation concerns into every relevant spatial planning process and building codes;
- political will, by treating adaptation as a full-fledged part of climate policy and by seeking win-win solutions with mitigation and other important societal governance themes;
- organisation, by using a combination of management techniques that best suit the local governance arrangements in order to enhance coordination efforts;
- economic resources, by raising the political will, so that priorities in resource allocation shift towards adaptation.

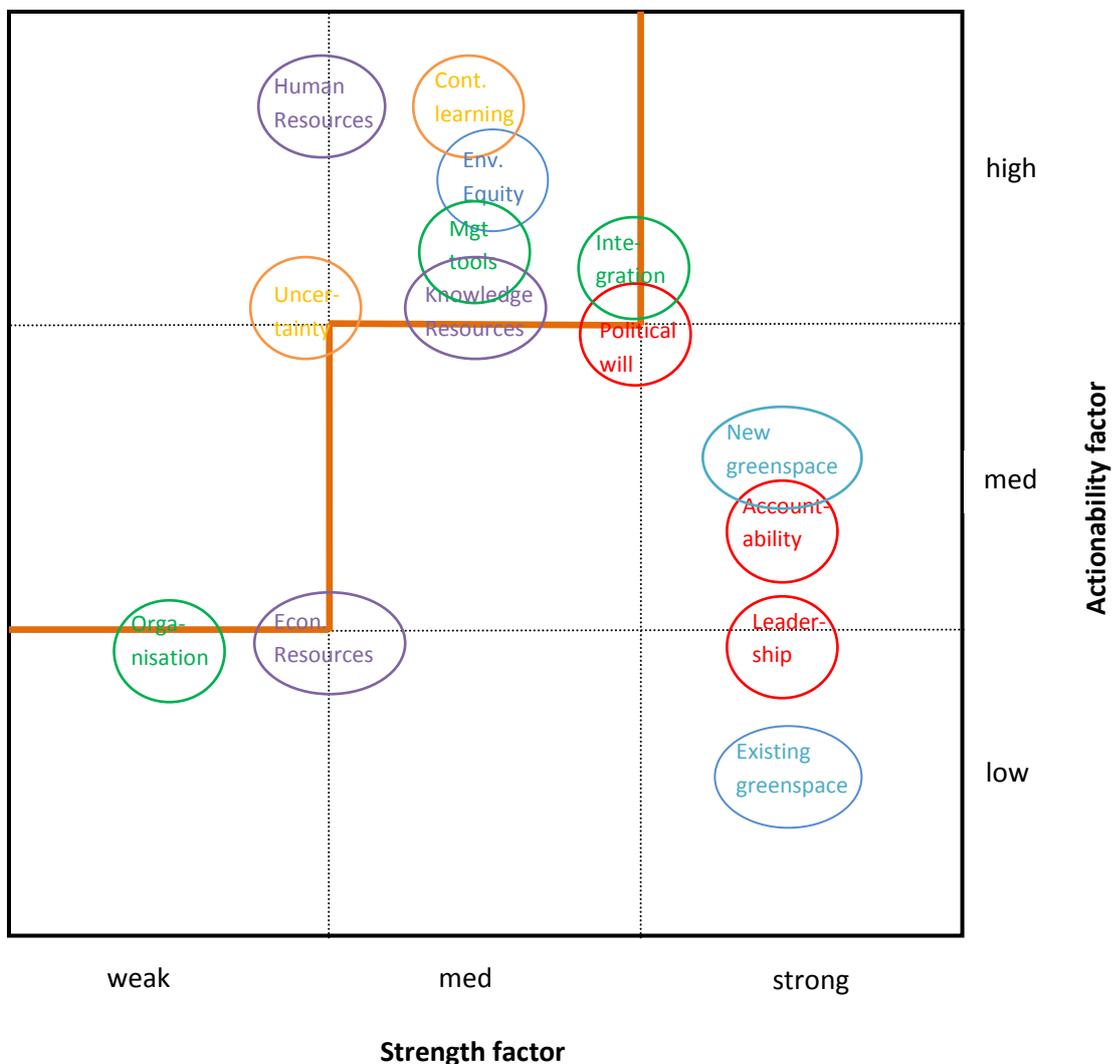


Figure 7.1. Strength-Actionability matrix of the critical aspects of governance capacity

7.5. Discussion and recommendations

This final section of the thesis discusses the points for improvement of the research design and results gathered from experiences gained throughout the research, and ends with recommendations for future research.

