

**Mainstreaming climate change adaptation into urban development:
Lessons from two South African cities**

By

Leanne A. Farrell

B.A. International Relations
Stanford University, 2002

Submitted to the Department of Urban Studies and Planning
in partial fulfillment of the requirements for the degree of

Master in City Planning

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2010

© 2010 Leanne A. Farrell
All rights reserved

The author here by grants to MIT the permission to reproduce and to distribute publicly
paper and electronic copies of the thesis document in whole or in part.

Author _____
Department of Urban Studies and Planning
May 20, 2010

Certified by _____
JoAnn Carmin
Professor of Urban Studies and Planning
Thesis Supervisor

Accepted by _____
Joseph Ferreira, Jr.
Professor of Urban Studies and Planning
Chair, MCP Committee

Mainstreaming climate change adaptation into urban development: Lessons from two South African cities

By
Leanne A. Farrell

Submitted to the Department of Urban Studies and Planning
on May 20, 2010 in Partial Fulfillment of the
Requirements for the Degree of Master in City Planning

ABSTRACT

There is a risk that urban climate change adaptation planning – often led by city environmental agencies – will remain isolated from ongoing city decision-making processes, and thus irrelevant, unless adaptation is mainstreamed into municipal line functions' existing activities and planning processes. Yet little empirical research exists showing what the adaptation “mainstreaming” process actually looks like for a city government department. This thesis addresses this gap, and identifies key drivers, limiting factors, and implications of adaptation mainstreaming within municipal service departments. Specifically, I analyze progress toward climate adaptation mainstreaming by the housing and stormwater management departments in Cape Town and Durban, South Africa: two cities that are widely considered adaptation frontrunners in the Global South.

The experiences of the departments analyzed lead to several conclusions about the adaptation mainstreaming process for departments faced with pressing short-term service delivery challenges and capacity constraints. Foremost, the process encompasses, and requires, both substantive and conceptual elements. Substantively, departments start with complying with mandates and accommodating requests from other departments that advance adaptation. Gradually, they move to more deeply internalize these and other push factors, initiating actions to “climate proof” core activities and processes. Culminating the process, they eventually see climate change as a reason to more heavily collaborate and engage external actors around managing climate risks. Substantive mainstreaming progress, meanwhile, both depends on and advances a department's conceptual embedding of the adaptation agenda. Several enabling factors advance the process, prominently including access to additional funding and support to supplement scarce and inflexible resources. Progress is also influenced by the innate longevity of a department's planning horizon, its decision-making autonomy vis-a-vis higher levels of government, and its degree of regulatory vs. service-provision focus, among other pre-existing departmental qualities.

Tracing the adaptation mainstreaming process further suggests a few key implications for donors and others looking to support cities in their climate adaptation efforts. Firstly, the process of integrating adaptation into municipal line function core operations and decision making processes is undeniably challenging and slow. Thus, in light of scarce resources and other more seemingly pressing agendas, a department is unlikely to begin substantively embedding adaptation unless first seeing the agenda as conceptually intertwined with core functions and immediately actionable. Secondly, although this research did not control for the presence of a city-wide climate adaptation office, the experience of the featured departments suggests that such an office can play a critical role in pushing and supporting departments to mainstream adaptation. Such offices can identify and channel additional sources of funds for adaptation, educate departments about climate change

risks, and keep the adaptation agenda politically visible. Thirdly, the way in which adaptation is framed as an agenda within a city has repercussions for departmental buy-in. For example, an environmental problem framing may not be the most advantageous for departments such as housing who historically see environmental agendas as external to, or even in conflict with, their core mandates. Meanwhile, other departments may be reluctant to respond to push factors or support from city-wide climate offices if they perceive adaptation as working against fulfillment of some core responsibilities, even if enhancing others.

Thesis Supervisor: JoAnn Carmin

Title: Professor of Urban Studies and Planning

Keywords: mainstreaming; climate change; adaptation; urban; South Africa; Cape Town; Durban

ACKNOWLEDGEMENTS

A heartfelt thanks go foremost to Professor JoAnn Carmin, my thesis and academic advisor. She introduced me to climate change adaptation as a field, and to South Africa as a research context, in my first year at DUSP. She then brought me under the financial and intellectual umbrella of her larger research initiative on urban adaptation planning, mentored me in the field on the ins and outs of qualitative research methods, and continuously engaged and pushed me to be clear about my ideas and assertions in my writing. Her support and commitment to my learning throughout the process have been truly enviable.

A warm thanks also to Professor Bishwapriya Sanyal, my thesis reader, for helping me to think about the bigger picture relevance of my findings, and for challenging me not to understate the difficulty and messiness of institutional change.

I am extremely fortunate to have had a team of fellow student researchers live through the field research part of this process with me. A shout out to fellow DUSP students Ian Gray, YeSeul Kim, and Yuan Xiao for keeping things lively in the field, as well as for being willing sounding boards for my thoughts and ideas upon return to MIT.

Isabelle Anguelovski also deserves special mention for being generally supportive throughout the process, and for offering helpful feedback on my proposal and aspects of the write-up. Thanks also to the members of the MIT Center for International Studies' Program on Environmental Governance and Sustainability Working Group for helping me think through my preliminary findings in a safe and supportive space.

This thesis would not have been possible without the generosity of interviewees in South Africa in giving their time and thoughts. In Durban, special thanks go to Debra Roberts, Director of the Environmental Management Department for the eThekweni Municipality, for helping to arrange interviews with key informants. In Cape Town, I am indebted to the University of Cape Town's African Centre for Cities (ACC), particularly Sue Parnell. She offered me the initial chance to become acquainted with South Africa generally, and urban climate adaptation planning in Cape Town specifically, through a short research internship with the ACC in January 2009.

Last but definitely not least, thanks to friends and family for emotional support throughout the process.

This material is based upon work supported by the National Science Foundation under Grant No.# 0926349. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

CONTENTS

ABSTRACT	3
LIST OF ACRONYMS AND TERMS	8
CHAPTER 1: INTRODUCTION	9
Research questions	11
CHAPTER 2: ADAPTATION MAINSTREAMING IN THE DEVELOPING WORLD	13
2.1 Importance of urban climate adaptation to developing countries	13
2.2 Types of adaptation actions	14
2.3 Implementing adaptation: mainstreaming	15
Adaptation mainstreaming as a factor of context	16
Adaptation mainstreaming as a methodology	17
Adaptation mainstreaming as a product	18
The missing piece: adaptation mainstreaming as a process	19
CHAPTER 3: RESEARCH DESIGN	20
3.1 Country and city selection	20
3.2: Department selection	21
3.3 Data collection and analysis	23
CHAPTER 4: ADAPTATION PLANNING IN SOUTH AFRICA	24
4.1 Context: Urban South Africa	24
4.2: Adaptation Planning Efforts in Durban and Cape Town	26
Durban	27
Cape Town	29
Summary of city adaptation planning processes	32
CHAPTER 5: MAINSTREAMING ADAPTATION: HOUSING DEPARTMENTS	33
5.1: The housing sector in Durban and Cape Town: Overview	33
National housing policy development	33
Housing in Cape Town and Durban	34
5.2: Mainstreaming climate adaptation into low-income housing: Overview	36
5.3: Housing departments' progress in mainstreaming climate adaptation	38
Accommodating requests from city-wide adaptation processes	40
Reinterpreting existing core activities as supporting adaptation	41

5.4 Factors limiting housing departments' degree of adaptation mainstreaming	42
Uncertainty about climate change risks	42
Adaptation agenda not seen as within core mandate	43
Lack of financial resources to take on adaptation	46
Behavioral/social factors limit uptake of new technologies and approaches	47
Limited legal mandate over private sphere	48
5.5 Chapter summary	49
CHAPTER 6: MAINSTREAMING ADAPTATION: STORMWATER DEPARTMENTS	50
6.1 Stormwater management in Durban and Cape Town: Overview	50
Trends in urban stormwater management	50
Stormwater management in Cape Town and Durban	52
6.2: Mainstreaming climate adaptation into stormwater management: overview	53
6.3 Stormwater Management Departments' progress on climate adaptation	55
Recognizing the relevance of climate change to department goals/objectives	56
Taking ownership over adaptation: in-house initiatives	59
Moving beyond silos: initiating and deepening outward collaborations	62
6.4 Remaining challenges in adaptation mainstreaming	65
6.5 Chapter Summary	67
CHAPTER 7: SUMMARY FINDINGS AND CONCLUSIONS	68
7.1 Findings on the process of city departmental adaptation mainstreaming	68
Adaptation mainstreaming: substantive process components	69
Adaptation mainstreaming: conceptual process components	71
7.2 Findings on the key drivers and limitations in adaptation mainstreaming	72
Drivers and enablers of mainstreaming	73
Factors limiting mainstreaming	75
7.3 Implications of departmental adaptation mainstreaming	76
7.4 Broader lessons in supporting departmental adaptation mainstreaming	78
7.5 Limitations to findings	81
WORKS CITED	84

LIST OF ACRONYMS AND TERMS

BNG	Breaking New Ground (current South African housing policy)
CAPA	Climate Adaptation Plan of Action (Cape Town)
CDM	Clean Development Mechanism
EMD	Environmental Management Department (Durban)
ERM	Environmental Resources Management Department (Cape Town)
EIA	Environmental Impact Assessment
eThekweni	Name of Durban metropolitan municipality
GEF	Global Environment Facility
GHG	Greenhouse Gas
IDP	Integrated Development Plan (South African municipal 5-year statutory plan)
IPCC	Intergovernmental Panel on Climate Change
MAP	Municipal Adaptation Plan (Durban)
OECD	Organization for Economic Cooperation and Development
RDP	Reconstruction and Development Programme (previous South African housing policy)
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER 1: INTRODUCTION

Climate change is real: even the most stringent actions to reduce greenhouse gas (GHG) emissions will not completely halt or reverse current warming trends (IPCC 2007a). The regional effects of planetary warming are projected to vary, including changes to precipitation frequency and intensity, changes to average and extreme temperatures, sea level rise, and glacial melt. These myriad effects, in turn, will have significant environmental, social and economic implications. Just a few examples include changes in water availability for agricultural, industrial and household uses, erosion and inundation of coastal properties, increased risk of floods, and the spread of disease vectors into previously unexposed areas. While actions for climate *mitigation*, or the reduction of GHG emissions, can still dramatically alter the intensity of these impacts, governments are now increasingly recognizing the imperative for climate *adaptation*, or “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 2007b Appendix B).

While the field of adaptation is still quite new globally, cities and local governments are increasingly taking action. As the impacts of climate change will vary locally, adaptation requires tailor-made solutions for each locality (Agrawal 2008). Furthermore, global trends in governance reform have decentralized many previously state-held powers and responsibilities for service and infrastructure provision, revenue management and land use planning. Given also that national governments in most countries are not actively pursuing or mandating adaptation planning, some local governments are taking the lead to avert the worst effects of climate change.

Local governments in most countries will play important roles in shaping climate resilient futures for cities. Yet how exactly should a city tackle climate adaptation? A large number of donors and international research institutes emphasize starting with a comprehensive vulnerability assessment, grounded in science-based climate scenario models. Various methodologies for vulnerability assessments exist, yet their common goal is to identify priority locations, populations and sectors of intervention to drive identification and prioritization of adaptation actions (IPCC 2007b; UNEP 2002; UNFCCC 2008). Given the interdisciplinary nature of addressing climate change, such assessments and follow-on planning aim to aggregate and reconcile diverse viewpoints from varied urban stakeholders and sectors. This way they can identify strategic adaptation opportunities and requirements that are beyond the purview, mandate or budget

capabilities of individual line ministries or single neighborhoods. Absent such a strategic city-wide process, efforts by sectors or individuals might be ad hoc, reactive, or even conflicting, undermining their effectiveness and possibly resulting in “mal-adaptation” that ultimately could exacerbate rather than reduce the vulnerability of certain populations (Corfee-Morlot et al. 2009).

Yet despite the increasing buzz about urban climate adaptation, further support is needed for cities to actually take action, especially in developing countries where capacity is significantly more constrained. To date only a handful of cities globally have initiated vulnerability assessment driven strategic adaptation planning processes. While no comprehensive record exists of all cities and municipalities that have initiated formal adaptation planning, at least among capital and mega-cities there is furthermore a strong bias toward developed countries (Katich 2009). Particularly in light of predictions that developing countries will fare the worst from climate change, and given the strong linkages between adaptation and development, international discussions among donors and in climate policy circles have thus stressed the need to increase support to cities in the developing world to launch adaptation planning (IIED 2008; Müller 2008). At this point, most bilateral and multilateral donors have explicit programs in place directing at least some funding towards aspects of adaptation; a subset of these target urban areas specifically. Expectations in international climate policy circles are that such funding streams will increase significantly in the coming years.

Learning from the experiences of leading-edge cities that have ventured down the adaptation planning path is thus urgent, to help ensure that future international funding streams are utilized in the most effective way possible to embed adaptation within city governments. External funding is easiest spent hiring consultants to produce stand-alone vulnerability assessments or framework plans. However, the key challenge is to ensure such studies do not remain isolated from city decision processes. Particularly in light of the capacity constraints of city governments in developing countries, city-scale climate modeling and vulnerability assessments are unlikely to have their intended effect unless their recommendations can be integrated horizontally across government into the relevant sectoral line functions, and folded into their ongoing work portfolios and processes of planning, investment, construction and service delivery (McEvoy et al. 2008).

This process of *mainstreaming* climate change considerations is regarded by many as a cornerstone of adaptation success (Agrawala and van Aalst 2005; Huq et al. 2003; Persson 2008). Adaptation mainstreaming, put simply, is “the integration of climate concerns and adaptation responses into

relevant policies, plans, programs, and projects at the national, sub-national, and local scales” (USAID 2009). While various theoretical approaches to mainstreaming adaptation are discussed further in the next chapter, overall the importance of mainstreaming is heralded as an essential element of making sustained progress.

Yet whether and how city departments are actually undertaking adaptation mainstreaming – particularly those in the developing world where public sector capacity tends to be extremely limited – is poorly documented. Existing research suggests that, even where strategic adaptation planning is underway, it does not necessarily result in mainstreaming (Smit and Wandell 2006). One recent study of climate mitigation efforts in Japan, for example, found that climate change issues have been poorly integrated into the various policy areas of urban planning, instead being treated as distinct and separate (Sugiyama and Takeuchi 2008). Association of the climate change agenda with the environmental department of a city government, as is often the case, may also undermine the success of climate mainstreaming efforts into other agencies or sectors within government, when sectoral actors perceive it as an exclusively “environmental” agenda by association (Alber and Kern 2008; Corfee-Morlot et al. 2009).

There is a clear need to better understand how mainstreaming actually takes place, so that donor-funded vulnerability assessments and city-wide adaptation plans do not simply end up sitting on shelves or tasked to marginalized environmental agencies, while remaining all but irrelevant to the reality of urban politics, policies, and service delivery.

Research questions

This thesis looks at how city-wide strategic adaptation planning initiatives get translated into specific departmental actions and integrated into departmental decision-making. Specifically, I ask:

1. *What is the process that city government departments follow to mainstream climate adaptation considerations into their activities and policies?*
2. *What factors drive or inhibit progress on adaptation mainstreaming?*
3. *What are the implications of the adaptation mainstreaming process for departments?*

Drawing on interviews with stormwater and housing departments in Cape Town and Durban, South Africa, I find that mainstreaming consists of parallel substantive and conceptual processes of institutional change. While the process is slow and difficult due to numerous constraints and limitations that service departments face in their ability to modify behaviors and activities, external push factors as well as inherent enabling qualities of a department are shown to influence their mainstreaming progress. Successful mainstreaming may also shape a department's sense of boundaries and capabilities, with possible repercussions for broader city governance.

This study should be of interest not only to city government actors at all levels, but also to institutions that are supporting cities in their efforts to plan for climate change. Without a better understanding of the on-the-ground dynamics and challenges at the sub-municipal level to the mainstreaming of climate change adaptation within larger urban development agendas and activities, donor-supported vulnerability assessments, climate modeling, and other centralized activities risk remaining peripheral to actual municipal line-function operations and decisions. The lack of departmental uptake of the adaptation agenda, in turn, means that government actions could exacerbate climate vulnerability in the medium to long term. Meanwhile, since successful uptake of the adaptation agenda within municipal departments requires institutional change, it is critical to understand the enabling and limiting factors, as well as repercussions of that change process, to ensure an equitable, socially and economically sustainable path to increased climate resilience at the municipal scale.

CHAPTER 2: ADAPTATION MAINSTREAMING IN THE DEVELOPING WORLD

2.1 Importance of urban climate adaptation to developing countries

While GHG mitigation continues to be thought of as mainly the responsibility of highly industrialized nations, adaptation has meanwhile been framed largely as a developing country issue. Poor countries have heightened vulnerability to climate change's negative effects (Ayers and Huq 2008), defined as a function of both exposure/susceptibility to climate impacts and adaptive capacity (Levina and Tirpak 2006). Adaptive capacity means the "ability ... 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" (IPCC 2007b). Poor countries face more barriers to adaptive capacity, in light of more limited financial and human resources, a lack of infrastructure to protect populations and economic assets, and governance challenges that limit responsiveness and accountability, among other factors (Wilbanks et al. 2007b).

Climate vulnerability will furthermore fall disproportionately on poor populations within any country or region, as they tend to already be located in the highest-risk zones and have the least ability to cope with even current environmental or economic shocks triggered by climate variability. Communities that depend directly on natural systems for their livelihoods and subsistence are more exposed to climate impacts to those systems, such as changes in rain patterns or glacial runoff that in turn will affect agricultural yields, or declines to productive fisheries due to changing ocean temperatures and salinity (Satterthwaite et al. 2007). At the household level, numerous factors influence vulnerability and adaptive capacity, including income, education, health status, knowledge, access to technology, and social networks (IPCC 2007b; Yohe and Tol 2002). Each of these factors is also a common indicator of development, underscoring the linkages between development and adaptive capacity. Climate change is thus likely to exacerbate many existing development challenges, with its effects playing out unequally among countries, communities and households (Adger et al. 2003).

Poor urban settlements, too, are likely to be hotspots of climate vulnerability. In developing countries in particular, many of these settlements are already located on extremely precarious lands (new urban settlement formation by definition occurs on lands previously considered undesirable for some reason, or they would not be vacant), lack access to basic services and

infrastructure, and offer limited employment opportunities. Flooding from more frequent or intense storms, heat waves, water shortages, disease vectors, and food price shocks resulting from changes in rural agricultural yields are but a few potential climate change impacts that will be felt more intensely by the urban poor than by other urbanites.

In light of this reality, what can and should a city actually do to prepare for, reduce, and/or manage expected climate impacts? A range of possible climate resilience-enhancing actions are outlined below, as well as emerging approaches to adaptation planning.

2.2 Types of adaptation actions

Potential adaptation actions are as numerous and diverse as the varied elements that contribute to vulnerability in any given locale. Nonetheless, the adaptation literature emphasizes the importance of taking *proactive* actions – e.g., in advance of expected climatic changes and their effects – to increase both resilience and adaptive capacity (IPCC 2007b; Adger 2003; Satterthwaite 2007). In a city context, perhaps the most common conception of a proactive adaptation is a discrete physical intervention to build climate resilience, separate and additional to ongoing city projects and tasks. Classic examples might include construction of a seawall or levy system for a coastal settlement to fend off storm surges and sea level rise, or upgrades to stormwater drainage networks in anticipation of increased runoff. Such activities need not be limited to “hard” infrastructure investments. Structural actions could also encompass numerous “soft” activities, many of which have positive co-benefits even in the absence of climate change. Example activities include increasing tree cover to reduce urban heat island effects; restoring wetlands to improve stormwater drainage; setting up an early warning system for extreme events likely to cause floods; or strengthening public health response capacity in the event of a disease vector outbreak made more likely by climate change. Proactive adaptation activities also include regulatory or policy actions. For example, a government could modify land use zoning or environmental approvals rules to take into account sea level rise or flood vulnerability, change building codes to increase durability to extreme weather, or create policy incentive schemes to reduce water consumption. Numerous other measures to build adaptive capacity of the citizenry fall squarely into the gray area between adaptation and development, and may indeed not be “additional” to activities that governments are already undertaking in the name of development (Reed 2009).

In addition to proactive actions, adaptation may also encompass *reactive* actions in response to an observed impact, such as a flood disaster or drought. Reactive adaptation could be either *autonomous* or *planned*. *Autonomous* adaptation is defined by the IPCC as “[a]daptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems” (IPCC 2001). *Planned* adaptation, meanwhile, is “the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state” (IPCC 2001). Societies inherently possess some adaptive qualities, as they have constantly had to cope with and adjust to environmental changes and stresses throughout history (Smit and Wandel 2006). The qualities that enable effective coping thus factor into adaptive capacity, although coping itself is a reactive measure.

2.3 Implementing adaptation: mainstreaming

The idea of institutional mainstreaming of a policy agenda like adaptation has been developed in other policy areas, notably environmental management more broadly. Environmental mainstreaming within a government, also known as “environmental policy integration,” refers to integrating environmental management processes and staff into sectoral agencies, rather than keeping environmental functions together within a single, centralized environmental agency. There are pros and cons to the idea of environmental mainstreaming. The main argument in favor is that, by keeping a cross-cutting issue like environmental management separate from “operational” departments, it effectively ring-fences the agenda and prevents full ownership and integration of environmental aspects into the substantive activities of a government (Lafferty and Hovden 2003). An argument against mainstreaming, however, is that without a separate institutional structure with visible champions and autonomous budgets, the mainstreamed agenda will get buried under the more pressing, “dominant” agendas of individual line functions. Clustering of environmental professionals can also facilitate mentoring and sharing of good practices and ideas, whereas individual environmental staff embedded within other departments and agencies would remain more isolated from professional networks (Sowman 2002).

In the context of urban climate adaptation, meanwhile, there are multiple conceptual threads examining different aspects of mainstreaming. Below I outline three of these threads, framing mainstreaming in terms of its *context* within broader urban development agendas, its *application* to

actual policies and projects, and the potential *product* of its application across modes of governing. The first emerges from urban scholarship, the second primarily from donor agencies, and the third from policy studies. Each helps to frame adaptation mainstreaming conceptually; however, none of the three satisfactorily explains how the mainstreaming *process* occurs within different line functions of a city government, which is the focus of this research.

Adaptation mainstreaming as a factor of context

A first vision of adaptation mainstreaming starts with the assumption that adaptation priorities and existing urban development priorities are likely to compete with each other for scarce public resources and attention, and that mainstreaming thus consists of reconciling these priorities to re-shape existing decision-making processes (Carmin et al. 2009; Mukheibir and Ziervogel 2007; UNDP-GEF 2001). This approach emphasizes the interdependencies of urban and climate adaptation agendas in light of climate change. That is, without reconciling the two, development activities and investments may be undermined by externalized climate risks, and adaptation actions risk remaining peripheral to city operations and core activities (Klein et al. 2007; UNFCCC 2007).

Mainstreaming adaptation, in this view, thus consists of re-framing adaptation as a new lens on existing priorities and goals. The approach acknowledges that the process of reconciling agendas will be different from distinct vantage points within a city government, depending on each actor's core function and existing core priority. The key actors in a mainstreaming process are therefore institutions charged with carrying out existing urban directives: e.g., line function departments responsible for municipal service provision.

This conceptual thread makes a contribution to understanding mainstreaming by emphasizing the heterogeneous nature of city government, and by focusing on the *context* of competing priorities and mandates that must be dealt with before getting to the mechanics of the mainstreaming process. However, it falls short of providing guidance on both the process as well as the ultimate product of agenda-reconciliation. On process, the steps taken by departments to integrate or reconcile adaptation are not specified, even though they are likely to make a difference in how adaptation eventually gets defined by a department and thus considered within the department's core functions and organizational structure. On the product of mainstreaming, the implication is that adaptation and other competing priorities will undergo some sort of "meeting halfway," but

there is little understanding of what that actually means in practice for either adaptation goals or existing development goals. In addition, this theory does not delve into the key enablers or limiting factors, from the vantage point of municipal service departments, in reconciling and integrating adaptation.

Adaptation mainstreaming as a methodology

Many donor agencies have meanwhile spearheaded the development of tools for climate mainstreaming in the context of their project and program portfolios (Olhoff and Schaer 2010). Such tools are geared primarily at development practitioners. They lay out methodological steps for applying a “climate lens” to development planning, to examine: (i) whether a policy or program is vulnerable to climate risks, could *increase* vulnerability in light of climate change or could miss potential opportunities arising from climate change; and (ii) what changes to existing policies, plans and programs are needed to address these risks and opportunities (OECD 2009). Mainstreaming is thus considered to be the application of these methodologies.

Yet there is a dearth of evidence on the effectiveness of the various mainstreaming guidance tools in practice. Even within the donor community, preliminary research suggests a likely gap between the promise of mainstreaming and the reality of its achievement (McEvoy et al. 2008). And while some of these donor-developed mainstreaming tools intend to target public officials rather than just international organizations, their utility to city government actors is unproven. Many focus on the donor “project cycle”, but even those focusing on policy and planning processes do not sufficiently address the issue of motivation to undertake climate screening exercises in the first place. Donors may be motivated because of institutional mandates and evolving international norms, but busy city line department officials generally have no such mandate from mayors or higher levels of government, particularly in developing countries. Meanwhile, they face a pressing list of service provision tasks to accomplish in the immediate term that are generally perceived to be far more important to local residents, businesses and politicians.

Donor tools and guidance resources for mainstreaming furthermore lack detail on the actual processes to achieve the implied institutional changes within a decision making body such as a city line agency or department (Ahmat 2009). According to a 2010 UNDP review of 21 donor-

developed climate mainstreaming guidelines and screening tools, the basic steps to mainstreaming (into both policy and project cycles) can be summarized as:

1. Awareness raising about the effects and risks of climate change;
2. applying a climate lens: e.g., screening or assessing policies, strategies, plans or programs to determine their relationship to climate vulnerability, and proposing changes to address climate risks and opportunities;
3. detailed climate risk assessment;
4. identification of adaptation options;
5. prioritization and selection of adaptation options;
6. allocation of budgets for adaptation; and
7. monitoring and evaluation of adaptation measures (Olhoff and Schaer 2010).

These steps provide a roadmap for departments of city government that looks suspiciously similar to the steps advocated for city-wide strategic planning processes, focusing on the *what* rather than the *when* or *how* with regards to the steps to integrate climate concerns into sectoral work and policies. The presumption is that the user of the guidelines is already bought into the idea of mainstreaming. Nothing is said, meanwhile, about how that institutional change process would occur in the first place to get a department to a place where a climate screening tool would even be seen as useful.

Adaptation mainstreaming as a product

As a counterpoint to the above two approaches, mainstreaming could also be thought of in terms of its product or output, rather than its context or methodology. That is, adaptation mainstreaming ultimately consists of the substantive changes made to governing tasks based on consideration of climate change risks. This essentially encompasses the range of institutional, policy focused and sector-specific proactive “adaptation actions” highlighted by the adaptation literature, as mentioned earlier.

Attempting to structure thinking about the realm of mainstreaming outputs feasible, Alber and Kern (2008) organize adaptation interventions around four “modes” of urban governing: (i) “self governing” (e.g., the maintenance of government itself and its capacity to govern its own activities); (ii) “governing through enabling” (e.g., “facilitating, coordinating and encouraging action through partnership with private and voluntary sector agencies,” including through community engagement); (iii) “governing by provision” (e.g., direct delivery of services and resources including public infrastructure); and (Pikitch et al.) “governing by authority” (e.g., actions to regulate). Following this framework, adaptation mainstreaming into self governing functions might consist of

protecting core government assets (administrative buildings and infrastructure), while adaptation through the enabling mode may include influencing and supporting private actors to reduce and manage climate risks. Adaptation through provision would meanwhile consist of physically modifying infrastructure and services in light of climate change. Lastly, adaptation through authority would entail changing policies, zoning codes and regulations to factor in new risk profiles (Alber and Kern 2008).

The contribution of this approach is in providing an overview of the range of possible manifestations of adaptation mainstreaming in practice. It thus resolves one of the shortfalls of both of the previous two approaches outlined. However, its key limitation is that it focuses exclusively on the potential product of mainstreaming, while failing to explain both the process and the ultimate effects on the institutions themselves, vis-à-vis their existing core and ongoing responsibilities.

The missing piece: adaptation mainstreaming as a process

As outlined above, the existing theories and approaches to adaptation mainstreaming provide insights into (i) how adaptation would interface with the existing urban development *context*, (ii) specific *methodologies* to adjust programs and policies to climate change realities once commitment to do so exists; and (iii) what mainstreaming would *produce* once achieved, in light of the scope of existing functions of a given governing body. The missing perspective is on what the actual institutional change *process* of mainstreaming looks like, and what its implications are, in turn, for involved institutions. There is clearly a need for more empirical work documenting this aspect, from the vantage point of city government line functions who are charged with the task. This is furthermore particularly critical to understand in developing country contexts, where the task is slated to be the hardest: capacity is generally already insufficient to cover basic core functions, existing urban development priorities are the most urgent, expected climate vulnerability is the highest, and the least amount of data exists to project specific climate impacts. If city government departments faced with this sort of reality can make headway on mainstreaming adaptation, better endowed cities should have much to learn from the processes they follow.

CHAPTER 3: RESEARCH DESIGN

The case for mainstreaming adaptation into urban governance is thus clear, but several key questions remain: (i) What is the process that city government departments follow to mainstream climate adaptation considerations into their activities and policies? (ii) What factors drive or inhibit progress on adaptation mainstreaming? (iii) What are the implications of the adaptation mainstreaming process for departments?

3.1 Country and city selection

To answer my research questions, I will analyze the experiences of two South African cities that are widely acknowledged to be ahead of the pack in the Global South in proactively initiating climate change planning processes – Cape Town and Durban. I am selecting these cities for several reasons. Firstly, by looking at two cities in the same country, I am able to hold constant numerous variables related to national context – including a shared national history, political structure and policy environment – that might otherwise confound my findings.

Secondly, the two cities present appropriate contexts for examining the challenges to mainstreaming climate change agendas into urban development. Despite the relatively high visibility of strategic climate change planning efforts in both cities, the city governments are primarily focused on two other, sometimes conflicting, immediate mandates. They are firstly working to achieve demanding social development goals related to eradicating widespread poverty and income inequality left by the legacy of apartheid. They are also both simultaneously trying to position themselves as “global cities” to attract international business and tourism. The chosen South African cities are thus wrestling with reconciling competing local, national and global discourses about social and economic development, respectively. They therefore provide a fruitful context in which to examine how the difficulties of integrating climate change and development priorities play out on the ground, as well as if and how climate change is being acknowledged explicitly as relevant to both social and economic development agendas within different sectoral activities.

Cape Town and Durban furthermore make for strong comparative case studies because of their similarities. Both are among the largest cities in South Africa (and are growing quickly). Both are

faced with surmounting similar apartheid-era legacies of spatial segregation and vast inequality. Both are highly important nationally from an economic perspective. Both are coastal, and both cities' coastlines are drivers of economic activity (port and tourism related). Both face many similar future climate risks (including sea level rise, likely increases in storm intensity, and seasonal water scarcity). Both have also been leaders internationally in pioneering strategic climate adaptation planning processes at a city-wide level.

One of the aims of this research is to provide insights to donors who, in a post-Copenhagen world, are expected to increase financial commitments for adaptation efforts in cities in developing countries, particularly in Africa. Although global climate projections anticipate significant climate change impacts to Southern Africa, and donor interest is high in supporting African countries and cities in coping with these effects, little comparative research has been done to date on the emerging lessons from cities in the region that *have* begun the process of climate adaptation planning. Analysis of the mainstreaming element of adaptation planning in these two front-runner African cities will thus help guide donors in how to most effectively direct their funds to ensure “uptake” of adaptation diagnostics and centrally-led efforts within city agencies and activities.

3.2: Department selection

For my analysis, I chose to analyze the experiences of two municipal departments or units in each city: stormwater management and housing.

I focus on these departments firstly because they are both traditional “line function” agencies. At their core, they are both service delivery departments, maintaining and building public infrastructure, managing service personnel, and interfacing with public stakeholders during the normal course of their activities. Both departments also engage to varying degrees in strategic planning and regulatory activities. The gamut of governing functions that they cover thus broadly encompasses the types laid out by Alber and Kern (2008) cited in Chapter 2: e.g., self governing, enabling, provision and authority.

The *stormwater* departments build and maintain public drainage infrastructure, and undertake proactive, preventative measures to reduce flood risk, ranging from educational efforts to wetland restoration activities. They also have the authority to establish flood lines, and play a regulatory

function in reviewing and authorizing new developments that may fall within these lines to ensure appropriate site design including provisions for drainage. Other regulatory functions involve monitoring and controlling for the quality of stormwater runoff into public waterways and coastal areas. Both departments furthermore undertake their own strategic planning to model future demand and project infrastructure shortfalls.

The *housing* departments in both cities, meanwhile, are real estate developers for new housing construction, landlords of public rental units, and coordinators of informal settlement upgrading and eradication. They also play regulatory functions, setting building code requirements for new housing and imposing criteria for housing waitlist membership and ranking, as well as a policing function to control further growth in squatter settlements. Both housing departments also undertake strategic planning to identify new areas for greenfields housing developments and to prioritize and design interventions in informal settlements.

Secondly and critically for departmental selection, the impacts of climate change are likely to affect both departments' core activities, and their action or inaction on climate adaptation mainstreaming in turn has a role in reducing or exacerbating the climate vulnerability of urban settlements. The stormwater departments are obvious actors in successful climate adaptation planning, because of the expected changes to precipitation patterns in both cities that will likely lead to more intense storm events (Midgely et al. 2005; Naidu et al. 2006). These anticipated changes will alter the historical boundaries of areas at high risk of flooding, exposing many new areas to flood vulnerability if adjustments to stormwater management approaches and infrastructure coverage do not take place. The housing departments in both cities, meanwhile, play a role in ensuring new urban growth is directed away from climate-vulnerable areas through land acquisition and development of new housing projects. The department's decisions on the physical design of new homes will also impact not only their resilience to flooding and weather events, but also their ability to moderate rising indoor temperatures and enable residents to reduce energy and water use (with both direct financial implications for residents, as well as broader energy and water scarcity implications for the city). As instrumental actors in deciding when to upgrade vs. relocate informal settlements and in subsequently preventing re-colonization, they are key players in reducing the size and vulnerability of the otherwise most climate-vulnerable populations in each city.

Lastly, both stormwater and housing departments in each city face potential tensions between achieving their immediate goals through traditional approaches, and investing possibly extra resources now to ensure long-term minimization of future climate risks. Tensions are at least in part due to space constraints to urban growth in both cities, limited financial resources, and the political imperative to make fast and immediate progress to expand basic services to areas denied these services under apartheid. I look to understand how climate adaptation mainstreaming has been interpreted by each department, in light of these tensions.

3.3 Data collection and analysis

I conducted field research in Cape Town and Durban during January 2010, as part of a larger research project on climate adaptation planning in cities globally. Specifically, I carried out semi-structured in-person interviews with director-level and key technical staff within the stormwater management and housing departments in each city. Interviews ranged in duration from approximately 45 minutes to 1.5 hours. In addition, interviews were conducted with the lead actors orchestrating the city-wide strategic climate adaptation planning processes in each city. The interview techniques were standardized in advance to form a common set of core questions. All interviews were recorded (with the permission of the interviewees) and transcribed.

To analyze the data, I systematically coded the interview transcripts to construct effects matrices, as described by Miles and Huberman (Miles and Huberman 1984). I constructed matrices of (i) the types of activities identified by each department as relevant or related to the city's climate adaptation planning process; (ii) perceptions by interviewees of the effects climate adaptation mainstreaming has had on their department's core functions and processes; (iii) reasons offered by interviewees for the various actions and their effects; and (iv) any tradeoffs or contradictions between adaptation actions and core functions noted by interviewees. Each department in each city was listed in the matrix, with coded interview data categorized under headers established by listing, partitioning and clustering data along common themes and threads.

CHAPTER 4: ADAPTATION PLANNING IN SOUTH AFRICA

4.1 Context: Urban South Africa

Since the fall of apartheid in 1994, South Africa has gone through tremendous political, legal, institutional and social changes. The 1996 South African Constitution is among the most progressive in the world, embracing principles of racial equality, democracy, and broad political, social and economic rights for all citizens. Following international trends towards government decentralization (World Bank 2000) and as a reaction against the highly centralized government apparatus under apartheid (Mabin 2002), the new democratically elected government passed a series of reforms in the mid to late 1990s to transfer significant responsibilities for planning, regulation, and service provision to municipalities. Municipal boundaries were redrawn to facilitate integration and redistribution of wealth. In urban areas, former black townships were merged with rich white neighborhoods to form single metropolitan municipalities under the “one city, one tax base” mantra (Pillay et al. 2006; Wooldridge 2002). Policies oriented towards wealth redistribution meanwhile enshrined the principle of free basic services, such as water and electricity, for poor urban households.

Legal frameworks for planning were also radically revised, introducing the Integrated Development Plan (IDP) as the cornerstone statutory document guiding local government decision making. The IDP is a comprehensive five-year strategic plan, developed through a multi-stakeholder collaborative process and incorporating spatial, institutional and financial elements. It enshrines the concepts of participatory development and New Public Management, aiming to maximize local accountability, downsize and streamline administrative structures, and ensure locally appropriate government decisions (Pieterse 2002).

Needless to say, despite these sweeping reforms, addressing drastic and longstanding inequities in wealth, education, access to basic services, and economic opportunity between the minority white population and all other racial groups has been a slow and onerous task. The country still ranks as one of the most income unequal in the world, and income inequality has actually grown since apartheid’s demise, both across and within racial groups (Leibbrandt et al. 2010). South Africa also has among the highest HIV/AIDS infection rates in the world, with aggregate estimates of infection

afflicting approximately 15-20% of the overall population (UNAIDS/WHO 2008). In spite of HIV/AIDS's toll on overall life expectancy and population growth rates, urban household formation continues to grow rapidly, implying a continuous growth of cities. Yet although the national economy has also grown, livelihood opportunities and access to basic services remain dismally low for huge swaths of urban residents. Nationally, less than 45% of urban black and coloured individuals are employed in the formal sector, compared to over 88% of urban whites (Pillay et al. 2006 p. 8-13).

Despite legal empowerment through decentralization reforms, local governments are strapped in addressing these inequities. Technical capacity is generally thin, due to serious apartheid-era inadequacies in the education of non-whites, and aggravated by white flight following democratic transition. Municipalities also face significant budget limitations. Over 90% of service provision and administration costs are funded through the local tax base, with only small transfers from provincial and national government (Oldfield 2002). This income is stretched extremely thin in light of the massive service backlogs in areas formerly designated for blacks and coloureds (people of mixed race) under the discriminatory apartheid system.

The mandate for fully inclusive participatory local governance enshrined in the IDP process has also been difficult to achieve in practice. Low levels of basic education, high illiteracy, and multiplicity of languages are all barriers to meaningful inclusion of the masses in decision making processes. What's more, interest groups who stand to lose from strong formal governance systems may either disrupt or resist participatory processes. As explained by prominent urban scholars Susan Parnell and Edgar Pieterse,

The struggle against apartheid was waged in part around the campaign to make the townships ungovernable through rent boycotts, protests and civil disobedience. In the wake of the collapse of the apartheid state, powerful vested interests emerged around the informal, illegal and often coercive delivery of basic services like water... These individuals and groups survived and flourished on the back of disorder and lack of coordinated planning. It is in the interests of these opportunists... to remain beyond the arm of the state (Parnell and Pieterse 2002, p. 86).

Attention to environmental sustainability and justice considerations in local planning and decision making has also remained low. The constitutional and legal reforms of the mid 1990s included progressive environmental policies, backstopped by a constitutional clause that "everyone has the right to an environment that is not harmful to their health or wellbeing" (Republic of South Africa 1996). Yet traditions and institutions of environmental management are still highly

underdeveloped nationally. While national and provincial authorities handle most aspects of natural resource management and approval of Environmental Impact Assessments (EIAs), municipal governments are expected to ensure that sustainability considerations are integrated into IDPs and other local planning and decision processes. Research on the first wave of IDPs, however, showed inadequate attention to sustainability issues in practice (Sowman 2002). In many South African cities, environmental departments have been established, but these departments often remain isolated and marginalized from “core” urban development decision-making. Attention to environmental issues is frequently deemed a long term luxury, and separate from addressing immediate social and economic development challenges of the present. Nonetheless, a nascent but active environmental justice movement has attempted to elevate attention to the linkages between environmental quality and development outcomes (McDonald 1998).

4.2: Adaptation Planning Efforts in Durban and Cape Town

Against this backdrop, enter climate change. According to the Inter-governmental Panel on Climate Change (IPCC), Southern Africa is a global hotspot of climate vulnerability, with scenarios predicting increased temperatures and changes in precipitation patterns, less rainfall in some areas and more frequent and intense extreme events in others (IPCC 2001). Coastal regions will also be subject to sea level rise and the effects of more frequent and intense storm surges. Vulnerability is further aggravated by high socioeconomic inequality and limited adaptive capacity, due in part to the governance challenges explained above.

In light of the severity of projected climate impacts and as a major emitter of GHGs, South Africa ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 2002, and produced a National Climate Change Response Strategy in 2004. The National Strategy is largely climate mitigation focused, but also sketches out initial areas of consideration for national adaptation planning (Department of Environmental Affairs and Tourism 2004). Yet at provincial and local levels of government, planning for adaptation has been spotty at best. In spite of the fact that the National Strategy emphasizes the need to integrate climate change policy into all levels of government, national government has not been proactive in reaching out to, or providing assistance to, local governments for adaptation planning (Koch et al. 2005). South Africa has not yet translated its commitments under the UNFCCC into national policy reforms, so climate change planning by lower levels of government is not yet legally mandated.

A small number of South African cities have nonetheless forged ahead on adaptation planning, prominently including Durban and Cape Town. The adaptation planning processes pursued by each city bear several strong similarities, in spite of the fact that only recently – subsequent to the field research for this thesis – did the two cities begin to engage formally with each other on adaptation. A brief summary of each city’s process follows.

Durban

South Africa’s third largest city and a major industrial and logistics hub, Durban boasts over 3.5 million inhabitants and the busiest container port on the African continent. Like other South African metropolises, the city aspires to be a “global city” for trade and tourism while also wrestling to overcome significant apartheid-era inadequacies in basic service provision and economic opportunity for its majority poor black population. Poverty afflicts 40% of the total population; however, this figure is at 67% among black households, compared to 2% among white households (eThekweni Municipality 2002 p. 19). Sprawling along 97km of the Indian Ocean coastline and westward into hilly terrain, the eThekweni Municipality (which encompasses the city of Durban) currently enjoys a subtropical climate with warm, wet summers and mild winters.