The framework of analysis has proven to be an effective tool for analysing and comparing the governance capacity in and among the three cities. It has captured all the relevant aspects without causing real duplications and it was comprehensible for respondents. There is one point of critique. In hindsight an indicator for the capacity to monitor and assess the effectiveness of adaptation policies, is missed. Such an indicator might be rather important for the managerial capacity (residing under management strategies and tools), so that an analysis is made as to whether and which assessment/monitoring tools are put in place to monitor and assess adaptation measures after their implementation, so as to increase the effectiveness of policy making. For instance: is the extent of imperviousness tracked and traced, or the expansion and reduction of green spaces? How are the results of the integration of adaptation into planning processes and building codes going to be identified and evaluated over time?

Regarding the selection of respondents, there is an inherent bias towards people that have a favourable stance towards adaptation planning, because the selection contained many actors heavily involved in adaptation planning. This might colour the results and make them more favourable than they really are. It is not expected though that this has any effect on the main findings and conclusions of this research. Moreover, the sample contained many state actors, reflecting the dominant role of the state in adaptation planning at this stage. Nevertheless, more input from non-state actors such as insurance companies, developers and citizen(group)s could have yielded more diverse views and more perspectives to the issue. Future research on adaptation planning should take more account of the views of non-state parties, even if they are currently not yet actively involved in the issue.

Regarding the research design, a conscious choice was made for a comparative analysis. While this allows for the generation of general patterns, it might become too abstract to cover the full and complex reality. This is overcome as much as possible by doing detailed case study descriptions of each city prior to the comparative analysis. Those interested in the details are referred to chapters three to five of this thesis.

Regarding the research results, it is believed that the triangulation of research methods and sources, combined with a common framework of analysis based on a literature review and expert interviews, and with the breadth of three strategically sampled cases, have delivered robust results that are able to withstand the test of internal validity and to some extent external validity as well. Naturally even more cases would have increased the external validity.

Speaking of which, one recommendation for further research would be to broaden the number of cases using the same framework of analysis to test the universality of the governance conditions and the key barriers and opportunities of the governance capacity. This could be done by expanding with 'similar' cases or alternatively with different cases, for example cities in developing countries where good governance principles are less prominent, or cities which are not heavily influenced by the spatial planning principle of compact growth. Additionally the research could be extended into rural areas, to analyse whether the governance conditions still hold under rather different (spatial) circumstances.

Ideas to bring more depth into the research is by looking at specific topics. For instance one could look at adaptation planning specifically for urban transport and infrastructure, or look at the role of water management institutions in the governance of adaptation, or look into how key barriers such as fragmentation and compartmentalisation could be informed by theories from organisational science and public administration, in an effort to find solutions that can enhance the mainstreaming of adaptation.

Another limitation to this research has been the fact that only policy *intentions* could be taken into account because of the early stage of adaptation planning. Future research could look into the implementation of adaptation policies and their actual effects in five to ten years time.

Finally, it would be helpful to conduct some research as to the universality of the framework of analysis. As mentioned in chapter two, the inner ring represents a general framework for governance capacity, while the outer ring is a specification of governance capacity for climate greening cities.

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Appendix 1: Overview of official policy documents London/The UK

Document Name	Issue	By whom
General		
The Community Infrastructure Levy	jan-08	Department for Communities and Local Government
Greater London Authority Act 2007	2007	Her Majesty's Crown
Spatial Planning		
Planning and compulsory purchase Act 2004	2004	Her Majesty's Crown
Planning Policy Statement 1: Planning & Climate Change	dec-07	Department for Communities and Local Government
Planning Policy Guidance 2: Green belts	jan-95	Department for Communities and Local Government
Planning Policy Statement 3: Housing	nov-06	Department for Communities and Local Government
Planning Policy Guidance 17: Planning for open space, sport and recreation	2002	Department for Communities and Local Government
Planning Policy Statement 25: Development and Flood Risk	dec-06	Department for Communities and Local Government
The London Plan: Spatial Development Strategy for Greater London	feb-04	Mayor of London
The London Plan: Spatial Development Strategy for Greater London. Consolidated with Alterations since 2004	feb-08	Mayor of London
The London Plan: Spatial Development Strategy for Greater London. Consultation draft replacement plan	oct 2009	Mayor of London
East London Green Grid Framework: London Plan (Consolidated with Alterations since 2004) Supplementary Planning Guidance	feb-08	Mayor of London
Planning for Equality and Diversity in London: Supplementary Planning Guidance to the London Plan	oct 2007	Mayor of London
Open Space Strategies: Best Practice Guidance	sep-08	Mayor of London
London Plan Annual Monitoring Report 5	feb-09	Mayor of London
Living Roofs and Walls: Technical Report. Supporting London Plan Policy	feb-08	Mayor of London
Sustainable Design and Construction: Supplementary Planning Document	feb-09	Borough of Southwark
Green roofs and walls: Good Practice Guide 1	?	Borough of Islington
Sustainable Drainage Systems: Good Practice Guide 2	?	Borough of Islington
Climate Change Adaptation: Good Practice Guide 3	?	Borough of Islington
Biodiversity in the Built Environment: Good Practice Guide 4	?	Borough of Islington
Climate change		
Adapting to climate change in England: A framework for Action	jul-08	Department for Environment, Food and Rural Affairs
Climate Change Act 2008	2008	Her Majesty's Crown
Adapting To climate change: UK Climate Projections	jun-09	Department for Environment, Food and Rural Affairs
Planning to live with climate change: our seven commitments	2009	The Royal Town Planning Institute
The London climate change adaptation strategy: draft report	aug-08	Mayor of London
The draft climate change adaptation strategy for London: Public consultation draft	feb-10	Mayor of London
Action Today to Protect Tomorrow: The Mayor's Climate Change Action Plan	feb-07	Mayor of London
Adapting to Climate Change: A Strategy for Islington 2009-2012	2009	Borough of Islington
Other		
The Mayor's draft water strategy: Draft for public consultation	aug-09	Mayor of London
Greener London: The Mayor's State of Environment Report for London	jun-07	Mayor of London
The London Health Inequalities Strategy: Draft for public consultation	aug-09	Mayor of London
Leading to a greener London: An environment programme for the capital	jul-09	Mayor of London
Connecting Londoners with Trees and Woodlands: A Tree and Woodland Framework for London	march 05	Mayor of London
The London Housing Strategy: draft for public consultation	may 09	Mayor of London

Appendix 1: Overview of official policy documents Rotterdam

Document Name	Issue Date	By whom
General		
Rotterdam 2006-2010 "Voor een Rotterdams resultaat". College programma	sep-06	Gemeente Rotterdam
Spatial planning		
Wet Ruimtelijke Ordening	2008	Ministerie van VROM
Nota Ruimte	2004	Ministerie van VROM
Structuurvisie Randstad 2040	2008	Ministerie van VROM
Ontwerp Provinciale Structuurvisie. Ontwikkelen met schaarse ruimte.	nov-09	Provincie Zuid-Holland
Ruimtelijk Plan Regio Rotterdam 2020: Regio in Uitvoering	dec-05	Stadsregio Rotterdam
Ruimtelijk Plan Regio Rotterdam 2020: tienpunten plan	dec-05	Provincie Zuid-Holland+Stadsregio Rotterdam
Regionaal Groenblauw Structuurplan 2 (RGSP2): Naar een Groene Regio aan de Delta	feb-05	Provincie Zuid-Holland+Stadsregio Rotterdam
Stadsvisie Rotterdam. Ruimtelijke Ontwikkelingsstrategie 2030	nov-07	Gemeente Rotterdam
Ruimtelijk Plan Rotterdam 2010. Meer stad meer toekomst	march 01	Gemeente Rotterdam
Verbonden Stad. Visie openbare ruimte binnenstad. Ruimtelijke ontwikkelingsstrategie 2030	sep-07	Gemeente Rotterdam
Stadshavens Rotterdam. 1600 ha Creating on the edge	may 08	Gemeente Rotterdam and Havenbedrijf Rotterdam NV.
Climate change		
Klimaatakkoord Gemeenten en Rijk 2007 - 2011	nov-07	Ministerie van VROM and others
Maak Ruimte voor Klimaat! Nationale Adaptatiestrategie, de beleidsnotitie	2007	Ministerie van VROM and others
Maak Ruimte voor Klimaat! Nationale adaptatiestrategie, de interbestuurlijke notitie	2007	Ministerie van VROM and others
Ruimtelijke Klimaatscan	jan-09	Provincie Zuid-Holland
Klimaatwijzer: Agenda voor een klimaatbestendig provinciaal waterplan en provinciale structuurvisie	dec-08	Provincie Zuid-Holland
Rotterdam Climate Initiative: Actieprogramma en doelen 2007-2010	sep-07	Gemeente Rotterdam and partners
Rotterdam Climate Proof: The Rotterdam challenge on water and climate adaptation	may 08	Gemeente Rotterdam
Rotterdam Climate Proof: 2009 adaptation programme	may 08	Gemeente Rotterdam
Rotterdam Groen van Boven: Toepassing van groene daken in Rotterdam	2006	Gemeente Rotterdam
Klimaat & Groen toolbox	nov-09	Gemeente Rotterdam
Other		
Leefbare Stad, Groene Stad. Beleidsdossier.	jun-07	LNV Consumentenplatform
Groenplan Rotterdam. Uitvoeringsprogramma 2005	may 05	Gemeente Rotterdam
Bomenstructuurvisie Rotterdam	july 09	Gemeente Rotterdam
Waterplan2. Werken aan een aantrekkelijke stad.	2007	Gemeente Rotterdam en aantal waterschappen
Rotterdamse Energie Aanpak en -Planning. Op naar CO2 neutrale stedenbouw	apr-09	Gemeente Rotterdam, Rotterdam Climate Initiative, TU Delft
De Rotterdamse Standaard voor projectmatig werken. Werken aan fysieke projecten op z'n Rotterdams.	2008	DS+V, Gemeentewerken and Ontwikkelingsbedrijf Rotterdam