Durban has achieved global visibility in its efforts to proactively address climate change issues. The city’s Environmental Management Department (EMD) made initial forays into climate mitigation planning efforts in 2000. However, adaptation planning did not begin in earnest until 2004, when the EMD initiated the Municipal Climate Protection Programme. Since its inception, the program has gone through several rounds of evolution and scaling up, as the EMD has attempted various approaches to embed adaptation within city development processes.

With very few global examples of urban adaptation planning to draw from at the time, the EMD initially trail-blazed a centrally-driven process, identifying key cross-cutting climate vulnerabilities and aggregating adaptation perspectives from line function departments. As a first step, a city-level climate impact assessment was completed in 2006. The study highlighted various climate threats to the city, including increased vector borne diseases; more frequent and intense storms and droughts (with associated flooding and impacts to infrastructure); increased coastal erosion; decreased food and water security; and increased heat stress, the latter with associated impacts of

higher energy consumption from increased use of air conditioning (Naidu et al. 2006). Following shortly after was the development and City Council endorsement of a municipal Headline Adaptation Strategy. The process of Strategy development involved preliminary discussions with various departments about the findings of the impact assessment, a stock-taking of their current activities that could contribute to climate resilience, and a laundry list of potential future adaptation actions.

The Headline Strategy represented initial groundwork in what has since become a more nuanced, sectorally focused approach to identifying and framing adaptation options. According to EMD Director Debra Roberts, who designed the process and oversaw the consultant team, the creation of the Headline Strategy was useful for gaining political buy-in from City Council and senior city management for adaptation planning. However, the document itself did not result in any significant changes to activities or decision processes within various service-oriented municipal departments, for at least two key reasons. Firstly, in trying to be all-encompassing, it remained too general and high-level to be translatable into meaningful departmental action. Secondly, it did not sufficiently embed ownership over the idea of adaptation with the departments. Led by a consultant team, the process did not communicate a strong enough promise of continuity and commitment from within city government to get other departments to also commit sufficient time and energy for meaningful and sustained action (Roberts 2010).

With a series of intense winter storms in 2007 that captured national headlines and resulted in significant coastal erosion, political momentum built sufficiently for the launch of a second phase of adaptation planning. The EMD's goal for this next phase was to more significantly engage select line departments around the sectoral themes of water and health. These sectors were identified by the EMD in part because of signals from key individuals in the relevant departments of their willingness to engage, and in part because of the perceived urgency from a climate change impacts perspective to start considering adaptation measures for water and health services. Recognizing the central relevance of the disaster management function to achieving climate resilience around both of these themes, the EMD later reached out to the city's Disaster Management Department to also fold them into the MAP process. Out of this process, a water and health Municipal Adaptation Plan (MAP) was completed in late 2009, outlining measures for the eThekweni Water and Sanitation, Catchments and Stormwater Management, Health, and Disaster Risk Management Departments to mainstream climate considerations into their activities. The MAP aims to focus

especially on cross-cutting issues requiring coordination across line function silos, to address possible secondary effects of different types of planned and/or reactive actions responding to climate change. The EMD contracted a consultant team to work with the involved departments to produce the MAP, but Roberts also personally accompanied the entire process closely.

At a city-wide level, various other actions are underway to more deeply embed the adaptation agenda. The EMD first established a dedicated Climate Protection Branch in 2007, and in November 2009 re-named itself the Environmental Planning and Climate Protection Department. A GIS-based Integrated Assessment Tool was under development in early 2010 (with expected completion by June 2010), aiming to make climate data and potential adaptation options more easily accessible and understandable to city government stakeholders through the spatial visualization of impact modeling. The EMD is also running several community-level adaptation pilot projects, taking advantage of a window of Danish bilateral funding to test methodologies for community risk assessment and for enhancing food security and rainwater harvesting in low-income settlements. Also in 2009, the EMD hosted Durban's first public climate summit, which recommended the creation of a permanent Climate Change Partnership for ongoing dialogue with business, academia and civil society groups to solicit inputs and generate momentum for non-governmental actions supporting city-wide climate resilience objectives. As of January 2010, the EMD had put out a request for proposals from outside actors who could lead such a Partnership, as they did not believe they have the capacity to facilitate this kind of sustained public engagement in house (Roberts 2010).

Cape Town

Cape Town is a geographically expansive city with roughly the same size population as Durban, located on the Cape Peninsula in the southwestern-most corner of the country and continent. The city is the legislative capital of South Africa and a major destination for international tourism. The city has a Mediterranean climate, and unique and varied topography. Affluent areas hug the Atlantic beaches and the northern and western base of the dramatic Table Mountain, while the historically black and coloured townships as well as informal settlements spread eastward across the low-lying, sandy Cape Flats. The city's setting is also of global biodiversity significance, with a significant chunk of the entire globally-unique Cape floristic region located within municipal boundaries.

Cape Town is likely to experience significant stresses from climate change. The first assessment of likely impacts to the region, completed by the Western Cape Provincial Government in 2005, predicted increased temperatures, decreased overall precipitation, more intense coastal storm events, and sea level rise impacts. The implications of these impacts for Cape Town include, among others: increased water stress; erosion and damage to coastal development from storm surges and rising seas; increased risks of flooding; aggravated fire risk; loss of numerous endemic species; and respiratory health issues resulting from worsened air quality, in light of stronger inversion effects under warmer temperatures (City of Cape Town 2006a; Department of Water Affairs and Forestry 1994; Midgely et al. 2005; Mukheibir and Ziervogel 2006).

The Cape Flats region in particular – which already experiences annual flooding and is home to the poorest residents of the city – is particularly vulnerable to the expected impacts of climate change. Acute flood risks are due to the area’s low-lying, flat topography and are exacerbated by a high water table, inadequate drainage infrastructure provision, and blockage of existing drainage infrastructure by shifting sand, solid waste and informal settlements (City of Cape Town 2009a). Extremely dense settlement patterns, poor housing construction in informal areas, and widespread poverty across the region further aggravate the impact of floods or fires on property, human health and livelihoods.

While the 2005 provincial climate impact assessment was cautious in its projections of impacts and recommendations for action, it nonetheless laid critical groundwork for city-level adaptation planning to get underway. Following its completion, the city’s Environmental Resources Management (ERM) Department commissioned a Framework for Adaptation to Climate Change for the City of Cape Town (FAC⁴T) in 2006. Written by two consultants from the University of Cape Town, the FAC⁴T was never intended to be the city’s actual “adaptation plan”. Its purpose was to survey existing literature on projected impacts and propose a process and priority areas for more substantial adaptation planning at the city level, which it organized around the themes of (i) urban water supplies, (ii) stormwater, (iii) biodiversity, (iv) fires, (v) coastal zones, (vi) livelihoods, and (vii) health (Mukheibir and Ziervogel 2006). Due to staffing issues and other pressing priorities within the ERM, the document did not in the end immediately result in any serious follow-on work. However, widely available on the internet, the Framework gained global *de-facto* recognition as the city’s adaptation plan. Its proposed steps and thematic organization thus have proven influential in

defining the parameters of adaptation planning once re-initiated in a more serious way in 2009 (see below).

ERM's coastal management unit, meanwhile, commissioned an in-depth sea level rise risk assessment for the city in 2008, as part of the department's ongoing work to develop guidelines for broader regulation of coastal development. The assessment highlighted the urgency of implementing "no regrets" adaptation measures to minimize risks from sea level rise, such as preventing new developments in low-lying coastal areas and planning for possibly more significant coastal protection investments in the future (Cartwright et al. 2008). Meanwhile, Cape Town experienced an energy crisis and rolling blackouts in 2007. Together with national headlines on the 2007 Durban storm events and – more broadly – accelerating global discussion and visibility of the concept of adaptation, local political interest was piqued sufficiently for the ERM to initiate new efforts in 2009 to draft a city-wide, multi-sectoral Climate Adaptation Plan of Action (CAPA) (Oelofse 2010). These more recent efforts have been led by Gregg Oelofse, ERM's Policy and Research Coordinator and lead specialist on coastal management.

The CAPA, which is expected to be available publicly in draft form by mid 2010, aims to build on the groundwork of the FAC⁴T to outline initial adaptation actions that can feasibly be carried out by line functions across city government. The consultant drafting the CAPA generated its content through a series of discussions with various city government departments about the potential impacts of climate change on their work and feasible adaptation options. At least in its initial draft stages, however, the document had not been more broadly consulted with public stakeholders. As with Durban, the idea behind the process has been to first conscientize and get internal buy-in from city government departments and City Council, before initiating broader participatory planning (Oelofse 2010).

Meanwhile, in an effort to more effectively harness local research capacity to support city adaptation and mitigation planning, the ERM launched a Climate Change Think Tank in September 2009. Funded by the Royal Danish Embassy, the Think Tank involves over 30 academics and other specialists from Cape Town institutions, including prominently the University of Cape Town's African Centre for Cities and Sustainable Energy Africa. The Think Tank aims to meet quarterly to coordinate and encourage policy applicability of ongoing local research on climate change issues. While not explicitly an exclusive group, it serves a targeted research-oriented purpose, and does not aim to be a broadly participatory forum such as that envisioned by the Durban Climate Change

Partnership (Oelofse 2010). As of April 2010, planning for more extensive public engagement mechanisms of this sort was not yet underway.

Summary of city adaptation planning processes

In summary, Durban and Cape Town have thus far followed adaptation planning processes that bear several key similarities. Both processes originated within the municipalities' environmental management departments. Both were the outgrowth of initial climate mitigation and energy efficiency planning efforts. In both cases, sea level rise and coastal erosion/flooding were central climate risk factors shaping and motivating the city-wide processes. Both city planning processes were grounded in commissioned research on downscaled climate impacts. Both cities' processes explicitly recognize the importance of building adaptation systematically into sector-level planning and activities by engaging departmental line functions. Both cities have also thus far taken fairly introspective approaches to adaptation planning, with the process leaders focusing first and foremost on getting buy-in and understanding from constituencies *within* city government. More public initiatives to engage external stakeholders are envisioned, but have taken largely a back seat in the initial stages of planning for both cities.

CHAPTER 5: MAINSTREAMING ADAPTATION: HOUSING DEPARTMENTS

This chapter looks in depth at climate adaptation mainstreaming in the context of the housing sector. Low-income housing provision in urban South Africa is a nationally pressing social mandate, and the housing departments in both Cape Town and Durban are working to address several-hundred-thousand-household housing backlogs through settlement upgrading and new home provision. Climate change is relevant to the housing departments' activities along a number of dimensions, including but not limited to decisions about site selection and building design standards for new developments, prioritization and scope of activities in informal settlements, and education of subsidy home residents to manage climate risks. In both cities, however, the housing departments perceived climate adaptation to be largely tangential to their core mandates and goals, highlighting numerous limitations in their ability to mainstream adaptation considerations into decision making.

5.1: The housing sector in Durban and Cape Town: Overview

National housing policy development

Affordable housing provision occupies a central space in the political and social landscapes of post-apartheid South African urban development. The 1996 Constitution enshrines every citizen's right to "access to adequate housing" (Republic of South Africa 1996 Chapter 2 Section 26.1). Eliminating near-endless housing backlogs and eradicating informality are enormously high profile and high priority agendas in urban political arenas nationally, including in both Cape Town and Durban.

In 1994, the national government initiated the Reconstruction and Development Programme (RDP), which provides capital subsidies to households living in informal settlements or other substandard housing arrangements. Subsidy delivery was administered by local governments, who used the funds to construct single-family homes on behalf of beneficiary households. The program on balance was relatively effective in delivering volume, even if rather blunt in its execution, and even if still falling far short of the total volume needed. Criticisms nonetheless abounded of the original RDP policy's welfare approach to affordable housing development. Critiques centered around the one-size-fits-all, numbers based approach to delivering housing to the poor, which excluded nearly all consideration of local context and prevented meaningful community involvement. Built

primarily at urban peripheries, far from job opportunities and services, RDP housing was criticized to be merely perpetuating the racialized, economically stratified landscapes of the apartheid era (du Plessis et al. 2003). The policy's explicit pro-poor intentions turned out to be a double-edged sword, as low-income housing remained completely a government project and separate from high-income private real estate development (Swilling 2007).

In response to these critiques, the National Department of Housing released a new policy in 2004, termed Breaking New Ground (BNG). The new policy aims to move away from a strict by-the-numbers approach to housing delivery, recognizing the need for context specificity in housing development, and also acknowledging the impact of state housing provision on urban form and urban land markets more generally. The BNG policy's goal is "to terminate the mindset that equates pro-poor housing solutions with peripheralized greenfields developments. This, in turn, is key to reversing apartheid spatial forms" (Swilling 2007, p. 19). In particular, the new policy calls for siting low-income housing developments on well-located lands that promote compact and sustainable urban development. BNG also aims to further decentralize authority and discretion to municipalities to craft the most context-appropriate solutions to housing provision. Notably, the policy provides funding instruments for land tenure regularization and *in situ* upgrading in informal settlements, in addition to subsidies for new housing (South Africa Department of Housing 2004). As of December 2008, the South African government nationally had built 2.7 million houses through the subsidy scheme under both RDP and BNG policies, providing free shelter to over 13 million people (South African Government undated).

Housing in Cape Town and Durban

Yet in spite of clear rhetorical improvements over the old RDP model, the BNG program has been far from a silver bullet in the messy process of housing provision in Durban and Cape Town. Finding suitable land within the metropolitan region to accommodate new housing is still a key challenge for both cities' housing departments, as there is a paucity of developable land available, except on the remote urban fringe. Furthermore, while the BNG reforms have expanded the scope of the housing departments' activities beyond just new home construction, the fixed national subsidies are still their primary vehicle for improving human settlements. And the continued rigidity of subsidy amounts rule out any significant top-ups to homes, or modifications to the

current housing delivery model, unless funded directly by the city or through an external source (Byerly 2010; City of Cape Town Housing Directorate 2010).

In Durban, Mark Byerly, the Housing Department's Research and Policy Manager, estimated the housing backlog at about 408,000 households, based on 2007 surveys and aerial photography. Estimates vary substantially, however, depending on what baseline figures are used (Byerly 2010). Regardless, about 75% of the backlog is attributed to informal settlements (Makhathini et al. 2002 p. 2). The size of the informal settlement population varies depending on how defined, but is thought to be around 25% of total households, constituting a third of the total metropolitan population due to above-average household sizes. Of these households, nearly 30% are without minimum standards for basic sanitation, 18.4% are without home electricity service, and 20.4% are potable water-insecure (eThekweni Municipality 2002 p. 17).

In Cape Town, the situation is similar. In 2007, the total housing backlog for Western Cape Province was estimated to be 410,000 units, which was projected to nearly double by 2040 assuming continuation of 2007's housing delivery rate (Department of Local Government and Housing undated Executive Summary p. 2). Of this backlog, the vast majority is attributed to the City of Cape Town. Recent city estimates are that 500,000 people live in one of the city's 223 informal settlements (Adlard 2008). Migration from rural areas together with new household formation creates 18,000 to 24,000 new households each year, while annual subsidy home construction hovers at less than half of these figures (Reed 2009 p. 58). Given the vast housing shortage, most new migrants either end up in informal settlements or become "backyarders" on already dense formal township housing plots in the Cape Flats, joining the near-endless queue for housing subsidies. Residents of informal settlements are frequently in socioeconomically precarious situations: one study encompassing a random sample of residents in two Cape Flats townships found 64% unemployment, widespread food insecurity and malnutrition, poor access to health care and poor sanitation (de Swardt et al. 2005). Many of these settlements are furthermore located on flood-prone lands and already experience annual winter flooding (Bouchard et al. 2007).

Roles and functions of the municipal housing departments

Both the Cape Town Housing Directorate and the eThekweni Housing Department are foremost responsible for managing development of new low-income housing in "greenfields" areas, using the national BNG subsidies. Even though new home construction figures lag behind household

formation rates, the sheer volume of homes constructed annually still makes both departments major real estate developers at a city-wide level. The departments are thus prominent players in shaping the form and direction of urban growth in their respective cities. The Cape Town Housing Directorate noted in particular that they construct more properties than any single private developer in the city, at approximately 8,000 units per year (City of Cape Town Housing Directorate 2010).

The Housing departments in both cities also perform a variety of other functions related to eliminating substandard shelter in the city. Both departments act as landlords: Cape Town manages approximately 43,000 rental units, while Durban currently controls approximately 20,000 rental units (although the latter city is in the process of turning nearly all of this stock over to private ownership, intending to retain only a small fraction). Both departments oversee significant aspects of informal settlement upgrading and eradication, carried out in coordination with several other city government departments. Other areas of work include formalizing land tenure and coordinating upgrading activities for “backyarders”, as well as providing input into policy issues and strategic planning for the housing and residential sectors in their respective cities (Byerly 2010; City of Cape Town Housing Directorate 2010).

5.2: Mainstreaming climate adaptation into low-income housing: Overview

Before delving into how the housing departments in my two case study cities view and understand climate adaptation, I first briefly lay out a more generic framework for what adaptation *might* mean in the context of the housing sector in South Africa.

South African housing departments are relevant and important players in climate adaptation for several over-arching reasons:

- (i) Their core mandate is to reduce social vulnerability through provision of adequate housing and/or upgrading of existing settlements. Given the relevance of climate change to vulnerability, future climate impacts are likely to affect their ability to achieve at minimum their broader mandate, if not their immediate specific tasks.
- (ii) Their core constituencies are, by definition, among the most vulnerable segments of urban populations: they are low-income individuals living in informal settlements or other

- substandard housing arrangements. They are thus well-positioned to assist these communities in understanding and minimizing their exposure to climate risks.
- (iii) They define the terms of contract and design requirements for new home construction, retrofitting and upgrading activities. Even small modifications to the physical design and placement of homes can play a significant role in either limiting or exacerbating the climate vulnerability of the inhabitants.
 - (iv) As major real estate developers, they also play a significant role in shaping the trajectory of urban growth in their cities, with important implications for city-wide climate resiliency.

In light of the various core activities within their purview, I outline several possible adaptation mainstreaming actions for South African housing departments:

Siting of greenfields housing developments

Housing departments acquire lands for new “greenfields” developments, based on various criteria. Such criteria prominently include affordability and proximity to various services, but also look at environmental risk dimensions, such as location outside of flood prone areas and away from unstable lands. Climate change, in turn, will affect the future parameters of environmental and weather hazard risk (Neumann 2009). Risk aspects of land acquisition for development could be tackled through regulatory requirements, such as EIAs (which are required in South Africa for new housing developments). However, housing departments could theoretically also be proactive in internally revising their land valuation criteria to factor in future climate risks, given that EIA legislation does not explicitly require consideration of future climate risks at present.

New home design

Housing departments could also incorporate climate resiliency factors into their building design specifications and contract awarding processes (Hertin et al. 2003; London Climate Change Partnership 2005). The specifics of adaptive design and material composition attributes would vary geographically, but for Durban and Cape Town would likely include measures to reduce household expenditures for basic services like energy and water and to improve resilience to weather-related disasters. One example is simple weatherizing or floor-raising measures to make homes more storm and flood resistant and to prevent mold and standing water. Another example might be building design innovations for improved indoor temperature regulation (in light of projected overall temperature increases), such as insulation and ventilation features (Shaw et al. 2007).

Design elements at the project (rather than household) scale also make a difference to the climate resiliency of the future units' occupants. For example, building orientation on land plots influences passive lighting and heating effectiveness, and placement of units on gently sloping lands improves drainage. Incorporation of trees and green spaces in housing developments reduces urban heat island effect and improves rainwater absorption (Reed 2009). Density through use of multi-story units also helps to achieve broader compact development planning goals, which in turn enhances urban resilience (Hester 2006 p. 201 and 255), such as by reducing transportation costs, related air pollution, and general social vulnerability through economic marginality of isolated settlements.

Reducing informality

Upgrading informal settlements can help to reduce climate vulnerability simply by improving the physical resilience of homes and neighborhoods to extreme weather conditions. Nonetheless, upgrading and tenure formalization efforts can also be undermined by climate change risks such as flooding, erosion, and exposure to winds and storm surges (Grace and Bukola 2009). Decisions to *in-situ* upgrade vs. relocate an informal settlement, as well as decisions about specific upgrading measures, should thus explicitly factor in climate vulnerability considerations. In cases of slum clearance, once unsafe lands have been cleared of squatters, activities to prevent re-colonization should also incorporate soil stabilization and ecological restoration that would help reduce downstream vulnerability (ProAct Network 2008).

Community engagement and education

Housing departments might also incorporate information about simple measures households can do to increase climate resiliency – such as rainwater catchment schemes, maintenance of storm gutters, or home upgrades to seal floors from moisture – in their educational efforts with new subsidy house owners and occupants. Beyond information-sharing, housing departments might further explore possibilities in creating or stimulating pilot programs to facilitate such upgrading.

5.3: Housing departments' progress in mainstreaming climate adaptation

In relating the degree to which these hypothetical adaptation possibilities are perceived to be relevant and/or feasible in Durban and Cape Town housing contexts, the housing departments from both cities reported overall strikingly similar perspectives. Departments both communicated *some*

engagement with the concepts behind adaptation, at least in terms of following compliance frameworks and responding to other departments' and city-wide proactive adaptation efforts. Byerly from the Durban housing department furthermore articulated certain existing core activities as already inherently helpful in advancing at least some elements of climate resilience, even though explicit changes to these core activities to proactively anticipate or respond to climate change have not been undertaken. These observations are expanded upon below.

Responding to external mandates that advance adaptation

Officials from both city housing departments foremost talked about responding to higher level rules or mandates for environmental risk management and broader sustainability as their primary contribution toward climate adaptation.

In Cape Town, this “compliance approach” to adaptation was described in the context of multiple activity domains. With respect to siting new developments, for example, a Housing Directorate official who deals with land issues noted that “we do look at flood lines; we do look at the potential coastal [sea level] rise” (City of Cape Town Housing Directorate 2010), to the extent that these considerations are mandatory under zoning rules developed by the Planning and ERM Departments, and under national and provincial EIA legislation. In other cases, positive actions for adaptation are carried out because of implicit or soft mandates. For example, the department grants preferential treatment for subsidy home bidding contractors whose designs accommodate solar water heaters in addition to meeting minimum design requirements (City of Cape Town Housing Directorate 2010). While installation of solar water heaters is not yet mandatory under municipal rules, it may soon be so: a draft municipal by-law to require them on most new buildings has been under discussion as one mechanism to achieve energy reduction targets under the city’s mitigation-oriented Energy and Climate Change Strategy (City of Cape Town 2010). Thus, creating an incentive for solar water heater compatible designs is effectively mandate-driven. As a third example, the Housing Directorate reportedly carries out household relocations from informal settlements based at least partially on their winter flood vulnerability as laid out in the city’s annual Winter Preparedness Strategy, which is drafted by other departments.

Durban’s Housing Department flagged a similar mix of resilience-enhancing requirements applied to their core activities to explain how the department is working to address climate risks. In

assessing the suitability of a tract of land for new subsidy housing, criteria include: location in metropolitan area; serviceability by bulk infrastructure; size; environmental sensitivity; hydrological characteristics; tenure status; zoning; and land use considerations. Similarly, in determining which informal settlements to upgrade vs. relocate, risk evaluation criteria include flood, fire, erosion and environmental health risks (Byerly 2010). In both cases, the Housing Department must apply these criteria, but does not independently set them. The decision about how to weight or rank the relative risks was made by City Council, based on inputs from different departments. The specific risk determination along any single dimension for a given activity is furthermore carried out by other departments; Housing essentially just aggregates these determinations.

Thus, in both cities' cases, Housing is essentially a user of data and analyses on risk levels and priorities produced by other departments to guide their decision making processes about where and how to act. To the extent that these other departments mainstream climate change considerations into their strategies or risk determinations, they are thus automatically considered by Housing. However, in both cases, the Housing departments see their hands as more than full simply implementing housing and upgrading projects according to minimum national criteria, and they thus do not carry out "additional" planning or risk analysis in-house.

Accommodating requests from city-wide adaptation processes

In both cities, housing departments' activities related to achieving climate resilient development do go at least nominally beyond the bare minimum of compliance with externally imposed requirements. While neither may be showing major leadership on the issue of adaptation, both departments have at minimum engaged with the non-statutory city-wide adaptation planning efforts being led by the respective environmental departments. In both cities, Housing's participation has not required any dramatic shift of departmental funding or staffing allocation or operational priorities, but for initiatives coming with their own external funding, the departments have at least dedicated some staff time and effort.

As one example, senior representatives from both housing departments have attended meetings organized by others for coordination around city-wide climate adaptation planning. In Cape Town, this includes the Climate Change Think Tank, as well as an Executive Management Team Committee

on Energy and Climate Change that convenes the heads of all municipal directorates monthly to share information and coordinate activities. In Durban, Byerly related that Housing Department representatives regularly attend interdepartmental workshops on environmental issues broadly, which sometimes cover climate change issues. While it is uncertain what role the department representatives have played in these forums, at minimum they are present at the table.

While arguably more of a climate mitigation than adaptation effort, both cities' housing departments also mentioned working with the respective environmental departments to accommodate solar water heater installation on subsidy-built homes. As noted in the previous subsection, in Cape Town, these efforts may be somewhat more compliance-driven than voluntary, given the city's energy reduction mandates. Nonetheless, the Housing Directorate responded to the ERM's request for help developing a Clean Development Mechanism (CDM) project in the Khayelitsha township that aims to install solar water heaters on low-income households' roofs. The CDM project, supported by Danish bilateral funding, was driven mainly by the ERM, but required collaboration with Housing to select low-income households to pilot the green infrastructure and to help coordinate solar water heater installation. Meanwhile, in Durban, a formal city-wide mandate for solar water heaters has not been adopted, but Housing there has likewise responded to the EMD to look into enabling installation of this technology on subsidy homes.

Cape Town's Housing Directorate also noted that they are accommodating the ERM's initiative to integrate broad environmental education materials into their housing consumer education program for all new subsidy housing owners, soon to be extended for informal settlements and backyarders as well. While the ERM module is not exclusively or specifically about climate change issues, and while its incorporation would not have taken place without ERM's initiative, the collaboration nonetheless shows that Cape Town's Housing Directorate is at least open to working "environmental" (and, by their association, climate adaptation related) elements into their core activities when provided the necessary components and pushed to do so by an external actor.

Reinterpreting existing core activities as supporting adaptation

Byerly from the Durban Housing Department further saw elements of his department's work as fundamentally positive for the environment, and by extension also positive for climate adaptation. He perceived his department's main contribution towards climate resiliency as their *in-situ* upgrading work in

informal settlements: “Just by formalizing, putting proper runoff, giving people energy... and water and sewage, we are reducing the degradation of the environment that would happen by the persistence of the informal settlement” (Byerly 2010).

The department is further demonstrating at least some aptitude for climate resilient thinking within their core activities. Byerly explained how, in new housing developments, the department has effectively pulled in additional resources beyond fixed subsidy amounts to “top up” certain basic services, under the rationale that these improvements will pay for themselves in the long term by reducing both maintenance costs as well as other indirect societal costs associated with inadequate services. One example was the upgrading of dirt roads to tar roads, which resist erosion and thus end up costing the city less in maintenance over their 15-20 year lifespan. Another example was topping up new developments’ pit latrines – the minimum sanitation infrastructure initially budgeted for – with waterborne sewage systems, due to their health benefits. Attempts are also being made to densify new developments by going multi-story to achieve compact development benefits. Each of these top-ups also enhances climate adaptation. More importantly, they also demonstrate that the department is motivated and able to make the case to City Council for additional funding to improve or innovate on the minimum service model because of justifiable long-term development benefits beyond the immediate purview of the housing department’s short-term achievement of housing delivery goals.

5.4 Factors limiting housing departments’ degree of adaptation mainstreaming

Notwithstanding the two Housing Departments’ activities and efforts outlined above, both departments conveyed significant limitations to their ability to mainstream the adaptation agenda. Explaining their limited engagement with adaptation, the departments related uncertainty about climate impacts; their perception of adaptation as an environmental and/or elite issue and thus external to housing’s core service domain; and numerous operational constraints and pressures that make efforts to address “additional” issues like climate risks extremely difficult.

Uncertainty about climate change risks

Representatives from both departments raised doubts about the inevitability of climate change and its possible effects on their work. In Durban, Byerly noted that “it’s a good idea to reduce carbon [and] pollution, notwithstanding,” but that “there are very strong scientific arguments on both

sides” as to whether climate change is in fact taking place (Byerly 2010). A land acquisition official from Cape Town’s Housing Directorate echoed that “we haven’t consciously thought about [sea level rise], but that’s partly because it’s a relatively new debate...” (City of Cape Town Housing Directorate 2010).

Adaptation agenda not seen as within core mandate

For both departments, adaptation was fundamentally seen as external or, at best, additional to their core agenda, and thus not something they could realistically be charged with taking on. Officials stressed that they are unable to even *think* about planning proactively around a long-term issue like climate change because they are too overburdened coping with present housing backlogs.

“Other priorities and pressures”

According to a land acquisition official from Cape Town’s Housing Directorate, climate change issues were simply not on the department’s radar because “we have other priorities and pressures” of more central importance, elaborating that:

The entire housing sector is driven – propelled – by need, urgency. There are problems that are yipping at our heels, as opposed to meeting global [climate change] agenda targets. [Climate adaptation] is not something that propels us. And it’s not something we get credits for, politically, financially or any other way (City of Cape Town Housing Directorate 2010).

He further encapsulated this inability to think long-term with a story about a housing tour he had given to visiting university students, when he recalled thinking about the implications of sea level rise on low-income settlements in the Cape Flats for the first time: “When we got to the top of the mountain and looked over the city, I said, ‘wow. There’s the beach, there’s the sea and it’s all so flat; what if we go up about three meters, have you guys thought about this?’ And obviously we just laughed” (City of Cape Town Housing Directorate 2010).

With respect to post-disaster housing assistance, another Cape Town Housing representative explained a similar predicament of recognizing that the department’s actions may not be facilitating adaptation, but feeling unable to do anything differently when in a reactive mode:

If we need to provide a lot of people with a surging need immediately, the cheapest way we can do it is to provide them with corrugated iron. And think about a thousand of those standing next to each other, what impact would that have with your climate change? I haven’t had any conversations about that [issue], but there are concerns about it... (City of Cape Town Housing Directorate 2010).

The trouble, explained the official, is that in a post-disaster situation the demand is to simply provide shelter quickly, and “that’s the type of kits [our budgets] allowed” (City of Cape Town Housing Directorate 2010).

Durban’s Byerly echoed the sentiment that the magnitude of the housing backlog puts his department in a constantly reactive mode that undercuts longer-term strategic thinking. Responding to a question about whether the department has been able to leverage their role as major real estate developers to proactively anticipate, acquire and plan out new growth areas for the city (and, in turn, whether such planning has looked at these areas’ possible future climate vulnerability), he commented, “Why increase the current problem that you’re struggling to cope with? It’ll take us another 30 years to deal with the current issue. And now you want to say more people will come in.... no, we’re not managing influx, except by default” (Byerly 2010). Likewise, similarly to Cape Town, limited budgets and immediate time horizons for action do not allow the department to think about long-term vulnerability considerations when providing emergency shelter in the aftermath of a disaster.

Both departments also understood adaptation as fundamentally an environmental agenda, and thus as tangential to – or potentially even conflicting with – their core mandate. One Cape Town housing official explained, “First and foremost, certainly, my core function is to provide new housing opportunities to people who are in need. Whether I use green technologies or this or that, that’s my core business.” (City of Cape Town Housing Directorate 2010). In Durban, Byerly echoed this sentiment, highlighting an ongoing tension he perceived between housing provision and environmental objectives:

Even if the individuals [within our department] might want to be doing it otherwise, our focus is housing. If environmental goodies come out of it in the end, that’s nice to have. But it’s always going to be the second agenda, with people shouting and protesting for houses. We don’t want to put them in the wrong place, and all those kinds of things. But we’re going to end up in [the Environmental Management Department] about where we can put them. Environment’s going to want to retain as much green space as possible. And we’re going to want to access sufficient open space to put people in. (Byerly 2010)

Byerly also dismissed the idea that education efforts with low-income constituencies on home risk-reduction measures and/or basic upgrades to reduce climate vulnerability would fall within Housing’s purview. Such activities – which are not currently offered in Durban, as far as Byerly was aware – were viewed as the domain of the EMD, even though public behavior and culture were

identified as key limiting variables to the Housing Department's ability to introduce home design innovations or technologies (see discussion further below).

Adaptation as an environmental and thus elite issue

The dominant "environmental" issue framing for adaptation (globally as well as in both cities studied) has led both housing departments to understand the range of possible adaptation options in their sector as those more closely aligned with the climate mitigation agenda. In the housing sector, this would predominantly encompass energy efficiency and conservation issues related to home construction, rather than other types of climate risk and resiliency considerations undercutting their activities more broadly. Testament to this is the fact that both departments both first brought up their efforts to accommodate solar water heaters on subsidy-built homes when asked about adaptation-related activities (self-initiated or otherwise) they were engaged with. Solar water heaters are certainly helpful for adaptation in that they reduce direct household expenditures on energy and thus increase economic resiliency, a key component of adaptive capacity in light of the strong linkages between adaptation and economic development (du Plessis et al. 2003 p. 250). Solar energy may also replace dirtier fuel sources, such as wood or paraffin, that cause localized air pollution, a problem that at least in Cape Town is otherwise expected to intensify under projected climate scenarios due to an accentuated summer air inversion effect (Mukheibir and Ziervogel 2006). However, their primary benefit from a climate perspective is arguably more on the mitigation front. The largely environmental and climate mitigation-oriented framing for adaptation is not surprising, given that in both cities the adaptation agenda emerged after earlier climate mitigation planning and has been driven by the municipal environmental departments.

Because of this dominant framing of adaptation, however, representatives from both departments noted seeing adaptation as foremost an issue for the elite class, and thus as something going against or detracting from their core pro-poor mandates. Byerly of Durban's Housing Department made a point to note, for example, that "the high end consumers are actually more to blame than the low [income] population for all these detrimental [climate] effects," and that, in turn, "the focus on [incorporating climate considerations into] low cost housing is going to have far less effect than a focus on the major consumers of goods and services of all sorts" (Byerly 2010). In Cape Town, too, a housing official explicitly noted that low-income neighborhoods may be unfairly getting blamed for energy consumption and climate problems, highlighting that, due to extremely high population

densities in low-income areas with multiple families occupying the same homes and shacks, “the per capita level of efficiency I think is actually higher than is often attributed” (City of Cape Town Housing Directorate 2010).

Following from this view, both departments expressed reservations about placing the climate agenda (as they understood it) on low-income households, at least in terms of piloting technological innovations in building design. Byerly opined that, as high-end consumers already understand and can afford new technologies for reducing energy and water use, such efforts should focus on this sector rather than on low-income constituencies (Byerly 2010). A land acquisition official with the Cape Town Housing Directorate echoed this sentiment:

You should start with the sophisticated [consumers]. Anybody who markets a new product ... starts at the high end of the market and it filters down. By the time it reaches the lower end of the market, you’ve got a support infrastructure in place... If we’re going to test some new technology, [or] test a new policy, don’t start with the poor, as if they’re your guinea pigs (City of Cape Town Housing Directorate 2010).

Lack of financial resources to take on adaptation

The foremost tangible (as opposed to perceptual) constraint to adaptation action brought up by both departments was the limited overall housing subsidy amount, which greatly restricts how homes can be designed and built. In the words of the land acquisition official from Cape Town:

If you want to add anything [to the subsidy homes] in terms of tenders, it costs. Now you either find the costs from... donors, or the community makes an upfront savings for a period and makes a contribution. Or you cut something which previously you would have sought. So it’s a very rigid system that we’ve got. (City of Cape Town Housing Directorate 2010)

The Cape Town official further explained that, due to fixed housing subsidies, mandating additional design elements for energy efficiency or climate resiliency would likely require cutting corners on size or other core structural elements, unless outside funding is brought in (as was the case with the CDM project that the department has worked on with ERM). To move beyond this stalemate situation between basic service delivery and innovation, the official posited that the Revenue Department would need to credit Housing with the savings generated through innovations such as efficiency measures, water metering, etc., or through reduced disaster response costs when homes experience less storm damage. Without this sort of financial incentive, Housing cannot take on these “external” agendas, as the long-term benefits accrue back into general city coffers without any

added bonus to Housing *per se* to offset additional upfront costs (City of Cape Town Housing Directorate 2010).

Although the alternative of bringing in outside funding from donors was mentioned by both departments, this option was viewed by both to be only beneficial on a pilot basis. In Cape Town, Danish funding supported the CDM solar water heater project in Khayelitsha, and while the funds were well spent in the eyes of several housing officials in terms of building awareness and capacity to sustain the infrastructure (City of Cape Town Housing Directorate 2010), the initiative ultimately will remain on a pilot scale without more systemic shifts in municipal funding. The eThekweni Housing Department, meanwhile, has been less successful in securing external funding for their solar water heater initiative. Byerly related how the National Department of Science of Technology, for example, initially indicated a willingness to fund several thousand solar water heaters on new subsidy homes, but then ultimately backed down, requiring the project to be cancelled (Byerly 2010).

The prohibitive cost of scarce desirable lands is another constraint to eliminating location-based climate risks (such as flooding) in new housing developments. It is precisely this problem – the reality that vast new housing developments can only find affordable land on the peripheries of South African cities – which led to the BNG housing policy revision in 2004. And yet, despite the new policy’s innovations, both departments echoed that the basic land problem persists, especially in light of citywide planning objectives to minimize the cities’ overall urban footprints and promote density (Byerly 2010; City of Cape Town Housing Directorate 2010).

Behavioral/social factors limit uptake of new technologies and approaches

Both departments also pointed to the preferences of their low-income clientele as a significant constraint on their ability to introduce climate resiliency measures to subsidy homes. Both noted that subsidy recipients prefer big, stand-alone, “brick-and-mortar” houses, and don’t want to modify these expected core qualities when they don’t immediately see or readily understand the value. The result is a significant roadblock for the departments in advancing a new and unfamiliar agenda such as adaptation. A Cape Town official responsible for new housing delivery explained this predicament:

If I can ... state in my tender to build the houses that we want [contractors to] use green building technology, why not? But if it comes at a price that’s going to reduce

my house size, then I say, well, the community must now start making input... and we know what the people would choose. We know from experience that a good house is a big house, looking from a community perception point of view. Size is everything, and when it gets to [adaptation enhancing] alternatives it becomes very difficult because ultimately it's *their* subsidy that we're using... (City of Cape Town Housing Directorate 2010).

In Durban, Byerly noted the exact same predicament of community distrust for new technology, explaining the dilemmas caused by perceived unequal treatment within a community when deviating from standard models:

People know bricks and mortar and they know how to do it. And they can do it. And it's been around for years and will be around... If you want [new or different building materials or styles], go into your middle and high income market where you can show them the statistics: 'Here are the tables and the graphs. Here's all the proof. Do you want to buy? It's going to cost you 10% more, but in 20 years, it [will] have the same cost.' You try and sell that to a low income place, sorry... For example, we put in wooden roof trusses in some houses. And then because wood [prices] went up, we put in metal ones in the other houses in the same project... And the people [said], 'why have they got wood ones and we got metal ones? We're supposed to get the same project.' Now you [environmentalists] are coming, so we're going to start experimenting, but that has to be an individual's choice and the individual is not choosing it (Byerly 2010).

A converse problem noted by a Cape Town housing official is when communities *favor* new technologies, if such technologies are not made universally available. The department encountered such difficulties in their recent work with the ERM Department initiating the CDM solar water heater project. One official described the headache in selecting only a handful of households within the Khayelitsha township to pilot the new infrastructure, given limits to the external funding that was covering the costs: "Scaling up the benefit on an equitable basis is very, very difficult to handle... because it's left to us as to who's going to benefit from this" (City of Cape Town Housing Directorate 2010).

Limited legal mandate over private sphere

Both housing departments noted another significant barrier to their ability to increase climate resilience in the residential sector: their legal limitations on influencing homeowner actions and housing conditions within the private residential sphere. Trends in housing policy since 1994 have emphasized increasing individual tenure and minimizing the state's previous largesse as a landlord. Durban in particular aims to get rid of all but a few thousand of its low income rental units (still at around 20,000 units in 2010) through transfer to private ownership (Byerly 2010). The departments do routinely upgrade properties before transferring titles to ensure structural

integrity and minimum quality standards. However, once titled, municipalities are legally prohibited from supporting upgrading activities or otherwise investing in privately held units (Byerly 2010; City of Cape Town Housing Directorate 2010).

What's more, the private actions of low-income housing residents, once homes and plots are titled, were seen to sometimes undermine the effectiveness of city-initiated, climate resilience oriented initiatives. Even if more climate mitigation than adaptation oriented as noted earlier, solar water heater provision in Durban was brought up as showcasing this predicament. The eThekweni Housing Department has noticed that households don't always use their solar water heaters once installed, preferring to switch them off and continue to make use of "free" energy sources such as illegally harvested wood. As another example, in Durban, residents sometimes pave over their yards to create parking, increasing the downstream risks of erosion and flooding in low-lying areas. While such illegal paving without an advance permit is noticed by the Housing Department, it is outside their direct control to prevent or address (Byerly 2010).

5.5 Chapter summary

To recap, the Cape Town and Durban housing departments told remarkably similar stories about their attempts to mainstream adaptation considerations into their activities as well as the limitations they face to making further progress. Neither department has deeply integrated climate change considerations into their thoughts or actions; in fact, key planning staff in both departments remain hesitant about the existence of climate change and the extent to which it poses risks they can and should be responsible for addressing. Both departments also questioned whether residential adaptation should legitimately focus on the low-income sector, in light of perceptions of adaptation as an environmental and "elite" issue. Meanwhile, both departments are nonetheless minimally complying with environmental policy mandates, which they consider to be contributing to ensuring climate resilience of their operations. Both are furthermore accommodating requests from the city environmental departments for assistance on adaptation-oriented pilot initiatives and participation in adaptation-oriented forums. They are constrained in making their further progress principally by a lack of financial resources and budgeting flexibility to modify or innovate on basic service models; behavioral and social factors that limit demand for climate-resilient modifications to core products; and legal limitations to engage with privately titled housing.