Appendix 1: Overview of official policy documents Toronto

Document Name	Issue Date	By whom
General		
City of Toronto BY-LAW No. 583-2009, Green Roofs	may 09	Toronto Council
Ontario Regulation 166/06, Conservation Authorities Act	may 06	Ontario Ministry of Natural Resources
Spatial Planning		
Greenbelt Plan 2005	feb-05	Ontario Ministry of Municipal Affairs and Housing
Places to Grow. Better choices. Brighter Future. Growth Plan for the Greater Golden Horseshoe 2006	2006	Ontario Ministry of Public Infrastructure Renewal
Healthy Communities. Sustainable Communities. The 21st Century Planning Challenge.	Fall 2007	Ontario Professional Planners Institute
Provincial Policy Statement 2005	2005	Ontario Ministry of Municipal Affairs and Housing
Planning & Development Procedural Manual	jan-08	Toronto and Region Conservation Authority
Toronto Green Standard Update: Performance Measures for Sustainable Development	okt-08	Toronto City Planning
Toronto Green Standard. Low-rise residential, Low-rise non-residential and Mid to High rise residential, commercial, industrial and institutional Development	jul-05	Toronto City Planning
Toronto Official Plan	aug-07	Toronto City Planning
Design guidelines for 'greening' surface parking lots	nov-07	Toronto City Planning
Climate Change		
From impact to adaptation: Canada in a changing climate	2008	Natural Resources Canada
Climate Change: a Policy Paper	2008	Canadian Institute of Planners
Adapting to Climate Change. A Risk-based Guide for Ontario Municipalities	dec-06	Ontario Ministry of Municipal Affairs and Housing
Adapting to Climate Change in Ontario	nov-09	Ontario Expert Panel on Climate Change Adaptation
Go Green. Ontario's Action Plan on Climate Change	aug-07	Ontario government
Development of a Toronto-Specific, Spatially Explicit Heat Vulnerability Assessment: Phase I	jul-09	Toronto Public Health
Meeting the Challenge of Climate Change. TRCA Action Plan for the Living City	2008	Toronto and Region Conservation Authority
Ahead of the Storm... Preparing Toronto for Climate Change	apr-08	Toronto Environment Office
Climate Change Adaptation Strategy. Staff Report	may 08	Toronto Environment Office and others
Change is in the air. Climate Change, Clean Air and Sustainable Energy Action Plan.	jun-07	Toronto Environment Office and others
Cool Toronto project: Tree Planting for Shade. Fact sheet	?	various partners
Basement flooding fact sheet.	?	Toronto Water
Other		
Wet Weather Flow Management Policy	aug-03	Toronto Water
Tree Protection Policy and Specifications for construction	mrt-09	Toronto Urban Forestry
The Unequal City. Income and Health Inequalities in Toronto	okt-08	Toronto Public Health
The City of Toronto Green Guide 2006. Your directory of environmental projects and programs	2006	Toronto Environment Office and others
Request for Proposal. Environmental Risk Assessment: First Application - climate change	okt-09	Toronto Environment Office
Ecoroof Incentive Program Staff Report	okt-08	Toronto Environment Office
Our Common Grounds. Parks and Recreation Strategic Plan	2004	Toronto Parks, Forestry and Recreation
Hot Weather Response Plan 2009	2009	Toronto Public Health
Toronto and Region Conservation Authority Annual Report 2008. Greening the Economy	2008	Toronto and Region Conservation Authority

Appendix 2: List of respondents (grouped and in alphabetical order)