CHAPTER 6: MAINSTREAMING ADAPTATION: STORMWATER DEPARTMENTS

This chapter turns to adaptation mainstreaming in the stormwater management sector. Globally, best management practices in urban stormwater management have increasingly emphasized low-impact and ecological approaches at the site, neighborhood and watershed scales. Both Cape Town and Durban are increasingly embracing these approaches as they grapple with complex flood management challenges. As with the housing departments, both stormwater departments conveyed highly similar perspectives and experiences vis-a-vis climate risk management. Climate change considerations are integral to both departments' thinking about their core services and regulatory roles. Both departments emphasized how their gradual shift towards more ecological and low impact design oriented approaches also fully supports and advances adaptation goals. Both departments have furthermore commissioned studies to model climate impacts, and are building on collaborative work with the cities' respective environment departments to explore new approaches to climate-sensitive flood risk management. Yet despite this high degree of adaptation mainstreaming, both departments also highlighted some remaining challenges to the mainstreaming process that speak more broadly to the implications of mainstreaming on departmental priorities. Each of these findings is elaborated on below.

6.1 Stormwater management in Durban and Cape Town: Overview

Trends in urban stormwater management

In contrast to the highly visible issue of housing provision, stormwater management is, when done well, an “invisible” service. Yet when systems do not function correctly, flooding can threaten lives as well as cause significant damage to infrastructure, property, and natural systems. Disruptions to transportation and basic municipal services, economic activity, and health (such as through increased mold, moisture and standing water breeding grounds for vector-transmitting mosquitoes) are among the numerous possible knock-on effects that can undermine local, regional and potentially even national development objectives (Constable and Cartwright 2009).

Good practice urban stormwater management internationally has recently de-emphasized strict “hard engineering” solutions to drainage, in favor of low-impact site-level approaches to managing runoff together with preservation and restoration of natural riparian buffer zones and attenuation

areas (Marsalek and Schreir 2009). Dykes and levees as well as practices of canalization or burying of urban rivers have historically been popular in urban areas, because they increase the speed of surface water runoff and create the perception of containment of flood-prone areas, enabling development to align closer to floodplains than otherwise would be possible. However, increasing research has shown that these approaches may actually increase overall urban flood vulnerability by decreasing or eliminating the natural 'buffer zone' between developed land and drainage infrastructure, and creating a reliance on engineered solutions that can fail or malfunction (ProAct Network 2008). When extreme rainfall events overwhelm pipe or river channel capacity, or if drainage infrastructure is not adequately maintained, neighboring or downstream settlements can be highly exposed. Fast-moving water flowing over hardened surfaces can also threaten lives and homes if it breaches canalized riverbanks (Ellis 2008). Low-impact techniques for stormwater management, meanwhile, emphasize protection and restoration of urban river catchments to enhance water absorption and mitigate water quality concerns from stormwater runoff (Smith 2001).

In South Africa, stormwater management is a municipal responsibility; there is no national policy governing what approach to follow. It is therefore difficult to characterize overall trends in stormwater management practices nationally, although the larger metros are certainly aware of international best management practices in low-impact management. The challenge at the city level is to apply this knowledge to local contexts, in light of huge variation in local topography, soil systems and land use (the latter with political and socioeconomic roots and implications). In South African cities, as in cities of many other countries, reliable and sufficiently detailed data are not always available on historic rainfall, urban topography and land use to accurately predict stormwater runoff rates (Anonymous 2008). Even with such maps, countless other variables affecting the pace, location, and pattern of residential and industrial development distort the accuracy of rainfall modeling in projecting adequate dimensions for stormwater engineering solutions. These include prominently the functioning of parallel wastewater and solid waste management systems, present and future changes in urban density and land use patterns, and a range of social behaviors.

Effective stormwater management is thus multi-disciplinary by nature. Its dimensions include not only adequate maintenance of pipes and gutters, but also effective solid waste management to prevent drainage clogging; road construction that facilitates drainage; full catchment-level planning

and management to maximize upstream absorption; education of communities to prevent trash disposal in storm drains; and squatter prevention and control measures to keep informal settlements from blocking drainage routes, among other dimensions. The last of these mentioned factors, in turn, depends on the adequacy of broad poverty reduction initiatives plus affordable housing availability. It is easy to quickly unravel the interconnectedness of stormwater departments' objectives with various other urban development and service provision objectives.

Stormwater management in Cape Town and Durban

Improving stormwater management in Cape Town is among the priority issues for the city, in light of ongoing annual flooding challenges. Cape Town's 2007-2012 Integrated Development Plan calls on the city to "reduce the impact of flooding on community livelihoods and regional economies," and to "safeguard human health, protect natural aquatic environments, and improve and maintain recreational water quality" (City of Cape Town 2007 p. 19). Flooding in the low-lying Cape Flats is an annual challenge. Seasonal winter flooding stems from a combination of factors, including natural features (flat topography, low-lying, with a high water table that slows absorption); inadequate coverage of drainage infrastructure; urban development patterns that exacerbate runoff problems; and the sub-optimal functioning of existing infrastructure due to insufficient budgets as well as clogging. The latter, in turn, results from a combination of sand silting, inadequate sanitation and solid waste management, and intentional blockages by informal communities to create places of shelter. Rapid urban growth is also leading to an increase in hard surface cover that further restricts absorption of runoff. In the winters of 2007 and 2008, high rainfall led to significant flooding that affected over 8000 households in informal settlements, although even in an "average" year, approximately 4000 of these households are expected to flood (City of Cape Town 2009a pp. 9, 12). Despite the anticipated overall decrease in precipitation for the Cape region under future climate change scenarios, the models also predict a likelihood of more intense storm events (Midgely et al. 2005). Thus, climate change is likely to put further stresses on existing drainage systems.

Unlike Cape Town, Durban's topography is mostly hilly, facilitating more rapid drainage following stormwater events, although urban watercourses are also significantly larger. Yet, as with Cape Town, informal settlements are the most vulnerable to the impacts of floods, due to their frequent location on marginal lands as well as poor housing construction and high population densities. At

least 9,000 households are directly at risk of flooding, based on current flood zone boundaries (eThekweni Municipality 2001); however, the boundaries of risk are a moving target. Climate change models for the Durban area predict up to a 30% increase in total precipitation by the end of the century, leading to significantly higher average runoff and stream flow (Knoesen et al. 2009; Summerton 2008). What's more, individual storm events are likely to intensify and last longer (Webster et al. 2005). Coupled with trends towards increased paved surface cover as the region continues to urbanize, this is likely to lead to a greater risk of floods over a greater area.

Roles and functions of the municipal stormwater departments

The Cape Town and Durban stormwater departments are situated slightly differently within the overall institutional geography of their respective municipal governments. In Cape Town, the Catchments, Stormwater and River Management Department sits within the Transport, Roads and Stormwater Directorate. In Durban, the equivalent department encompasses also coastal management, and sits under the umbrella of the Engineering Unit. To facilitate direct comparison, coastal management elements of the Durban department's work were left out of this analysis.

Notwithstanding these differences, the two departments have otherwise largely parallel core responsibilities. Both are responsible broadly for effectively managing drainage to reduce flood risks across their municipalities, as well as minimizing pollution impacts on urban wetlands and coastal waters from surface runoff. In these ambits, both departments plan, build and maintain "hard" drainage infrastructure as well as manage urban river corridors and wetlands. Both departments carry out key policy and planning functions, setting flood lines (which in turn feed into city-wide spatial development frameworks) and determining site-specific flood management requirements for the approval of development applications that fall within flood zones. Both departments further coordinate regularly with other municipal departments on issues including disaster management, coastal management, protection of environmentally sensitive areas, management of health issues associated with flooding, and inputting into the prioritization of informal settlements for relocation.

6.2: Mainstreaming climate adaptation into stormwater management: overview

Given its obvious direct relationship with weather systems, and in light of climate change's expected effects on precipitation patterns in many parts of the world, the field of stormwater

engineering is conceptually easy to associate with climate adaptation. According to one author from the US, “Stormwater management occupies a space in the urban landscape that promises to alleviate some of the areas of greatest concern under climate change scenarios, signifying that stormwater managers will play an increasingly leading role in preparing and sustaining urban infrastructure” (Funkhouser 2007).

Various specific changes may be needed to ensure that cities can adequately manage stormwater and drainage as the climate changes. Table 1 illustrates four main dimensions of climate change relevant to stormwater design, as envisioned by New Zealand stormwater engineering scholars: (i) an increase in heavy rainfall; (ii) a change in mean total rainfall (affecting soil saturation points); (iii) an increase in mean temperature (affecting evaporation rates and soil moisture saturation), and (iv) increased wind (affecting the way rain impacts the landscape). These are summarized in Table 1 below:

Table 1: Climate changes relevant for stormwater design (Shaw et al. 2005)

Type of change	Relevance for stormwater planning
Increase in heavy rainfall	Increase in total rainfall depth for design storm events for durations of up to 72 hours
Change in mean rainfall	Change in antecedent soil moisture saturation
Increase in mean temperature	Change in evaporation from soils and ponds, which changes antecedent soil moisture saturation
Increase in wind	Changes in rainfall over complex topography – increases upwind of hills and ranges

While this table illustrates that climate change impacts on stormwater management are complex, Geoff Tooley, Manager of Stormwater and Catchment Management in Durban, foresees the most critical dimension of change as the intensity and duration of individual precipitation events, rather than the total monthly rainfall (Tooley 2010). Fewer but more intense storms are harder for a city to manage effectively than a constant drizzle, as the latter can generally drain slowly without overwhelming drainage capacity.

As explained by IPCC authors, strategies for adapting stormwater systems to climate change “are likely to include increases in reserve margins and other types of backup capacity, [and] attention to system designs that allow adaptation and modification without major redesign and that can handle more extreme conditions for operation” (Wilbanks et al. 2007a p. 381). Shifting overall thinking

about stormwater from waste product to asset – an approach termed “total water management” by some – will also facilitate adaptation to climate changes that are likely to include greater wet and dry extremes. Such an approach would create incentives for collecting and reusing rainwater for productive on-site purposes, while dis-incentivizing runoff from a property that could overload public graywater systems (Oberts 2007). Approaches to stormwater management that emphasize natural systems rather than hard engineering are also more likely to succeed in situations of increasing uncertainty and variability in precipitation patterns, as will be the case in most regions under future climate scenarios (NACWA 2009).

6.3 Stormwater Management Departments’ progress on climate adaptation

In sharp contrast to the housing departments, the stormwater management departments in both Durban and Cape Town are quite advanced in mainstreaming climate adaptation. In both cases, the departments viewed their strategic and regulatory functions of setting flood lines and reviewing development applications as particularly relevant and powerful in advancing climate resilience objectives. This view coincides with both departments’ increasing overall emphasis on containing or modifying *development* to minimize its impact on natural drainage systems, rather than containing and rapidly draining runoff to minimize its impact on development. While not originating initially from a climate change impetus, this new approach was seen by both departments as strongly facilitating, and in line with, adaptation objectives.

As discussed in more depth below, the two stormwater departments overall revealed largely similar experiences in explicitly considering climate adaptation, as well as significantly fewer limitations to mainstreaming adaptation than their housing department counterparts. Beyond drawing connections between climate resilience and their current approach to core functions, both departments have proactively taken up climate change as a specific and new challenge. Both departments have sought out new knowledge on climate change risks, commissioning studies to help them improve the rainfall and flood risk modeling that underpins flood zone boundaries. They have also both collaborated beyond their institutional boundaries to coordinate and streamline efforts around advancing urban climate resilience.

Recognizing the relevance of climate change to department goals/objectives

Both cities' stormwater departments readily understood climate change as an issue of extreme relevance to their core work streams. In both cities, stormwater officials explained that reaching this understanding was not a conceptual leap, as they are *already* well aware of – and working to accommodate – the dynamic nature of environmental systems. Barry Wood, Director of Cape Town's Catchments and Stormwater Management Department within the city's Transport, Roads and Stormwater Directorate, stressed that the type of flooding issues anticipated under climate change scenarios are already observed annually in the Cape Flats region (Wood 2010). Geoff Tooley, the Manager of Stormwater and Catchment Management for Durban, meanwhile noted that his department has already had to increase their spending in recent years to protect existing drainage infrastructure, in light of upstream land use changes and more frequent and intense storms already intensifying runoff volumes and leading urban rivers to seek “a new equilibrium” (Tooley 2010).

For both cities, recent severe flooding and coastal erosion events (2007 and 2008 in Durban; 2008 in Cape Town) have further elevated the political profile of flood management, enabling more readily drawn linkages between the stormwater departments' core services and the threats of climate change. Tooley commented, for example, that “There was this whole talk about, oh, we're going to have increased rainfall, and then boom, we got nailed by a big storm. Politicians said, OK, well, maybe these guys are not talking nonsense” (Tooley 2010).

As an extension of the above, both cities' stormwater departments made ample linkages between their current core activities and climate resilience, even outside the context of specific actions each are also undertaking to understand and address climate change risks. Senior stormwater managers in both cities explained that their gradual adjustment of approach to managing floodplains and urban rivers over the past decade-plus – from a focus on hard engineering to a more natural systems-based model – fundamentally works towards climate resilience.

In Cape Town, Henry du Plessis, the Roads and Stormwater Acting Director, emphasized that the effect of climate change “all depends on how you develop your city going forward” (du Plessis 2010). Climate adaptation, therefore, flows from and is supported by the department's efforts to steer private development away from floodplains and manage runoff through low-impact site

design interventions. His recognition of the department's role in reducing climate change risks to the city stems from a sincere sense of responsibility to act once aware: "We have a responsibility as officials and as administrators that we shouldn't be going and further endangering people's lives... fully conversant of the climatic changes that are coming" (du Plessis 2010). Wood also made explicit linkages between climate resiliency and the department's increasing focus on natural systems approaches (as opposed to hard engineering approaches) to stormwater management, noting that "engineered systems can fail, and that's a risk [with] climate change" (Wood 2010).

Along these lines, two new municipal policies for managing flood plains, river corridors, and urban stormwater impacts were drafted by the department and enacted by Cape Town's City Council in May 2009. The new Floodplain and River Corridor Management Policy emphasizes steering new development away from rivers and floodplains and, in turn, managing watercourses to restore and protect their ecological integrity, rather than relying on engineering solutions to keep runoff away from development. The new Management of Urban Stormwater Impacts Policy, meanwhile, espouses principles of water sensitive urban design and localized (whenever possible) urban drainage solutions, aiming to reduce erosion as well as pollution of both inland and coastal waters.

While neither of Cape Town's new policies discusses the specific issue of climate change extensively, the introductory language in both does make reference to climate change as one of several motivating factors in moving towards more low-impact and natural systems-based approaches to managing urban flood plains and waterways. The preambles for both policies rationalize that the approaches being pushed are "particularly important in the context of changing weather patterns..." (City of Cape Town 2009b p.1; City of Cape Town 2009c p.1). The Floodplain and River Corridor Management Policy further elaborates that "climate change predictions indicate greater variability in the intensity and magnitude of storm events coupled with accelerated sea level rise. These uncertainties pose significant challenges for the management of major drainage systems" (City of Cape Town 2009b p. 3). Wood further made the explicit connection that both policies are "about conserving our resources, so there's some climate change benefits to that as well" (Wood 2010).

In Durban, Tooley meanwhile stressed similar linkages between his department's overall approach to stormwater management and climate adaptation objectives. As with Cape Town, their regulatory activities (setting flood lines, reviewing development applications, and determining necessary

actions by developers to manage stormwater risks) were readily interpreted as contributing to climate adaptation objectives. Tooley explained that the department's conservatism in creating the existing 100-year flood lines by using the medium case statistical models for rainfall has enhanced the city's flood resilience to annual climate variability with or without climate change. It also helps to create a buffer to the onset of possibly more significant climate change (Tooley 2010).

The department in Durban also requires stormwater management plans to be submitted for all greenfield developments to ensure no net change in site runoff. The purpose is to prevent land use changes that could indirectly or cumulatively impact downstream runoff volumes and throw drainage systems out of equilibrium. Applications for developments within or close to flood line boundaries must further include detailed calculations of site-level flood risks, as well as outline design features to ensure the development's resilience and safety for occupants in light of identified risks. Although in effect since 2003, predating explicit discussion of climate change in the department, these requirements for developers were explained by Tooley as enhancing climate adaptation at the site level, as they have stimulated resilience-building innovations from private developers:

“We’re seeing innovative things where guys are catching the water off their roof, putting it into tanks that are built into the house, and that’s being put back into a header tank on the roof and running the toilets off of that water. So these are initiatives that, as a result of us asking for people to manage their stormwater, they are starting to think smart and are getting a benefit out of catching that water.”(Tooley 2010)

Tooley further considered his department's discretionary and differentiated approach to judging acceptable flood risks in different contexts as adaptive because of its comprehensive view of vulnerability. That is, the rules are written in such a way that the department can apply significant discretion in deciding whether stormwater management plans and site-level drainage design features are sufficient. What's more, requirements for development siting are explicitly stricter for low-income housing than for high end real estate, in recognition of the fact that the same level of exposure translates into greater vulnerability for a low income resident because they likely do not have private insurance (Tooley 2010).

Underpinning the Durban stormwater department's ability to exercise significant discretion in implementing policies to account for climate change, related Tooley, is a long tradition of conservatism in zoning development away from urban rivers and floodplains, along with more

recent emphasis on holistic management of stormwater runoff. Floodplain policies have been in the city's by-laws since 1975, so there is a history of institutional acceptance of the idea that development should be kept away from flood risk areas and infrastructure and buildings should be modified to facilitate drainage. What's more, "where there has been development in the floodplains, it's been done with the knowledge of risk – so for instance, factory floors have been developed at a level that's high enough above the flood plains, so that yes, you might flood the parking around the factory, but the contents of the factory aren't negatively affected." (Tooley 2010)

Taking ownership over adaptation: in-house initiatives

Improving baseline information to update policies and enhance systems

In addition to re-framing their core functions and activities as climate resilience-enhancing, both cities' stormwater departments have also commissioned studies of rainfall and drainage dynamics in preparation for making climate change-specific adjustments to flood zone boundaries and stormwater management systems. The approach being followed by both cities is very similar. Both have started foremost with improving knowledge of current flood risks, through detailed analysis of historical rainfall data and downscaling of existing information about current land uses and drainage infrastructure. Once this baseline data is more adequately in place, both departments intend to apply a (still unspecified) climate change factor to the model, to project where increased attention will be needed in the future to manage flood risks.

In Cape Town, the department has commissioned analyses of the frequency, duration and intensity of historic rainfall, with the intent to then re-evaluate the 100-year flood lines and design standards for stormwater systems. The study will also develop more comprehensive hydrological models of open drainage catchments across the municipality, to enable more precise scenario planning for flood and disaster management and projections of future changes to risk parameters in light of expected climate changes.

Durban's stormwater department has meanwhile commissioned very similar work to more deeply analyze historic rainfall data, with the same objectives: improve the nuance in current drainage and catchment modeling across the municipality, to provide the necessary groundwork for

understanding climate change implications at the site level. Tooley explained that after historic rainfall data has been more completely analyzed and interpreted, “our idea is then to take the new rainfall [projections in light of climate change], run that through the model, and actually see what are the impacts. And so that then starts guiding development plans” (Tooley 2010). Separately, the department is also conducting a detailed inventory of existing drainage infrastructure across the municipality, with the goal again of getting a better handle on the current dynamics of urban drainage at a micro scale. Current records of existing infrastructure are spotty “because we’re taking on a lot of outer areas [for development], and the records weren’t that good” (Tooley 2010). Both of these analyses would improve the department’s ability to plan and regulate the drainage aspects of new developments with or without climate change; however, Tooley explained that the department’s interest in doing this work has been piqued in light of discussions about climate change impacts (Tooley 2010).

The focus on first improving knowledge of status-quo dynamics of stormwater runoff before considering climate change was explained in Cape Town to be part of a strategy to ensure as solid a footing as possible on climate change-altered flood lines and requirements for developers, in anticipation of political push back. As Wood explained:

We anticipate applying some sort of a [climate change] factor [to project future changes in the 100-year flood line], but it’s got to be based on something... we can’t just suck things out of our thumb, because it has impacts on what and how the city can develop, on private landowners, etc. So we’ve got to at least go through some sort of due diligence... get it to some numbers on which we can start applying the controls, especially land use controls, and incorporate it into our planning and designs (Wood 2010).

Internalizing incentives and push factors

Beyond the domain of “in-house” efforts to improve their core functions in light of climate change, the stormwater departments in both cities have also interfaced substantially with their cities’ respective environmental departments on various activities initiated and funded under the umbrella of the city-wide adaptation planning processes. In both cases, the city-wide processes have served as substantial push factors to further embed and support adaptation mainstreaming within the stormwater departments. As will be shown in subsequent sections, responding to these push factors has in turn catalyzed more entrenched collaboration across institutional silos, enhancing climate adaptation goals.

In Cape Town, the Catchments and Stormwater Management Department, as with Housing, is

participating in the city-wide Climate Change Think Tank being organized by the ERM. Wood explained that the department was invited by ERM into this forum, but sees the direct relevance of participating. He hoped that it will serve as a place of reconciliation of divergent viewpoints:

We certainly are hoping that at the end of it we're going to get some better direction, if anything. That's what we need. And considered direction, because there are a whole lot of different players involved..., and we're probably going to get some very divergent opinions, which hopefully we can find the middle ground... so it's always with these kind of things, when there's uncertainty, multidisciplinary sometimes is best (Wood 2010).