Name	Title	Organisation
Experts overall		
Bas van den Griendt	General Manager Environmental & Sustainable Affairs of Development Dept	Bouwfonds Hoevelaken
Vincent Nadin	Professor of Spatial Planning and Strategy, Faculty of Architecture	Delft University
Barrie Needham	Emeritus Professor of Spatial Planning, Nijmegen School of Management	Radboud University Nijmegen
Chris Zevenbergen	Professor of Flood Resilience of Urban Systems, Department of Urban Water&Sanitation and Managing director of the Business Development Department of DuraVermeer	UNESCO-IHE Dura Vermeer
Experts for London/UK & Toronto/Ontario		
Nick Bailey	Professor of Urban Regeneration, School of Architecture & the Built Environment	University of Westminster, London
Roger Keil	Professor and Director City Institute, Faculty of Environmental Studies	York University, Toronto
Actors/stakeholders London		
Ian Blackburn	Development & flood risk team	Environment Agency
Jared Boow	Principal Environment Policy Officer	London Councils
Tracy Chapman	Senior consultant urban design officer	Borough of Southwark
Miles Duckworth	Principal policy officer, Sustainable Design & Construction	Greater London Authority
Dusty Gedge	President and co-founder	Living Roofs.org
Helen Goulder	Senior planning officer	Borough of Southwark
Jack Hayes	Area planning team	Environment Agency
Andrew Jones	Policy & Programmes' Manager Urban Greening	Greater London Authority
Bevan Jones	Climate Change Adaptation Officer	Borough of Islington
Tony Leach	Director	London Parks and Green Space Forum
Alex Nickson	Strategy Manager Climate Change Adaptation and Water	Greater London Authority
David Taylor-Valiant	Senior Strategic Planner	Greater London Authority
Andrew Tucker	Principal Policy officer, Climate Change Adaptation (until end September 2009)	Greater London Authority
Actors/stakeholders Rotterdam		
Marjolein van Dongen	Projectleider milieustrategie	Stadsregio Rotterdam
Daniel Goedbloed	Adviseur water management	Gemeentewerken Rotterdam
Pieter de Greef	Senior adviseur ruimtelijke ordening	Dienst Stedebouw en Volkshuisvesting
Jan van Horne	Senior planoloog	Dienst Stedebouw en Volkshuisvesting
John Jacobs	Senior adviseur watermanagement	Rotterdam Climate Proof
Erica Koning	Senior adviseur Milieu en Ruimtelijke Ontwikkeling	Gemeentewerken Rotterdam
Peter Kroonen	Projectmanager/Teamcoördinator Technisch Beheer	Ontwikkelingsbedrijf Rotterdam
Arnoud Molenaar	Programma manager	Rotterdam Climate Proof
Elisabeth Nijhuis	Adviseur duurzame ontwikkeling	Gemeentewerken Rotterdam
Kees van Oorschot	Senior adviseur ruimtelijke ordening	Dienst Stedebouw en Volkshuisvesting
Willem Rietveld	Projectleider groen en water	Stadsregio Rotterdam
Tanja Verbeeten	Strategisch adviseur Bureau Beleidscoördinatie en advies	Provincie Zuid-Holland
Joris Vermeiren	Urban landscape designer	Stedbouwkundig buro BGSV
Karen van Vliet	Director	Stedbouwkundig buro BGSV
Actors/stakeholders Toronto		
Joe D'Abramo	Director Zoning and Environmental Planning	Toronto City Planning
Michael D'Andrea	Director Water Infrastructure Management	Toronto Water
Rike Burkhardt	Planner Toronto Urban Forestry	Toronto Parks, Forestry and Recreation
Stephanie Gower	Research Consultant of the Environmental Protection Office	Toronto Public Health
Lisa King (partly by e-mail)	Senior Planner	Toronto City Planning
Mary MacDonald	Head of Environment	Mayor's Office
David MacLeod	Senior Environmental Specialist	Toronto Environment Office
Jennifer Penney	Director of Research	Clean Air Partnership
Dan Sandik	Manager, Resilient Communities & Research	Institute for Catastrophic Loss Reduction
Chandra Sharma	Watershed specialist	Toronto and Region Conservation Authority
Peter Simon	Planner Toronto Urban Forestry	Toronto Parks, Forestry and Recreation
Richard Ubbens	Director of Urban Forestry	Toronto Parks, Forestry and Recreation

Appendix 3: Interview Guide

Legal capacity (planning rules, principles & regulations vs informal practice, environmental equity)

Climate greening can be done basically in three ways: 1) add green to existing space (green roofs, street trees etc) 2) add green by claiming new space (urban parkland, surrounding green, other open spaces) 3) maintaining existing green space (all green including sport fields, private back gardens, etc)

- Which policy instruments are used to *add green to existing space*? Planning instruments, financial instruments, legal instruments, other.
- Which policy instruments are used to *add green by claiming new space*? Planning instruments, financial instruments, legal instruments, other.
- Which policy instruments are used to *maintain existing green space*? Planning instruments, financial instruments, legal instruments, other.
- How much influence do these rules and principles have in practice? (governance culture)
- What about other sectoral rules/principles (eg water, greenery)?
- How can the planning principle of the “compact city”/green belt protection be combined with a “green city”? How can intensification of density be combined with climate greening?
- Which governance style do higher level authorities use for spatial planning and adaptation planning?
- To what extent is environmental equity taken into account in relation to climate change risks and the availability of green space? What kind of information is available regarding the inequity of certain population groups re flood risk and heat stress?
- How do policies address environmental equity? (vulnerable/minority/deprived groups)

Managerial capacity (organization, cooperation, integration, type of instruments used)

- How are spatial, adaptation and green planning organized? Roles/responsibilities per policy field.
- How is climate greening integrated into other policy areas? Make distinction between 1) integration into overarching policy documents 2) city wide adaptation policy 3) sector specific adaptation policies.
- What kind of integration mechanisms are being employed between planning and climate adaptation and greening policy?
- How is the cooperation between the respective government sectors that play a role in climate greening the city (planning, adaptation planning, water, forestry/greening etc).? Why, if applicable, is the cooperation between government sectors (and levels) difficult?
- How is the geographical cooperation among jurisdictions within the greater city region?
- Municipal governments are sometimes accused of being “compartmentalised”. What is your opinion about this for your own city? Or is compartmentalisation a good thing?
- What kind of tools/strategies do you use to facilitate cooperation/coordination?
- What are your experiences with public-private cooperation? How often does this happen in relation to climate greening your city? How fruitful are these cooperations/partnerships?
- To what extent is multi-functional land use being promoted in your city? Does MFL play a role in climate greening your city?

Political capacity (participation and representation, accountability, leadership, political will)

- To what extent are all relevant stakeholders, including citizens involved in the policy making for spatial planning? And for climate greening? How representative is this participation and how influential?
- How open and transparent is the process of policy making?
- To what extent is the policy making being monitored and reported?
- Wrt leadership: who has made climate greening happen? How influential is this person/group? What is the role of the Mayor or any other high-level political figure?

- What is the level of political support for climate greening your city?
- How is this support gained and how is it maintained?

Resource capacity (land, money, knowledge, power)

- How, according to you, can resources for long-term weak interests such as adaptation (like many other sustainability issues) be mobilized?
- How does the budget for climate greening your city relate to the overall budget?
- Has additional land become available for climate greening lately? Examples. By contrast, how much green land has been lost to other developments such as housing and industrial sites?
- Does your agency/division have sufficient knowledge with respect to climate greening your city?
- Which kind of knowledge is still missing?
- How much assistance do you get from external experts, consultants etc. (epistemic community)

Learning capacity (ability to experiment and innovate, exchange ideas, deal with uncertainty)

- Is there sufficient room for conducting experiments regarding climate greening and why (not)?
- What is the level of innovation (measures or procedural) in regard to climate greening?
- To what extent does information exchange take place (among other cities in your country, other cities abroad, relevance of transnational networks such as The Clinton Climate Initiative)?
- To what extent is continuous learning being promoted wrt climate greening? Presence of an information network, knowledge database, expert network, feedback mechanisms. Existence of websites, workshops, webinars etc.
- How does your agency/department deal with the uncertainties regarding climate change? (probe on uncertainty viewed as an opportunity or as a risk).
- What kind of tools and strategies are employed to handle this uncertainty? (Make distinction between tools to reduce uncertainty/increase evidence base and tools that manage uncertainty, eg risk mgt tools)

Overall key questions?

For both questions, the focus is on *institutional* aspects, rather than technical or otherwise.

- What are, according to you, the main barriers/constraints in the governance of climate adaptation by means of green space?
- What are, according to you, the main opportunities in the governance of climate change adaptation by means of green space?
- If necessary probe on:
 - To what extent do you think the following barriers play a role (derived from literature)?
 - Institutional fragmentation/complexity
 - Lack of vision and political gut
 - Lack of knowledge/competences
 - To what extent do you think the following opportunities play a role (derived from literature)?
 - Multifunctional land use/combinations of benefits
 - Linking with other high profile governance themes
 - Separate climate (adaptation) group/partnership vs mainstreaming into current policies
- Which other themes/issues etc would you like to express related to climate greening your city, which have not yet been addressed or discussed in this interview?