Cape Town's department has additionally been pulled into a "task team" focused specifically on coastal management policy and planning in light of climate change. The task team was convened by the ERM following significant storms in the winter of 2008 that led to substantial erosion along the Strand beach waterfront. The department's specific focus within the task team is to model the implications of sea level rise on coastal drainage (still underway as of January 2010). The goal is to propose mitigation measures to curtail expected erosion and reduce water quality concerns from increased stormwater runoff. Pilot projects to treat stormwater before it reaches the ocean are subsequently anticipated. Polluted stormwater runoff is of particular concern because of its implications for beach closures and coastal tourism.

In Durban, meanwhile, the Stormwater and Catchment Management Department has benefited from being a central player in an EMD-organized collaborative process around climate adaptation considerations specifically for the water and health sectors. The process, encompassing also the city's Water and Sanitation and Health Departments since 2008, as well as more recently the Disaster Risk Management Department, has resulted in a detailed water and health oriented Municipal Adaptation Plan (MAP). The MAP development process, which has been closely accompanied – and funded – by the EMD at every step, outlines a prioritized list of specific adaptation actions for each department, stressing the interlinkages between departmental domains and responsibilities in managing the complex system dynamics of climate change with respect to water and health management.

Beyond the MAP process, Tooley related his department's involvement in a separate pilot activity being led by the EMD to test green roof technologies to reduce runoff. While the pilot project was EMD's brainchild, Tooley explained that it has been internalized into his department because of the perceived benefits for their uses:

We've got quite involved with it, because we see the benefit for us. If we can get this as an idea that catches on through private development in the city, it will have a positive spinoff for us in terms of the level of service and risk that, from a flooding point of view, the city faces in urban drainage systems. (Tooley 2010)

Moving beyond silos: initiating and deepening outward collaborations

Engaging other departments

While none of the above-mentioned collaborations were initiated by the stormwater management departments themselves, the departments both have highly internalized these and other adaptation oriented interdepartmental interactions beyond merely accommodating requests from city-wide adaptation planning initiatives. Officials from both departments highlighted the value they saw to collaborating with other departments, to leverage limited human and financial resources as well as to ensure appropriate identification and management of possible indirect effects of their actions on other sectors in light of climate change. Regardless of whether the collaboration was initially instigated by an external push factor (such as the city-wide adaptation planning initiatives) or by the department itself, the full embedding of the collaboration seems to represent a deeper internal transformation in how a department conceptualizes the boundaries of its own actions and responsibilities. I argue that this, in turn, is the benchmark of a more advanced stage of departmental adaptation mainstreaming.

In Durban's case, Tooley described the MAP process – even though an EMD-led venture – as transformative in his department's conception of its own actions and inactions, and in turn, its approach to problem solving. The actual actions outlined in the MAP are nothing revolutionary for the department, according to Tooley: "There's always been buy-in. What the MAP document has done is just put in one place a number of the initiatives that were already starting to happen." However, the value added from the process is that "it helped us start to look at [climate change] from a holistic point of view..." (Tooley 2010). In other words, while the mechanics of solutions to better manage stormwater issues are not new, the collaborative cross-departmental approach to adaptation planning has "started to raise the idea that, well, if we do this, what does it impact, how does it impact? Or is there a better way of doing things?" This, in turn, is "helping us understand and talk and say [to other departments with downstream responsibilities], we're thinking of doing this. Do you see any positive or negative impacts? Or if we do it slightly differently, can we impact better on your [activities]?" (Tooley 2010).

Collaborations resulting from the Durban MAP process have in particular transformed how Stormwater interacts with the Health Department. Tooley explained that:

[Before the MAP process started,] the interaction was more, if we saw a problem, we would report it to [the health department], and they would take action, or if they had a problem that they couldn't solve because of the magnitude of it, they'd interact with us, and we'd work with them to help resolve it from an engineering point of view... but not necessarily the discussions in terms of looking at how we impact each other... (Tooley 2010).

Tooley also noted how collaboration further helped his department leverage limited resources towards a common goal, "because our resources are short anyway, so it's a case of, how can we piggyback on each other's efforts?" (Tooley 2010). His department began to realize these benefits to collaboration on complex problems even before the MAP, through their work with the Planning Department in the early 2000s on the city's Spatial Development Plan (the spatial component of the Integrated Development Plan):

We had long hours of debate with the planners to try and, us understanding where they're coming from and them understanding where we're coming from, and about how their decisions impact on our decisions, on how we deliver services, and obviously about how we deliver services impacts on how they plan. And so there's this cross-pollination that started to happen...of understanding that you can't make a decision in a silo... (Tooley 2010)

In Cape Town, Wood likewise explained the value his department saw to building and strengthening collaborative relationships with other departments to tackle climate risks. On their involvement in the ERM-initiated task team for coastal management, Wood explained how the initiative was especially timely given his own department's independent work to address coastal erosion and runoff: "We were independently working on [a related issue], and now [adaptation planning] has come up, and they dovetail, and it's actually sometimes amazing, where the one project might need the other one" (Wood 2010).

As in Durban, the Cape Town department's systematic thinking about climate change has led to increased self-reflection about areas of climate resilience where the department is too thinly resourced to effectively handle the problem alone and would need to rely on other departments. Wood reflected that, while his department is clearly strong in the upstream planning and regulatory sphere, the operational side of keeping systems clean and responding to floods falls more to other departments such as Disaster Risk Management and Housing. Their complementary strengths have underscored the need to tightly collaborate on these issues, such as through the development of an

annual city-wide Winter Preparedness Strategy. The Strategy originated from and continues to be primarily authored by the Transport, Roads and Stormwater Directorate, even though implementation is almost entirely through other departments. As another example, Wood noted that public engagement and education to help private households better manage flood risks – an essential component of achieving climate resilience – requires close collaboration with other departments in light of in-house capacity constraints. He commented, “I think our biggest weakness at the moment relates to community capacity building; because we’ve been struggling with staff resource levels, that’s an area... which we can’t do effectively at all” (Wood 2010), but that the Disaster Risk Management and ERM departments do lend additional capacity in this regard.

Engaging external stakeholders

Following from this last point, both stormwater departments – as with both housing departments – are keenly aware that managing climate risks goes beyond city government alone, given the huge implications of actions in the private sphere. While both *housing* departments conveyed this as a limitation to their ability to mainstream (e.g., that most activity influencing vulnerability or resiliency is external to their direct scope of work), both *stormwater* departments seem instead to view their limitations as reason to engage and educate public and industry stakeholders.

In Cape Town, du Plessis explained that his department has begun to engage industry in particular, to “get [them] on board to apply the new [Management of Urban Stormwater Impacts] Policy and guidelines in terms of how they do development... so that it becomes part of the normal business” (du Plessis 2010). As of January 2010, the engagement has consisted of a workshop for diverse actors including consultants, engineers, and landscape architects to explain the new policy’s requirements and educate them on its purpose. He explained, “Providing this interactive engagement with industry, we feel that it will be less of an aggressive engagement and more of an accommodating engagement with them.” The ultimate goal is “so we don’t have to come to a development site and tear down the development because it doesn’t meet the requirements as set out in the policies.” The initial workshop is envisioned as part of a longer, ongoing process of engagement, as change was acknowledged to be a slow process (du Plessis 2010).

Durban’s Tooley likewise noted that “we’re finding that [industry] consultants are having to develop capacity in terms of [hydraulic modeling in light of proposed land uses],” because of the department’s new emphasis on requiring stormwater management plans for greenfields

developments (Tooley 2010). Tooley did not mention his department holding specific workshops for consultants or others, such as in Cape Town. Nonetheless, he flagged his department's recent publication of fine-tuned hydraulic modeling of the entire metro area as an important action that has begun to influence private banks' lending behaviors and insurance companies' property insurance metrics. Through sharing of data and modeling, the department is effectively helping to steer private development away from properties at high risk of flooding or erosion.

6.4 Remaining challenges in adaptation mainstreaming

In contrast to the housing departments, who are just beginning to engage with the climate change agenda and perceived numerous limitations to their more substantial mainstreaming of adaptation, the Cape Town and Durban stormwater departments identified far fewer limitations. However, they spoke to a few key *challenges* encountered along the path of mainstreaming climate change adaptation, outlined below: (i) the political nature of managing scientific uncertainty about climate change impacts; (ii) cultural and structural constraints to organizational change; and (iii) perceived internal trade-offs to taking on a new agenda, depending on its problem framing.

Political nature of managing scientific uncertainty

Even as both stormwater departments are clearly quite advanced in mainstreaming concepts of climate adaptation into their overall responsibilities and work portfolios, both also stressed the challenges to acting on uncertain climate projections. In Cape Town, Wood explained that a key dilemma is in deciding how cautious to be in setting future development limits: "I just want the answers. Someone must tell me, 'Sea level's going to rise in the next 20 years about half a meter. Start applying it.' That's all I need" (Wood 2010). Tooley echoed that, even if major storm events call attention to climate change as an issue, there is always political push-back on whether the storms are a result of climate change as opposed to mere climate variability:

[The politicians] are saying, 'well, we know there are cycles, we have seven to nine year cycles of major floods...historically, and is this not just another upturn in the cycle...?' That's the part we're grappling with. Is it a cycle that we're going through, or is it a cycle plus climate change? And what is the percentage of climate change? (Tooley 2010)

What's more, even if future storm and flooding probabilities in light of climate change could be accurately predicted, the level of tolerable risk for different activities is still a judgment call. This is not anything new *per se* for stormwater engineers, as Wood explained:

If we look at the 100 year flood line, that's a 1% chance that it can happen in any particular year... [Given climate change], maybe we have to move to, like in the United States, the .5% probability or 200 year flood line. But we don't believe that's justifiable here in Cape Town. So it just depends on what the community wants (Wood 2010).

This perceived need to appear “reasonable” in creating rules to guide and limit development, combined with inherent uncertainty about climate change's effects, shows the inherently political nature of climate risk management. Tooley explained this point in terms of the decision to authorize the new Durban airport (under construction in early 2010) in a low-lying area by the harbor, even when the city knew that area would be likely among the first areas underwater with sea level rise, “because that's a big chunk of land that will deliver a whole pile of rates over the next 40 years before it gets affected” (Tooley 2010).

Organizational structure and culture undermines institutional change

Both departments also highlighted how slow and difficult it is to bring about institutional change, in light of entrenched cultures and inherited organizational structures. In Cape Town, the broader change process underway in stormwater management – towards an emphasis on siting development away from natural systems and implementing on-site retention and drainage design features – was noted to be difficult because “engineering professionals have been used to doing things a certain way, and the clients and developers expect it like that, and it takes time to [change]” (Wood 2010). Du Plessis echoed that, “like human nature, it's difficult to bring about change” of any sort within an institution, including to think more proactively and explicitly about a future challenge such as climate change (du Plessis 2010). Tooley of Durban added also that the post-apartheid reorganization of city government to flatten management structures “created an environment where you were dealing with the ‘now’ problems, and the strategic planning needed to be done, but because of time constraints, always got put off” (Tooley 2010). Because of this, it is difficult for his department or any other core service line function to prioritize long term planning.

Internal trade-offs generated by problem framing of adaptation

A further challenge relates to balancing potential trade-offs that come with adopting a “new” agenda that has been framed in a way that conflicts or competes with elements of a department's core functions and responsibilities. This was specifically raised in Cape Town by Wood, with respect to a perceived tension between dedicating staff resources towards long-term coastal planning for sea level rise versus the immediate flood challenges in informal settlements existing today:

It's not the science. It's around what it does to current priorities. So you have to plan ahead, I have no hesitation about that... but it doesn't in my view help to get very excited about a two meter or a one meter rise in sea level when we've got quite large areas in Cape Town which, if we get a one-in-100-year flood today, there's going to be significant damage... one has got to be careful with this kind of thing in terms of what it can do to the resources flows within an organization, not necessarily financially, but at a discussion level (Wood 2010).

Wood's comments speak more broadly to the potential tradeoffs and equity considerations resulting from different city-wide framings of climate adaptation planning, even if theoretically being driven by explicit concerns about vulnerability:

If we were to publish all our flood lines that show all these houses that technically, theoretically, have a 1% chance of being underwater, maybe people will be alarmed. And this is what happened – the sea level rise study was taken, and it was published, and there are whole swaths of Cape Town where the sea was going to come in. So it obviously attracts attention. The city, then, politically put together an energy and climate change committee... but one has to just be careful as to where the focus is. Are we focusing very long term [e.g. by concentrating on sea level rise] and not worrying about now? Or are we achieving a better balance? (Wood 2010)

6.5 Chapter Summary

To recap, the Cape Town and Durban stormwater management departments told largely similar stories about their attempts to mainstream adaptation considerations into their activities, as well as the limitations they face to making further progress. By any measure of adaptation mainstreaming, both departments are well advanced. They both see climate risks as highly relevant to their core goals and functions, and are both taking proactive actions to better understand and address those risks. Both have benefited from support from city-wide adaptation planning initiatives, but have also gone beyond merely accommodating requests from other departments. They have more deeply internalized the value of cross-departmental and external collaboration, in light of their own limitations to address such a complex and interdisciplinary issue as climate change. Yet despite this promising progress on mainstreaming, both departments also highlighted inherent challenges along the way. Firstly, deciding how to actually address risks even once acknowledged and identified is not automatic, in light of political realities and institutional cultures. Secondly, even when adaptation is not seen to conflict with core departmental objectives in a fundamental way, its problem framing at the city wide level may still exacerbate internal tensions between short and long term objectives, creating perceived tradeoffs for departments in prioritizing it as an explicit agenda.

CHAPTER 7: SUMMARY FINDINGS AND CONCLUSIONS

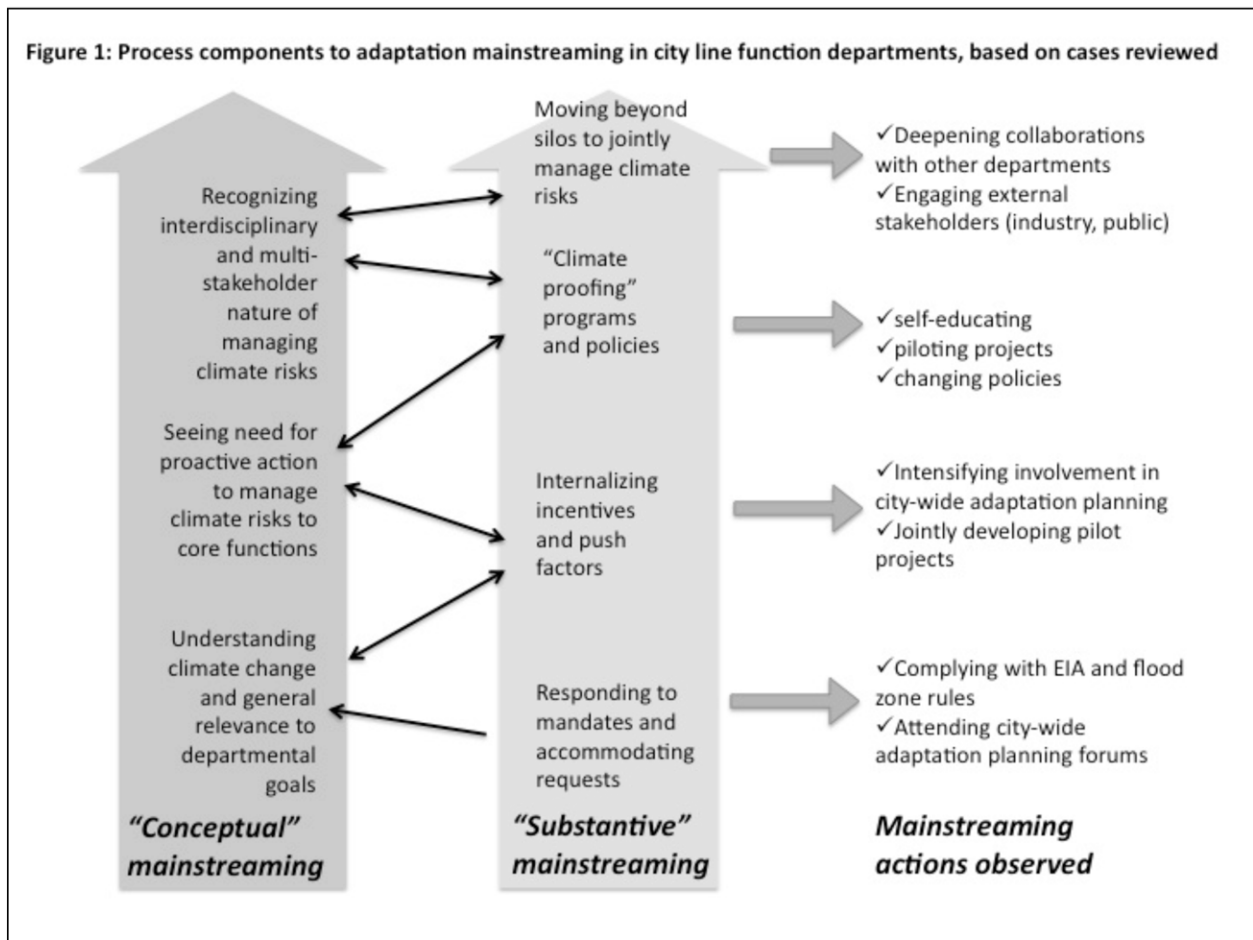
I set out in this thesis to answer three questions about mainstreaming adaptation into city line-function departments: the mainstreaming process that departments follow, the key factors driving or inhibiting progress on mainstreaming, and its implications. Based on the experiences of the departments analyzed, I argue that progress on adaptation mainstreaming is manifested through substantive activities or actions related to: (i) accommodating requests and responding to mandates; (ii) internalizing incentives and push factors; (iii) “climate proofing” internal programs and policies; and (iv) moving beyond silos to emphasize joint management of climate risks with other departments and stakeholders. However, incremental progress through these categories of actions depends also on a less tangible process to conceptually embed adaptation. This parallel conceptual process starts with understanding the existence and relevance of climate change, moves to linking this understanding with core responsibilities, and finally to recognizing departmental limitations in addressing complex climate risks. The substantive and conceptual mainstreaming processes are both positively influenced by several key enabling factors. Even as adaptation becomes institutionally embedded, however, substantive action can still be further curtailed by additional limitations and challenges that departments face.

All of this implies that departmental progress on both conceptual and substantive aspects of adaptation mainstreaming is a complex, context specific and potentially slow endeavor. Substantive in-house actions to “climate proof” departmental activities – the benchmark most commonly highlighted in the existing adaptation mainstreaming literature – are only one piece of a much larger institutional change puzzle. For donors and others looking to support city governments in adaptation mainstreaming efforts, these findings underscore the need for external support to generate “push factors” and to remove roadblocks to both institutional embedding and tangible action. These points are explored in more depth below.

7.1 Findings on the process of city departmental adaptation mainstreaming

While significant differences clearly exist between how the housing and stormwater sectors have approached climate adaptation, their very different experiences and views nonetheless convey several common themes. The cases analyzed show a far more complex picture of the *process* of adaptation mainstreaming for service departments in city government who are not already

“process leaders” at a city-wide level on adaptation (e.g., departments who have potentially competing dominant functions and objectives) than is conveyed by the existing adaptation literature. Below, I lay out a series of *substantive* (externally visible) and *conceptual* (behind the scenes) process components or stages of adaptation mainstreaming. These parallel processes are closely interrelated; however, as explained further below, a department’s progress in both realms is heavily influenced by both enabling and limiting factors. The process is summarized schematically in **Figure 1 below**.



Adaptation mainstreaming: substantive process components

The following mainstreaming steps constitute what is visible to the external observer. They encompass the actual actions taken by a department as adaptation becomes more deeply embedded conceptually:

1. *Responding to mandates and accommodating requests:* Evidenced by the fact that all four departments analyzed in this study demonstrate actions at least at this level, this is arguably the first substantive step in adaptation mainstreaming. Actions in this category described by the departments include complying with regulations that support adaptation; participating in city-wide adaptation oriented committees and planning forums; and accommodating requests for inputs into studies and initiatives being carried out under the purview of the city-wide adaptation planning process.

2. *Internalizing incentives and push factors:* There is a gray area between this stage of adaptation mainstreaming and the last, as departments here are still responding to external push factors. This stage, however, implies a deeper involvement or commitment by the department. Whereas a department may go through the motions of the activities listed under (1) above without necessarily seeing strong linkages between climate change and departmental core functions, at this stage a department must have made that linkage. A department here is thus effectively using push factors to test approaches or develop new relationships that may in turn lead to more deeply embedded and cross-cutting in-house activities or approaches. Because of this prerequisite, I argue that neither housing department has fully made it to this “substantive” stage of adaptation mainstreaming. Substantive activities in this bucket include participating more intensively in collaborative adaptation planning initiatives and developing joint pilot projects with other departments (still at the other department’s initiative, but with more sustained and intensive involvement).

3. *Climate proofing departmental programs and policies:* This phase encompasses proactive in-house activities by a department specifically to address climate change, beyond simply following the lead of a city-wide or third party adaptation planning initiative. Linking back to the conceptual threads of adaptation mainstreaming outlined in Chapter 2, activities achieved at this stage might be likened to the expected outcomes of donor-driven methodological approaches to “climate proofing.” A department at this stage has taken more complete ownership to embed adaptation within its core activities. Again observed only with the stormwater departments, specific actions could include commissioning studies or conducting in-house pilots to better understand climate risks and possible responses, and in turn modifying departmental policies and approaches based on study findings.