Appendix 4: Strengths of critical aspects

Capacity/critical aspect	Overall score of strength
Legal capacity:	strong
<i>Protection of existing green space</i> No regulations in place: weak Some green space is protected, but other types not: medium Extensive coverage of regulations for many types of green space: strong	Extensive coverage in all three cities: strong
<i>Creation of new green space</i> No regulations in place: weak Regulations in place, but not for green roofs: medium Regulations in place also for green roofs: strong	extensive coverage, except for green roofs in Rotterdam: strong
<i>Environmental equity</i> No information available regarding vulnerabilities to climate change: weak Information available, but no redistribution policies: medium Information available, and redistribution policies in place: strong	Info is available, but no redistribution policies, except for some policies in London: medium
Managerial capacity:	medium
<i>Integration of adaptation into spatial planning documents and processes:</i> Limited integration, limited role green planning: weak Medium integration medium role green planning: medium Extensive integration, important role for green planning: strong	Medium integration in documents and processes; important role for green planning: medium/strong
<i>Organisation of spatial, green and adaptation planning :</i> Strong fragmentation and compartmentalisation blocking coordination: weak Medium fragmentation and compartmentalisation blocking coordination: medium Low fragmentation and compartmentalisation blocking coordination: strong	Both fragmentation and compartmentalisation are strong barriers, blocking coordination: weak
<i>Management strategies & tools:</i> Limited amount of strategies-tools and multifunctional land use: weak Medium amount of strategies-tools and multifunctional land use: medium Extensive amount of strategies/tools and multifunctional land use: strong	Medium to extensive use of partnerships, forums, project management structures, task forces etc.; limited use of MFLU: medium
Political capacity:	strong
<i>Accountability:</i> Limited stakeholder involvement and transparency of processes: weak Medium stakeholder involvement and transparency of processes: medium High stakeholder involvement and transparency of processes: strong	High stakeholder involvement and transparency of processes: strong
<i>Political will:</i> Limited political support, limited strategies to gain/maintain support: weak Medium political support, several strategies to gain/maintain support: medium High political support, extensive strategies to gain/maintain support: strong	High political support for climate policy, although less for adaptation; several strategies in place to maintain support: medium-strong
<i>Leadership:</i> Limited leadership/leadership from only one of three forms of leadership: weak Medium leadership/leadership from two of three leadership forms: medium High leadership/leadership from all three leadership forms: strong	All three forms of leadership present, reinforcing each other: strong
Resource capacity:	weak-medium
<i>Economic resources:</i> Limited levels of funding and land available for climate greening: weak Medium levels of funding and land available for climate greening: medium High levels of funding and land available for climate greening: strong	Limited levels of funding and land available, except for in Rotterdam: weak-medium
<i>Human resources:</i> Limited amount of staff, limited level of know-how and skills of staff: weak Medium amount of staff, medium level of know-how and skills of staff: medium Extensive amount of staff, high level of know-how and skills of staff: strong	Limited amount of staff (except for Rotterdam); weak-medium level of know-how and skills: weak-medium
<i>Knowledge resources:</i> Limited natural and social scientific knowledge, no epistemic community: weak Medium natural and social scientific knowledge, some external experts: medium Extensive natural and social scientific knowledge, epistemic community present: strong	Medium natural scientific/limited social scientific knowledge: epistemic community present: medium
Learning capacity:	weak-medium
<i>Dealing with uncertainty:</i> Uncertainty regarded as a risk; limited use of technical/managerial techniques: weak Uncertainty regarded as a risk and opportunity; some use of technical/managerial techniques: medium Uncertainty regarded as an opportunity; extensive use of technical/managerial techniques: strong	Uncertainty primarily regarded as a risk (except for Rotterdam); several technical and managerial techniques used to handle uncertainty: weak-medium
<i>Continuous learning processes:</i> Limited (technical and managerial) infrastructure and networks present: weak Some (technical and managerial) infrastructure and networks present: medium Extensive (technical and managerial) infrastructure and networks present: strong	Some infrastructure and networks present: medium

Appendix 5: Actionability of critical aspects

Capacity/critical aspect	Overall score
<p><i>Legal capacity: Protection of existing green space:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: difficult based on the 3 cities, so low Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: no, it is only one of many reasons to protect green space, so low In hands of local authorities: yes, protection of green space is delegated to local authorities, so high Ease and timeliness of remediation actions: difficult to pass/adapt law or planning policies, so low</p>	low
<p><i>Legal capacity: Creation of new green space:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: for instance green roof policies, so high Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: specific actions can be geared towards adaptation, such as green roof provisions, so high In hands of local authorities: partly (some support from higher govt needed for regulations), so medium Ease and timeliness of remediation actions: difficult to pass/adapt law, so low</p>	medium
<p><i>Legal capacity: Environmental equity:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: information re access to green space, UHI etc., so high Extent of opportunities mentioned by respondents: GIS mentioned for information gathering, so high Focus on adaptation: information seeking and policies can be completely geared towards adaptation, so high In hands of local authorities: yes, completely, so high Expected ease and timeliness of remediation actions: relatively quick to realise with limited resources, so high</p>	high
<p><i>Managerial capacity: Integration of adaptation into spatial planning documents and processes:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: high level of activity in each city, so high Extent of opportunities mentioned by respondents: integration into all kinds of processes mentioned ... times, so high Focus on adaptation: can be completely geared towards adaptation, so high In hands of local authorities: partly, some support from national governments needed, eg. sometimes building codes are handled nationally by central govt, central govt determines the scope of statutory consultees, etc. so medium Expected ease and timeliness of remediation actions: rather difficult to realise, resistance expected from stakeholders, so low</p>	medium/high
<p><i>Managerial capacity: Organisation of spatial, green and adaptation planning:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: high level of activity in each city, so high Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: rather difficult to change existing org.structures just for the sake of adaptation, so low In hands of local authorities: partly, depending on existing governance and administrative structures, so medium Expected ease and timeliness of remediation actions: very difficult to realise, resistance expected from stakeholders, so low</p>	low/medium
<p><i>Managerial capacity: Management strategies & tools:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: high level of activity in each city, so high Extent of opportunities mentioned by respondents: multi-functional land use mentioned as opportunity, so high Focus on adaptation: partly possible to gear towards adaptation, some existing tools can be used for adaptation, so high In hands of local authorities: completely, so high Expected ease and timeliness of remediation actions: rather quick to realise with reasonable amount of resources, so high</p>	high
<p><i>Political capacity: Accountability:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: stakeholder sessions in preparation phase, so medium Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: partly possible to gear towards adaptation, so medium In hands of local authorities: completely, so high Expected ease and timeliness of remediation actions: rather quick to realise with reasonable amount of resources, so high</p>	medium
<p><i>Political capacity: Political will:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: many activities possible as shown by the 3 cities, so high Extent of opportunities mentioned by respondents: win-win solutions mentioned relatively often, so high Focus on adaptation: partly possible to gear towards adaptation, but often in combination with mitigation, so medium In hands of local authorities: partly, some policy support from higher govt levels necessary, so medium Expected ease and timeliness of remediation actions: rather quick to realise with reasonable amount of resources, so high</p>	medium/high
<p><i>Political capacity: Leadership:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: not very explicitly, dependent on individuals, so low Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: partly possible to gear towards adaptation, so medium In hands of local authorities: partly, some leadership from higher govt levels is needed, so medium Expected ease and timeliness of remediation actions: rather difficult to realise, so low</p>	low/medium
<p><i>Resource capacity: Economic resources:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: dependent on priority settings, so low Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: partly possible to gear towards adaptation, so medium In hands of local authorities: partly, some budget provisions from higher govt levels is needed, so medium Expected ease and timeliness of remediation actions: rather difficult to realise especially considering current economic crisis, so low</p>	low/medium
<p><i>Resource capacity: Human resources:</i> Extent of (remediation) actions already employed to ameliorate this aspect: many training and education programmes, so high Extent of opportunities mentioned by respondents: training and education programmes mentioned repeatedly, so high Focus on adaptation: training programmes can be geared towards adaptation planning, so high In hands of local authorities: completely, so high Expected ease and timeliness of remediation actions: rather quick to realise with a reasonable budget, so high</p>	high
<p><i>Resource capacity: Knowledge resources:</i> Extent of (remediation) actions already employed to ameliorate this aspect: many research programmes, so high Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: can be exclusively geared towards adaptation, so high In hands of local authorities: partly, some research programmes are run by higher govt levels is needed, so medium Expected ease and timeliness of remediation actions: rather quick to realise with a reasonable budget, so high</p>	medium/high
<p><i>Learning capacity: Dealing with uncertainty:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: many activities employed in the 3 cities, so high Extent of opportunities mentioned by respondents: none, so low Focus on adaptation: can be exclusively geared towards adaptation, so high In hands of local authorities: completely, so high Expected ease and timeliness of remediation actions: feasible within reasonable time frame and budget, so medium (experimentation requires more time to set up than for instance training programmes)</p>	medium/high
<p><i>Learning capacity: Continuous learning processes:</i> Extent of (remediation) actions that can be employed to ameliorate this aspect: many activities can be employed, so high Extent of opportunities mentioned by respondents: peer city networks mentioned quite a few times, so high Focus on adaptation: partly possible to gear towards adaptation, so medium In hands of local authorities: completely, so high Expected ease and timeliness of remediation actions: rather quick to realise within reasonable time frame and budget, so high</p>	high