4. *Moving beyond silos to jointly manage climate risks:* Given the complex interdisciplinarity of climate change risk management, the importance of interdepartmental and multi-stakeholder collaboration around adaptation has been widely recognized (Koch et al. 2005; Tompkins p. 147). From a departmental perspective, the mainstreaming process appears to culminate in the realization that their work and efforts need to engage others across the city to ensure climate change risks do not undermine a department's core development and service objectives. Looking at the experiences of the two stormwater departments, the result is more proactive engagement with other departments and external stakeholders (notably industry), to minimize constraining factors on the department's own effectiveness in climate proofing its domain. While in earlier stages of mainstreaming these exact same limitations or constraints may be seen as impediments to adaptation action (as in the case of the housing departments), in this final stage they are instead a motivation for action to leverage scarce resources, address cross-cutting issues and indirect effects of adaptation activities, and spread awareness and knowledge about jointly managing climate change risks.

Adaptation mainstreaming: conceptual process components

The above substantive stages of adaptation are presented sequentially, but are only part of the story of mainstreaming. The experiences of the housing and stormwater departments suggest that a parallel process must also take place to embed the idea of adaptation as an issue of relevance and importance to a department. I term this parallel process the *conceptual* mainstreaming process. Progress in conceptual mainstreaming enables, and manifests itself through, substantive mainstreaming progress. Substantive mainstreaming actions, in turn, may serve as "pull factors" to advance a department's conceptual thinking about adaptation.

1. *Understanding general relevance of climate change to departmental goals and activities:* This is the conceptual mainstreaming step that underlies any substantive mainstreaming beyond its initial phase (e.g., beyond responding to mandates and accommodating requests). If departmental decision makers do not fundamentally believe climate change is a real threat and do not understand its basic relevance to departmental activities, they will see little incentive to consider how they might facilitate adaptation. Evidence from the housing sector suggests that, at this initial stage of thinking about the implications of climate change, departmental staff will start by identifying how existing activities inherently enhance climate resilience, even before

thinking about whether and how to modify activities in light of climate risks. Yet both housing departments analyzed also continued to raise some doubts about climate change's effects and basic relevance, suggesting that achievement of this conceptual mainstreaming stage is still in progress.

2. *Seeing need for proactive action to manage climate risks to core goals:* As departments more significantly internalize incentives and external push factors for action, they conceptually embed the idea that climate change is not only underway, but that it may undermine departmental success in achieving core goals without some departmental modifications to their own processes and activities. Once at this step, departments take increasing ownership and may begin to self-educate about climate risks, initiate in-house activities to advance adaptation objectives, and “climate proof” their own policies and procedures.
3. *Recognizing interdisciplinary nature of managing climate risks:* This is the conceptual step that accompanies progress on the “substantive” mainstreaming ladder leading a department to look beyond silos and initiate or deepen external engagements with other departments or stakeholders. Getting to this stage signifies a particularly advanced level of adaptation mainstreaming, because it entails a transformation in how a department evaluates its own success in achieving core goals and, in turn, the boundaries of its own responsibilities and influence. At this stage, departments must have sufficiently embedded concepts of climate vulnerability to view their responsibility and capabilities with respect to adaptation as extending beyond their direct decision-making and service delivery purview. The conceptual shift here is in turning a limitation to direct departmental influence into a rationale for collaborative action.

7.2 Findings on the key drivers and limitations in adaptation mainstreaming

The conceptual process of adaptation mainstreaming outlined above may help explain a department's substantive mainstreaming actions, but it is still not clear what contextual or intrinsic factors drive or limit a department's ability to make progress along the conceptual scale. The discussion below highlights findings on factors that may explain the stark differences between the housing and stormwater departments' conceptual and substantive progress on mainstreaming climate change adaptation.

Drivers and enablers of mainstreaming

The stormwater departments notably benefited from several enabling factors to adaptation mainstreaming that housing departments lacked:

1. *Climate impact directly threatens core mission:* Stormwater management is fundamentally about managing weather; thus, the impacts of climate change are more central to these departments' mandate in the immediate sense. Meanwhile, although climate change is obviously relevant to achieving sustainable human settlements, it is harder for housing departments to link short-term agendas – to build as many homes as possible – with the longer-term goals of ensuring the sustainability of those homes and the protection of their occupants from climate change vulnerability.
2. *Previous responsibility or experience managing environmental risks:* For both Durban and Cape Town stormwater departments, the adaptation agenda has been a natural outgrowth of their ongoing trends towards using strategies that emphasize ecological systems and restrictions on development to address drainage issues at a city scale. While the housing departments have also benefited from recent policy shifts that acknowledge the need to consider site-specific context and incremental approaches to addressing the housing backlog, they did not relate any prior experiences that caused them to see environmental or general weather-related risks as central to the sustainability or effectiveness of their strategies.
3. *Longevity of departmental responsibility over infrastructure and services:* Whether a department will continue to be responsible for the infrastructure it builds or the services it provides in the long term appears also to factor into the extent to which a department sees climate change as directly relevant to them. The stormwater departments have strong incentives to be concerned about future changes to weather patterns, as they are responsible for stormwater system maintenance in an ongoing fashion. In contrast, in light of the current national housing policy emphasis on homeownership, the housing departments' direct role and influence ends in most cases immediately following the completion of home construction and transfer of title. In other words, even though they *could* do more to influence home designs, they are neither responsible nor legally allowed to intervene in actually maintaining or improving private homes once titles

are transferred, so their default time horizon is much shorter in terms of their planning activities.

4. *Ability to leverage additional funding and resources:* With respect to explicit efforts to conduct modeling and plan for climate change, both stormwater departments have been able to successfully access more supplemental financial and human resources than the housing departments. Beyond tapping resources associated with the city-wide adaptation initiatives, both departments have also been able to capitalize on recent storm events to leverage additional city-wide funds for improved flood management. As Tooley from the Durban stormwater department commented, “when ... we need funds for certain projects that we know are essential [to manage flood risks], then the storms make it a lot easier for us to get the funding” (Tooley 2010). Furthermore, even while all four departments noted limited financial and skilled human resources as a significant hurdle to adopting further action on a “new” agenda, the stormwater departments have been more effective at leveraging online communities and sharing work with other departments as ways to “work smarter... to stretch the resources we do have” (Tooley 2010). The housing departments, meanwhile, emphasized being faced with a situation of extreme inflexibility in their subsidy-based primary funding source, and have been unable to leverage outside networks or actors as effectively or in a sustained manner to enable innovation on the basic subsidy housing product.

5. *Degree of autonomy to make decisions:* In South Africa, urban stormwater management is more inherently decentralized as a sector than housing. Even in spite of the 2004 housing policy reforms to increase the local context-specificity of strategies to address housing backlogs, housing departments are still significantly beholden to national and provincial agendas because of their funding streams, as well as mayoral/political agendas within their cities. Stormwater management is more obviously site-specific, and thus enjoys more inherent decentralization of regulatory and decision-making authority.

6. *Degree of regulatory/planning focus:* As outlined earlier, both stormwater and housing departments have some regulatory and planning functions, in addition to direct service delivery functions. However, the stormwater departments play a larger role in this arena than the housing departments, and their policy role affects a greater geographic and economic swath of the city. As related by both types of departments, adaptation seems to be more easily

mainstreamed into planning and regulation-setting activities than into service provision activities. The stormwater departments' greater regulatory focus gives them an advantage on adaptation mainstreaming over the housing departments.

Factors limiting mainstreaming

A department's ability to mainstream adaptation depends not only on the presence of the enabling factors outlined above. Three additional factors, outlined below, were raised by some or all of the departments as key limitations or challenges to their mainstreaming progress. While I argue that these factors do not explain the differences between stormwater and housing departments' progress, they are nonetheless relevant considerations for any department.

1. *Social acceptance of adaptive actions:* Both housing departments mentioned behavioral or social factors among subsidy housing recipients as limiting or complicating their ability to successfully implement new green or climate resilience-enhancing technologies. Such factors encompassed both suspicions about the inferiority of design aspects that deviate from the standard "brick and mortar" housing product, as well as jealousies within a community about which households can receive limited pilot technologies such as solar water heaters. While neither stormwater department touched on this issue directly, similar challenges would likely also apply to attempts to pilot new approaches to low impact design, such as green roofs or other site-scale interventions. This challenge underscores the need to engage and educate the public about the rationale for, and value to, new approaches.
2. *Political nature of managing uncertainty in climate science:* A challenge to adequately considering and managing environmental risks more broadly is that the future climate cannot be predicted with certainty. This was seen as a reason for skepticism and slow action by the housing departments, and even the stormwater departments highlighted climate uncertainty as a hurdle in their ability to know what substantive decisions to actually make to promote adaptation. Furthermore, even if the future probabilities of storm events, droughts, or other climate impacts could be known with precision, deciding what level of risk is acceptable to society is ultimately a political as well as a technical judgment call. Setting regulations such as flood zone development guidelines depend on the level of risk deemed acceptable by the city at large, beyond a single department's purview.

3. *Entrenched organizational culture and structure*: Representatives of both stormwater departments highlighted the inherent difficulties in changing entrenched engineering cultures and mentalities that, in their case, favor traditional rather than ecological approaches to stormwater management. In Durban, Tooley also mentioned how post-apartheid political reforms flattened management structures, making long-term planning more difficult to prioritize vis-a-vis short term core service objectives. The housing departments did not specifically mention these challenges, but in all likelihood would agree that they face similar structural and cultural constraints to making actual changes to their operations and activities in light of climate change. These difficulties are further discussed in the next section.

7.3 Implications of departmental adaptation mainstreaming

Tracing the parallel processes of substantive and conceptual mainstreaming, and the various drivers of and limitations to departmental progress along either scale, the big picture take-away is that mainstreaming is complex, context specific, slow, and challenging even when enabling conditions are favorable. Entrenched institutional cultures and existing staff skills, limited budgets, and political and legal mandates all limit what a department is able to do to innovate, experiment, and re-prioritize in light of new challenges, especially when the said challenges are perceived to still be far off in the future.

However, these findings also imply that the process can be viewed as a series of incremental steps that, over time, can build towards more profound change. With respect to that incrementalism, a few department-level themes are outlined below.

Firstly, responding to mandates and other push factors – and articulating this as adaptation-related – is itself a meaningful initial step in the conceptual process of adaptation mainstreaming. Regulations and mandates not only get institutions to immediately change their behaviors in favorable ways for adaptation objectives, but as they become more entrenched and better understood, they push departments to think differently about their actions. Even while both housing departments appeared to see proactive integration of adaptation considerations into their activities as beyond their capability and purview, they both also actively identified their fulfillment of regulatory

requirements – such as environmental assessments, flood zoning rules, and energy efficiency mandates – as serving adaptation purposes. Meanwhile, both housing departments are at minimum aware of and present in city-wide adaptation planning activities that explicitly reach out to them. By responding obligingly to these push factors and recognizing the linkages between compliance and climate risk management, the departments are at least engaging peripherally with climate adaptation concepts, and are in fact adjusting their actions to factor in some risks (even if not voluntarily). These relationships and actions may in turn help to lay the groundwork for more significant proactive action in the future, once the validity of climate change is recognized and initial concepts of adaptation take further root within the departments.

Secondly, identifying what is already underway through the normal course of operations as resilience enhancing is an important building block of adaptation mainstreaming. Simply re-branding current activities as adaptation without any deeper analysis as to their actual impact on reducing climate risks may not initially seem productive in advancing overall adaptation objectives, as status-quo activities might in fact be overlooking and/or aggravating key dimensions of climate risk. However, making adaptation seem achievable is a critical first step to get buy-in from staff within a department. This notion is in line with observations from other institutional change processes that embedding new ideas or concepts within familiar concepts enhances their uptake and legitimization (Dacin et al. 2002 p. 47). From this foundation, departments may have more traction to leverage push factors for advancing new activities, seek out new knowledge, and eventually change core practices.

Thirdly, the ultimate substantive output of adaptation mainstreaming – moving beyond institutional silos to deepen collaborations and external engagements – may eventually help to galvanize other departments to act. While beyond the scope of this study to evaluate the effectiveness of the stormwater departments' efforts to engage other departments or stakeholders, it seems plausible that their actions may contribute to catalyzing adaptation mainstreaming in other departments. That is, by recognizing that effective climate change adaptation will require more than inward-oriented “climate proofing” of departmental policies and activities, they might themselves become “push factors” for other departments and stakeholder groups. Durban’s Roberts provided an inspiring metaphor for how this domino effect of change within individual departments may, in turn, build into larger-scale change at a city-wide level: “it’s like a pebble in a pond... and the ripples will start and people will change... so what you need is a large number of pebbles going into the

pond so eventually it gets so many ripples that the whole pond is just rippling, and the whole thing changes” (Roberts 2010).

Of course, the success of this sort of ripple effect depends fundamentally on the receptivity of the recipient department or stakeholder. In light of the difficulty of institutional change, a department’s influence over other departments is likely to be limited outside of the regulatory sphere. In the case of the stormwater departments, for example, their external sway will undoubtedly be strongest with stakeholders who must comply with their flood management policies (e.g., developers). However, as shown through this analysis, non-mandatory push factors can also be important in changing institutional behaviors and deepening a department’s conceptual mainstreaming of adaptation. A department’s proactivity in reaching out to other departments, even beyond compliance regimes, might then also contribute to the slow process of institutional change in other departments. This, in effect, is what the environmental management departments have demonstrated in both cities through their initiative in jumpstarting city-wide adaptation planning.

7.4 Broader lessons in supporting departmental adaptation mainstreaming

Beyond providing insights into the implications of mainstreaming for departments, I conclude with two larger take-aways for donors, higher levels of government, and others in positions to be supporting municipalities as they begin to plan for climate change impacts.

Firstly, external push factors are demonstrably important in getting departments to mainstream adaptation. This study looked exclusively at cities with central adaptation planning processes underway, and thus cannot prove the degree to which these processes served as push factors to departments. Nonetheless, at least for the stormwater departments (and particularly in Durban), the city-wide adaptation initiatives have provided at least some degree of leadership and support, elevating the visibility of climate change as an issue, and drawing in additional funds to support studies, pilot activities and planning processes. Donors or others looking to support urban adaptation mainstreaming would thus be wise to strengthen central offices that can recognize, provide incentives for, and cultivate progress in conceptually and substantively mainstreaming adaptation at the departmental level.

Along this line, the study's findings suggest four priority actions for city-wide "adaptation champions" (and their funders/supporters) looking to help advance departmental adaptation mainstreaming:

1. *Educate*: In light of the difficulty of institutional change, making the task look do-able may help motivate a department to take initial steps towards advancing adaptation objectives. City-wide adaptation offices can help with this by educating departments on what adaptation might consist of in practice in their sector. Such efforts can clarify confusions and misconceptions from departments not otherwise familiar with concepts of climate risk, providing a platform for departments to achieve the first level of *conceptual* mainstreaming which, as explained above, is essential for further progress in *substantive* mainstreaming. The city-wide adaptation process leaders in both Cape Town and Durban are pursuing such actions: in Cape Town through sector-by-sector discussions about climate risks and possible adaptations as part of the CAPA drafting process, and in Durban through the MAP process with water, stormwater, health and disaster risk management departments. While efforts in Cape Town are premature for judgment, Durban's MAP process was explicitly cited by the stormwater department there as instrumental in catalyzing a new level of understanding and integrating thinking about climate change risks.
2. *Elevate*: Endorsement of sectoral action on climate adaptation by a relevant municipal (or higher level) decision-making body, or other action to signal high-level commitment to adaptation, is likely to be helpful in getting otherwise-skeptical departments to begin to see their core activities and compliance actions through a climate lens, the first step towards further progress on adaptation mainstreaming. In Durban, the Headline Adaptation Strategy counts with City Council approval, and adaptation is mentioned as a strategic objective in the city's five-year Integrated Development Plan. This high-level support has helped the EMD raise the profile of adaptation across the city, as well as leverage external resources for adaptation planning activities that have benefited the stormwater department among others. In Cape Town, while the formal city-wide adaptation plan was still under development at the time of writing, the ERM's Sea Level Rise Risk Assessment has served to politically elevate the adaptation agenda, at least in the coastal ambit. This in turn likely aided the ERM in re-

initiating city adaptation planning through the CAPA as well as leveraging funds to launch the Climate Change Think Tank, both of which aim to support departmental mainstreaming efforts.

3. *Use “sticks”*: Turning adaptation into a compliance mandate to the extent possible can motivate departments otherwise not inclined to think about climate change due to more pressing immediate challenges. In South Africa, cities are not statutorily required to consider climate change in their development decisions; however, some countries, provinces and states around the world are beginning to institute such requirements. Even without a higher-level directive, mayors or city governments could create such municipal mandates. While not the case in either city studied, research from Quito, Ecuador suggests that department-level movement to incorporate climate considerations happened much faster because of a mayoral mandate to look at the climate implications of municipal decisions (Carmin et al. 2009).
4. *Provide “carrots”*: Financial incentives are meanwhile strong pull factors to get departments to internalize climate risk management. All departments analyzed mentioned resource constraints as a serious limiting factor in their ability to commission studies or pilot new approaches in support of adaptation goals. City-wide adaptation champions, in turn, played a key role in bringing in funding for nearly all adaptation-oriented activities mentioned by all the departments studied. Beyond securing grants or other “additional” funds, city-wide adaptation process leaders could also work with finance and budgeting departments to re-align financial incentives for departments to innovate in their approaches to service delivery in ways that could also help advance adaptation objectives. The fact that cost savings through energy efficiency measures in new subsidy homes would not accrue back to housing departments, for example, was an issue raised in both cities as a dis-incentive to institute such measures, particularly in light of push-back from constituents in changes to the basic “bricks and mortar” home design.

Despite the potential benefits of the above actions in advancing mainstreaming action at the departmental level, donors and central climate offices within cities must nevertheless be aware of how the problem framing and focus of the adaptation agenda within a city affects the degree to which departments perceive its urgency, relevance, and alignment with their core functions. As explained above, because institutional change is so threatening and difficult, departments are unlikely to latch onto a new agenda like adaptation unless it is framed in a way that they come to

see it as intimately relevant to their core functions. Such is the result of a predominantly “environmental” framing of adaptation, with respect to both cities’ housing departments. The environmental and climate-mitigation oriented framing has likely resulted because of city-wide adaptation leadership from the environmental departments, emerging from earlier inroads into climate mitigation and energy planning. Nationally and internationally, funding for climate-related activities thus far has also been mainly for climate mitigation efforts. Yet this framing has led adaptation to be viewed by both housing departments as an “elite” issue that detracts from their pro-poor core agendas. In the case of Cape Town’s Stormwater and Catchment Management Department, meanwhile, the predominantly coastal focus of the city-wide process so far (in light of its origination out of the ERM’s coastal management unit) has translated into elevated attention at the departmental level to climate change issues in the coastal context (e.g., sea level rise), at the possible expense of internal attention to immediate flood management challenges in low-lying informal settlements. Wood perceived that adaptation as an agenda may be misguiding time and resources away from addressing what he considers to be the more pressing and immediate vulnerability challenges of curbing flooding in inland informal settlements. He saw this occurring because of the greater political visibility of coastal issues, in light of the economic importance of tourism and the high real estate value of coastal property.

For funders looking to support urban adaptation, there is no easy answer to resolving this issue-framing problem. Adaptation’s close association with environmental management more broadly is not necessarily always bad, either. Notwithstanding the limitations of the mostly coastal focus in Cape Town discussed above, the environmental framing of adaptation has likely *facilitated* its mainstreaming by the two stormwater departments overall, because of the two departments’ already-evolving understanding of the linkages between their core mandates and ecological systems more broadly. Thus, the core message for funders is to consider carefully that funding for departmental mainstreaming is not immune from politics, even if it aims to be directed at largely internal technical processes and studies. This is likely to become even more true as funding streams for adaptation increase.

7.5 Limitations to findings

The findings of this study are limited by two main methodological constraints. Foremost is the case selection: the two cities studied were specifically selected because they are both following very

similar adaptation planning processes at a city-wide level. However, in the broader scheme of global cities undertaking adaptation planning, their approach is not universal, possibly limiting the applicability of the findings. Second is the limited number of individuals interviewed from each department featured.

On the similarity of adaptation planning settings, both Cape Town and Durban are thus far pursuing processes that begin introspectively within city government, emphasizing embedding the idea of adaptation within city line functions *before* engaging external stakeholders heavily on the agenda. This is perhaps only possible because neither city is (yet) experiencing significant push factors from external stakeholder groups – such as international organizations, donors, industry associations, or civil society groups – on adaptation specifically. This could change as climate change impacts become more visible and affect a broader cross section of the local population, or as the global situation of adaptation finance evolves, creating more vocal constituent groups. As it is, adaptation as its own agenda is still relatively low profile in both cities, even despite the city-wide initiatives. Both processes are also similarly led by the municipal environmental management departments. In other cities, adaptation planning may be spearheaded out of a different department, or might be more heavily driven and influenced by the mayor or elected decision making body, with implications for the problem framing and planning process across the city. More research is thus needed to test the extent to which my findings on adaptation mainstreaming would hold true in different adaptation planning contexts.

On the depth of perspectives captured within each department, the study is limited by the small total number of interviewees. For both Durban departments (stormwater and housing), only one individual was interviewed. The research thus did not control for the possibility of personal biases by these individuals, as well as limitations to their own knowledge of everything going on within their departments. Interviews with both Cape Town departments encompassed multiple officials; however, as the interviews were conducted in group settings, the opinions expressed by each official may have been self-censored to some extent. Findings were cross-checked with written documents and with the two lead planning figures (from the environmental management departments) to the extent possible to mitigate against these limitations. However, to further validate and nuance my findings, future research should ideally be based on individual interviews with a broader cross-section of staff at various levels of authority, and in various sub-units, within municipal departments struggling to mainstream adaptation.

In spite of the limitations of this research, its findings contribute to the understanding of sub-municipal adaptation mainstreaming as both a substantive and conceptual process that is shaped by the complex, messy realities of urban development and governance. The experiences of the housing and stormwater departments in Cape Town and Durban speak to the difficulty of institutional change in resource-constrained, legally and institutionally bound service departments. However, the stormwater departments' experiences in particular offer hope that adaptation can successfully move from being the exclusive agenda of a central unit, and be taken up in a meaningful way by traditional line functions. After all, climate adaptation is ultimately about development and vulnerability reduction – the underlying mandates of most service-oriented city departments.

WORKS CITED

- Adger, W.Neil, Saleemul Huq, Katrina Brown, Declan Conway, and Mike Hulme. 2003. "Adaptation to climate change in the developing world." *Progress in Development Studies* 3(3):179-195.
- Adlard, G. 2008. "Are informal settlements a housing solution? Is anyone responsible or accountable for informal settlements? What is the future of informal settlements in Cape Town? And other leading questions." Paper prepared for *Annual Conference of the South African Housing Foundation, October 2008*, Cape Town.
- Agrawal, Arun. 2008. "The Role of Local Institutions in Adaptation to Climate Change." Paper prepared for *Conference on the Social Dimensions of Climate Change, 5-6 March 2008*, Social Development Department, The World Bank, Washington, DC.
- Agrawala, S. and M. van Aalst. 2005. "Bridging the gap between climate change and development." *Bridge over Troubled Waters: Linking Climate Change and Development*, edited by S. Agrawala. Organisation for Economic Cooperation and Development, Paris, France.
- Ahmat, Imran Habib. 2009. "Climate Policy Integration: Towards operationalization." UN Department of Economic and Social Affairs, New York.
- Alber, Gotelind and Kristine Kern. 2008. "Governing Climate Change in Cities: Modes of Urban Climate Governance in Multi-level Systems." Paper prepared for *OECD Conference on Competitive Cities and Climate Change, 2008*,
- Anonymous. 2008. "South Africa Facing Urban Water Management Challenge." *Civil Engineering: Magazine of the South African Institution of Civil Engineers* 16(6):65.
- Ayers, J. and S. Huq. 2008. "Adaptation Funding and Development Assistance: Some FAQs." *IIED Briefing*. IIED, London.
- Bouchard, B., A. Goncalo, M. Susienka, and K. Wilson. 2007. "Improving Flood Risk Management in Informal Settlements of Cape Town." Worcester Polytechnic Institute, Worcester, MA.
- Byerly, Mark. 2010. Interview with Research and Policy Manager, eThekweni Housing Department, Durban, South Africa, 21 January.
- Carmin, JoAnn, Debra Roberts, and Isabelle Anguelovski. 2009. "Planning Climate Resilient Cities: Early Lessons from Early Adapters." Paper prepared for *World Bank 5th Urban Research Symposium on Cities and Climate Change*, Marseilles, France.
- Cartwright, Anton, G. Brundrit, and Lucinda Fairhurst. 2008. "Phase four final report: Sea-Level Rise Adaptation and Risk Mitigation Measures for the City of Cape Town." Produced by LacquaR Consultants CC for Cape Town Environmental Resources Management Department, Cape Town.
- City of Cape Town. 2006a. "Draft Water Services Development Plan 2006/07."
- . 2007. "Five Year Plan for Cape Town: Integrated Development Plan (IDP) 2007/8 - 2011/12." Cape Town, South Africa.
- . 2009a. "Winter Preparedness Strategy and Flooding and Storms Plan." adopted by Executive Mayor on 24 March 2009, Cape Town, South Africa.
- . 2009b. Floodplain and River Corridor Management Policy. Rule number C 58/05/09, issued by Cape Town Roads and Stormwater Department. Cape Town, South Africa.
- . 2009c. Management of Urban Stormwater Impacts Policy. Rule number C 58/05/09, issued by Cape Town Roads and Stormwater Department. Cape Town, South Africa.
- . 2010. "Solar Water Heater Advancement Programme", Retrieved May 2010, (<http://www.capetown.gov.za/en/EnvironmentalResourceManagement/projects/ClimateChange/Pages/SolarWaterHeaterAdvancementProgramme.aspx>).
- City of Cape Town Housing Directorate. 2010. Interview with multiple officials from City of Cape Town Housing Directorate, Cape Town, South Africa, 12 January.

- Constable, Lisa and Anton Cartwright. 2009. "eThekweni Municipality Municipal Adaptation Plan: Health and Water." Environmental Resources Management Consultants, Cape Town, South Africa.
- Corfee-Morlot, Jan, Lamia Kamal-Chaoui, Michael G. Donovan, Ian Cochran, Alexis Robert, and Pierre-Jonathan Teasdale. 2009. "Cities, Climate Change and Multilevel Governance." *OECD Environmental Working Paper N° 14*.
- Dacin, M. Tina, Jerry Goodstein, and W. Richard Scott. 2002. "Institutional Theory and Institutional Change: Introduction to the Special Research Forum." *Academy of Management Journal* 45(1):45-57.
- de Swardt, C., T. Puoane, M. Chopra, and A. du Toit. 2005. "Urban poverty in Cape Town." *Environment and Urbanisation* 17(2).
- Department of Environmental Affairs and Tourism. 2004. "A National Climate Change Response Strategy for South Africa." Pretoria, South Africa.
- Department of Local Government and Housing. undated. "The Road Map to Dignified Communities: Western Cape Sustainable Human Settlement Strategy."
- Department of Water Affairs and Forestry. 1994. "Water – An Indivisible National Asset." *Water Supply and Sanitation Policy – White Paper*, Cape Town, South Africa.
- du Plessis, Chrisna, Daniel Irurah, and R.J. Scholes. 2003. "The built environment and climate change in South Africa." *Building Research and Information* 31(3):240-256.
- du Plessis, Henry. 2010. Interview with Acting Director of City of Cape Town Transport, Roads and Stormwater Directorate, City of Cape Town, 14 January.
- Ellis, JB. 2008 "Third generation urban surface water drainage: From rooftop to the receiving water sub-catchment." in *11th International Conference on Urban Drainage, August 31-September 5, 2008*. Edinburgh, UK.
- eThekweni Municipality. 2001. "eThekweni Municipality Long Term Development Framework: An overview of the key developmental challenges, unicity vision, outcomes and city strategy." November 2001, Durban, South Africa.
- . 2002. "eThekweni Municipal Area Development Profile: Changing Durban for good Urban Strategy Department." eThekweni Municipality, Durban, South Africa.
- Funkhouser, Laura. 2007. "Stormwater Management as Adaptation to Climate Change." *Stormwater* (July-August 2007).
- Grace, Adeniji and Ogundiji Bukola. 2009. "Climate Adaptation in Nigerian Cities: Regularizing Informal and Illegal Settlements in Ibadan." Paper prepared for *World Bank Fifth Urban Research Symposium*, Marseille, France.
- Hertin, Julia, Frans Berkhout, David Gann, and James Barlow. 2003. "Climate change and the UK house building sector: perceptions, impacts and adaptive capacity." *Building Research & Information* 31(3):278-290.
- Hester, Randolph T. 2006. *Design for Ecological Democracy*. Cambridge, MA: MIT Press.
- Huq, Saleemul, Atiq Rahman, Mama Konate, Youba Sokona, and Hannah Reid. 2003. "Mainstreaming Adaptation to Climate Change in Least Developed Countries (LDCs)." edited by International Institute for Environment and Development, London.
- IIED. 2008. "Adaptation funding and development assistance: some FAQs." edited by International Institute for Environment and Development, London.
- IPCC. 2001. "Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution to Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change ", edited by J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken, and K. S. White. Cambridge University Press, Cambridge, UK.
- . 2007a. "Synthesis Report: Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change." *IPCC Fourth Assessment Report: Climate Change 2007*, edited by R. K. Pachauri and A. Reisinger. IPCC, Geneva, Switzerland.

- . 2007b. "Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change." edited by M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson. Cambridge University Press, Cambridge, UK.
- Katich, Kristina Noel. 2009. "Urban Climate Resilience: A Global Assessment of City Adaptation Plans." Department of Urban Studies and Planning, Massachusetts Institute of Technology, Cambridge, MA.
- Klein, Richard J.T., Siri E. H. Eriksen, Lars Otto Næss, Anne Hammill, Thomas M. Tanner, Carmenza Robledo, and Karen L. O'Brien. 2007. "Portfolio screening to support the mainstreaming of adaptation to climate change into development assistance." *Climatic Change* 84(1):23-44.
- Knoesen, D., R. Schulze, C. Pringle, M. Summerton, C. Dickens, and R. Kunz. 2009. "Water for the Future: Impacts of climate change on water resources in the Orange-Senqu River Basin. Report to NeWater, a project funded under the Sixth Research Framework of the European Union." edited by Institute of Natural Resources, Pietermaritzburg, South Africa.
- Koch, Ingrid Christine, Coleen Vogel, and Zarina Patel. 2005. "Institutional dynamics and climate change adaptation in South Africa." *Mitigation and Adaptation Strategies for Global Change* 12(8):1323-1339.
- Lafferty, William M. and Eivind Hovden. 2003. "Environmental policy integration: towards an analytical framework." *Environmental Politics* 12(3).
- Leibbrandt, Murray, Ingrid Woolard, Arden Finn, and Jonathan Argent. 2010. "Trends in South African Income Distribution and Poverty Since the Fall of Apartheid." *OECD Social, Employment and Migration Working Papers No. 101*. Southern Africa Labour and Development Research Unit, School of Economics, University of Cape Town, Cape Town.
- Levina, Ellina and Dennis Tirpak. 2006. "Adaptation to Climate Change: Key Terms." edited by Organization for Economic Cooperation and Development (OECD) and International Energy Agency (IEA) Secretariats for UNFCCC Annex I Expert Group.
- London Climate Change Partnership. 2005. "Adapting to climate change: a checklist for development. Guidance on designing developments in a changing climate." Greater London Authority, London.
- Mabin, Alan. 2002. "Local Government in the Emerging National Planning Context." in *Democratising Local Government: The South African Experiment*, edited by S. Parnell, E. Pieterse, M. Swilling, and D. Wooldridge. Cape Town: University of Cape Town Press.
- Makhathini, M, C Pather, and F Seedat. 2002. "The eThekweni municipality's informal settlement programme: An informal settlement free Durban in 15 years - Dream or reality?" Paper prepared for *Western Cape Provincial Housing Conference, 24-27 March 2002*, Cape Town, South Africa.
- Marsalek, Jiri and Hans Schreir. 2009. "Overview of the Theme Issue: Innovation in Stormwater Management in Canada: The Way Forward." *Water Quality Research Journal of Canada* 44(1):(online).
- McDonald, David A. 1998. "Three Steps Forward, Two Steps Back: Ideology and Urban Ecology in South Africa." *Review of African Political Economy* 25(75):73-88.
- McEvoy, Darryn, Kate Lonsdale, and Piotr Matczak. 2008. "Adaptation and Mainstreaming of EU Climate Change Policy: An Actor-Based Perspective." *Center for European Policy Studies Policy Brief No. 149*.
- Midgely, GF, RA Chapman, B Hewitson, P Johnston, M De Wit, G Ziervogel, P Mukheibir, L Van Niekerk, M Tadross, BW Van Wilgen, B Kgope, P Morant, A Theron, RJ Scholes, and GG Forsyth. 2005. "A Status Quo, Vulnerability and Adaptation Assessment of the Physical and Socio-Economic Effects of Climate Change in the Western Cape." *Report to the Western Cape Government, Cape Town, South Africa*. CSIR, Stellenbosch, South Africa.

- Miles, M. B. and A.M. Huberman. 1984. *Qualitative data analysis: A source book of new methods*. Beverly Hills, CA: Sage.
- Mukheibir, Pierre and Gina Ziervogel. 2006. "Framework for Adaptation to Climate Change in the City of Cape Town (FAC4T)." Cape Town Environmental Resources Management Department, Cape Town, South Africa.
- . 2007. "Developing a Municipal Adaptation Plan (MAP) for climate change: the city of Cape Town." *Environment and Urbanization* 19(1):143-158.
- Müller, Benito. 2008. "Adaptation Finance: The Need for an Innovative and Strategic Approach." edited by Oxford Institute for Energy Studies, Oxford.
- NACWA. 2009. "Confronting Climate Change: An Early Analysis of Water and Wastewater Adaptation Costs." National Association of Metropolitan Water Agencies.
- Naidu, Shamini, Rob Hounsome, and Kogi Iyer. 2006. "Climatic Future for Durban: Revised Report." edited by Debra Roberts, A. Mather, and M. Maganlal. Prepared for eThekweni Municipality by CSIR Environmentek, Durban, South Africa.
- Neumann, James. 2009. "Adaptation to Climate Change: Revisiting Infrastructure Norms." Resources for the Future.
- Oberts, Gary L. 2007. "Climate and Stormwater: Coping with Change." *Stormwater* (September 2007).
- OECD. 2009. "Policy Guidance on Integrating Climate Change Adaptation into Development Cooperation." Paris: OECD.
- Oelofse, Gregg. 2010. Interview with Policy and Research Coordinator, City of Cape Town Environmental Resource Management Department, Cape Town, South Africa, 12 January.
- Oldfield, Sophie. 2002. "'Embedded Autonomy' and the Challenges of Developmental Local Government." in *Democratising Local Government: The South African Experiment*, edited by S. Parnell, E. Pieterse, M. Swilling, and D. Wooldridge. Cape Town: University of Cape Town Press.
- Olhoff, Anne and Caroline Schaer. 2010. "Screening Tools and Guidelines to Support the Mainstreaming of Climate Change Adaptation into Development Assistance - A Stocktaking Report." edited by UNDP, New York.
- Parnell, Susan and Edgar Pieterse. 2002. "Developmental Local Government." in *Democratising Local Government: The South African Experiment*, edited by S. Parnell, E. Pieterse, M. Swilling, and D. Wooldridge. Cape Town: University of Cape Town Press.
- Persson, Asa. 2008. "Mainstreaming Climate Change Adaptation into Official Development Assistance: A Case of International Policy Integration." edited by Ecologic – Institute for International and European Environmental Policy, Berlin.
- Pieterse, Edgar. 2002. "Participatory Local Governance in the Making: Opportunities, Constraints and Prospects." in *Democratising Local Government: The South African Experiment*, edited by S. Parnell, E. Pieterse, M. Swilling, and D. Wooldridge. Cape Town: University of Cape Town Press.
- Pikitch, E. K., C. Santora, E. A. Babcock, A. Bakun, R. Bonfil, D. O. Conover, P. Dayton, P. Doukakis, D. Fluharty, B. Heneman, E. D. Houde, J. Link, P. A. Livingston, M. Mangel, M. K. McAllister, J. Pope, and K. J. Sainsbury. 2004. "Ecosystem-Based Fishery Management." *Science* 305(5682):346-347.
- Pillay, Udesch, Richard Tomlinson, and Jacques du Toit. 2006. "Democracy and Delivery: Urban Policy in South Africa." Cape Town, South Africa: Human Sciences Research Council Press.
- ProAct Network. 2008. "The role of environmental management and eco-engineering in disaster risk reduction and climate change adaptation." Paper prepared for *International Disaster and Risk Conference, 26th August 2008*, Davos, Switzerland.

- Reed, Sarah Orleans. 2009. ""Building" Adaptive Capacity: Reducing the Climate Vulnerability of Urban Poor Settlements." Environment and Development Department, University of Edinburgh, Edinburgh, UK.
- Republic of South Africa. 1996. "Constitution of the Republic of South Africa, Act 108 of 1996." vol. 17678, 18 December: Government Gazette.
- Roberts, Debra. 2010. Interview with Director of eThekweni Environmental Management Department, Durban, South Africa, 19 January 2010.
- Satterthwaite, D., S Huq, M Pelling, H Reid, and P Lankao Romero. 2007. "Adapting to Climate Change in Urban Areas: The possibilities and constraints in low-and middle-income nations." *Human Settlements Discussion Paper Series – Climate Change and Cities*, edited by International Institute for Environment and Development, London.
- Shaw, H., A. Reisinger, H. Larsen, and C. Stumbles. 2005. "Incorporating Climate Change into Stormwater Design - Why and How?" Paper prepared for *4th South Pacific Conference on Stormwater And Aquatic Resource Protection (May 2005)*, Auckland, New Zealand.
- Shaw, R., M. Colley, and R. Connell. 2007. "Climate change adaptation by design: a guide for sustainable communities." Town and Country Planning Association, London.
- Smit, Barry and Joanna Wandell. 2006. "Adaptation, adaptive capacity and vulnerability." *Global Environmental Change* 16(2006):282-292.
- Smith, R. 2001. *Ecology and Field Biology (6 ed.)*. Boston, MA: Benjamin Cummings.
- South Africa Department of Housing. 2004. "Breaking New Ground: A Comprehensive Plan for the Development of Sustainable Human Settlements." Pretoria, South Africa.
- South African Government. undated. "Housing", *South African Government Information Website Portal*, Retrieved May 9, 2010 (<http://www.info.gov.za/aboutsa/housing.htm>).
- Sowman, Merle. 2002. "Integrating Environmental Sustainability Issues into Local Government Planning and Decision-Making Processes." in *Democratising Local Government: The South African Experiment*, edited by S. Parnell, E. Pieterse, M. Swilling, and D. Wooldridge. Cape Town: University of Cape Town Press.
- Sugiyama, Noriko and Tsuneo Takeuchi. 2008. "Local Policies for Climate Change in Japan." *The Journal of Environment and Development* 17(4):424-41.
- Summerton, M.J. 2008. "A Preliminary Assessment of the Impact of Climate Change on the Water Resources of the Mgeni Catchment." *Report No. 168.0/R001/2008*, edited by Umgeni Water.
- Swilling, Mark. 2007. "South African Cities in the Second Decade of Democracy: Emerging Conceptual and Policy Spaces for a New Urban Agenda." Paper prepared for *International Colloquium on Urban Challenges in Brazil and South Africa: Creating an Agenda for Research and Education Cooperation*, Rio de Janeiro.
- Tompkins, Emma. 2005. "Planning for climate change in small islands: Insights from national hurricane preparedness in the Cayman Islands." *Global Environmental Change* 15(2005):139-149.
- Tooley, Geoff. 2010. Interview with Manager of Catchments and Stormwater Unit, eThekweni Coastal, Catchments and Stormwater Department, Durban, South Africa, 20 January.
- UNAIDS/WHO. 2008. "2008 Report on the global AIDS epidemic." http://www.unaids.org/en/KnowledgeCentre/HIVData/GlobalReport/2008/2008_Global_Report.asp.
- UNDP-GEF. 2001. "Adaptation Policy Framework: Capacity Building for Stage II Adaptation. Draft for review, May 2001." Pp. 11.
- UNEP. 2002. "Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies, Version 2.0.", edited by J. F. Feenstra, I. Burton, J. B. Smith, and R. S. J. Tol. United Nations Environment Programme, Nairobi, and Institute for Environmental Studies, Vrije Universiteit, Amsterdam.
- UNFCCC. 2007. "Climate Change: Impacts, Adaptation and Vulnerability in Developing Countries."

- . 2008. "Compendium on methods and tools to evaluate impacts of and vulnerability and adaptation to climate change." UNFCCC Secretariat, with the services of Erica Pinto, Kay, R.C. and Travers, A., CZM pty. Ltd, Stratus Consulting Inc.
- USAID. 2009. "Adapting to Coastal Climate Change. A Guidebook for Development Planners."
- Webster, P, G Holland, W Leung, and H Chang. 2005. "Changes in Tropical Cyclone Number, Duration and Intensity in a Warming Environment." *Science* 309:1844-1846.
- Wilbanks, T.J., P. Romero Lankao, M. Bao, F. Berkhout, S. Cairncross, J.-P. Ceron, M. Kapshe, R. Muir-Wood, and R. Zapata-Marti. 2007a. "Industry, settlement and society. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change." edited by M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. v. d. Linden, and C. E. Hanson. Cambridge University Press, Cambridge, UK.
- Wilbanks, T.J., P. Romero Lankao, F. Berkhout M. Bao, S. Cairncross, J.-P. Ceron, M. Kapshe, R. Muir-Wood, and R. Zapata-Marti. 2007b. "Industry, settlement and society." *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by M. Parry, O. Canziani, J. Palutikof, P. v. d. Linden, and C. Hanson. Cambridge University Press, Cambridge, UK.
- Wood, Barry. 2010. Interview with Director of City of Cape Town Catchments, Stormwater and River Management Department, Cape Town, South Africa, 14 January.
- Wooldridge, Dominique. 2002. "Introducing Metropolitan Government in South Africa." in *Democratising Local Government: The South African Experiment*, edited by S. Parnell, E. Pieterse, M. Swilling, and D. Wooldridge. Cape Town: University of Cape Town Press.
- World Bank. 2000. "Entering the 21st Century. World Development Report 1999/2000." Oxford University Press, Oxford.
- Yohe, Gary and Richard S. J. Tol. 2002. "Indicators for social and economic coping capacity -- moving toward a working definition of adaptive capacity." *Global Environmental Change* 12(1).