THE POLITICAL ECOLOGY OF CLIMATE ADAPTATION PLANNING IN NEW YORK CITY

by

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(Under the Direction of Jennifer Rice)

ABSTRACT

Although several scholars have examined the role of cities in greenhouse gas mitigation, local governments have only recently embarked on the establishment of climate adaptation plans. Starting with its 2007 sustainability plan, PlaNYC, New York City created a leading urban climate change adaptation program, whose initiatives include improving stormwater drainage, raising wastewater systems, and developing stricter flood zoning regulations. Using theories of urban political ecology, science studies, and government with science, this thesis engages the socio-environmental narratives, forms of expertise, and governing strategies that characterized climate adaptation planning in New York City. By interviewing city government workers, scientific experts, and assessing official city documents and transcripts related to developing and implementing climate adaptation plans, this thesis finds the following. First, New York City relies on a bounded group of techno-scientific experts to develop a risk-management framework for prioritizing adaptation strategies that are cost-effective, make the city infrastructure most "resilient" to climate change, and emphasize addressing infrastructural threats to flooding. Second, to render this process visible, the city has undertaken a strategy to map, quantify, and communicate climate risks to its citizens. The process has stressed adapting New York City as an "ecological" system over a "social" system to climate change, meaning efforts have strived to improve "natural" processes (such as stormwater infiltration and increasing the wetland buffer), while people have been left to identify and prepare for their own climate risks.

INDEX WORDS: climate adaptation, climate resilience, risk-management, New York City

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LIST OF ACRONYMS

CEQR: City Environmental Quality Review

DCP: New York City Department of City Planning

DEC: New York City Department of Environmental Conservation

DEP: New York City Department of Environmental Protection

DOB: New York City Department of Buildings

FEMA: United States Federal Emergency Management Agency

GCTF: New York City Green Codes Task Force

NPCC: New York City Panel on Climate Change

OEM: New York City Office of Emergency Management

OLTPS: New York City Mayor's Office of Long-Term Planning and Sustainability

Parks: New York City Department of Parks and Recreation

SMIA: New York City Significant Maritime and Industrial Area

UGC: Urban Green Council

WRP: New York City Waterfront Revitalization Program

CHAPTER 1

INTRODUCTION

1.1 Statement of the Research Problem

In the absence of effective national and international climate policies, cities and local governments in the United States have clearly established themselves as sites of climate governance (Andonova et al. 2009; Anguelovski and Carmin 2011; Bulkeley 2010; Rice 2010; Seto et al. 2010). Where several scholars have examined the role of cities in greenhouse gas (GHG) mitigation (Betsill and Bulkeley 2005; Bulkeley and Moser 2007; Rice 2010; Lutsey and Sperling 2008; Rabe 2007; Rutland and Aylett 2008; Zahran et al. 2008), local governments have only recently embarked on establishing climate ***adaptation*** plans, which include raising infrastructure vulnerable to flooding threats, improving stormwater drainage and infiltration, and mitigating the urban heat island. Climate adaptation planning is particularly important for cities because the impacts of climate change, such as warmer temperatures, increased hyrdo-climate variability, and sea level rise, can complicate the delivery of basic city services like stormwater management, water provision, and extreme weather planning. Within this context of a changing climate, local government officials and government workers are also negotiating political economic issues related to urban development, corporate interests, and the provision of social services. This means that climate adaptation plans themselves become an important part of the wider negotiation of social and economic interests and production of socio-environmental geographies in the city. Local governments must ‘adapt’ to these changing socio-environmental

conditions, furthermore, or local government officials may face a transfer of power as unsatisfied constituents vote them out of office.

Several conceptual frameworks have emerged to understand and evaluate climate adaptation in cities, such as resilience (Leichenko 2011), vulnerability (Adger 2006), and adaptive capacity (Engle 2011). These concepts examine the methods of preparedness for new socio-environmental stresses and socio-ecological vulnerabilities that cities must navigate to adapt to climate change. Other studies have empirically engaged climate impacts and adaptation in cities. A literature review of global urban climate adaptation analyses finds cities more advanced in modeling sea level rise and warming than assessing infrastructural risks (Hunt and Watkiss 2010). In the United States, Poyar and Beller-Simms (2010) have found in their survey of seven urban climate adaptation plans a reliance on relatively inexpensive strategies that tend to have relatively little community engagement. In addition, several case studies have examined climate policies in cities, such as Hamilton, New Zealand (Ruth et al. 2007), Durban, South Africa (Carmin et al. 2012), and Boston, United States (Kirshen et al 2007; Douglas et al. 2011). These conceptual frameworks and empirical studies focus on methods and frameworks for policy-makers to approach the development and implementation of climate change adaptation, as well as surveying the progress of existing plans. In comparison, this study examines dominant socio-environmental narratives, “expert” and “political” networks, and government ideological strategies of notably advanced urban climate adaptation planning in New York City.

New York City has one of the most developed climate adaptation plans in the United States, making it the subject of several case studies (Rosenzweig et al. 2001; Poyar and Beller-Simms 2010; Rosenzweig et al. 2011; Horton et al. 2011). In the city, there is a centrally coordinated climate adaptation strategy that produces reports, legislations, codes, and regulations

to address this issue. Major goals include updating city infrastructure (such as its wastewater management system), improving water infiltration in the urban landscape (e.g., making streets more permeable surfaces and planting street trees), zoning for projected increases in flooding (e.g., raising new building height requirements), and making local climate change and disaster preparation information more available to the public. Existing scholarship on climate adaptation planning in New York City focuses on improving climate projections (Rosenzweig et al. 2010; Horton et al. 2011), developing climate adaptation frameworks, strategies, and coding methods (Rosenzweig et al. 2001; Rosenzweig et al. 2010), and assessing the progress of implementation efforts (Rosenzweig et al. 2011). The research presented here examines the intersection of expert knowledge and urban governance, which produces a particular set of adaptation strategies and technologies that inevitably advantage some political economic and social interests over others.

This thesis focuses specifically on (1) the socio-environmental narratives used by experts and city officials to articulate the focus and purpose of climate adaptation as well as (2) the government technologies that the city employs to understand and regulate climate adaptation in New York City. The socio-environmental narratives (Q1) are framed within two overlapping conceptual lenses: urban political ecology and science studies. Urban political ecology examines cities as socio-environmental systems that are part of a wider circulation of people, matter, and ideas, usually in service of capital accumulation. Thus, as climate change acts as a new urban shock, cities, such as New York City, approach climate change as a disruptive socio-environmental threat to both urban metabolism (flows of energy, matter, and nature that sustain urbanization) and the urban political economy. Science studies literature engages the politicized network of experts that cities rely on to develop climate adaptation plans and strategies by showing the intimate relationship between scientific practice and environmental governance. The

government technologies of climate adaptation (Q2) are analyzed using a government with science framework, which views the main role of government as centralizing and standardizing "nature" in an effort to define and manage ecological crisis through decentralized networks of power. Such simplifying efforts may include mapping and cost-benefit calculations, while decentralized power enrolls the participation of individual residents to provide for their own well-being. These socio-environmental and governing technologies of climate adaptation frame the two research questions of this thesis:

1. What socio-environmental narratives underlie the development and implementation of New York City's climate change adaptation plans?
2. What forms of knowledge and technologies of government are utilized in making climate change adaptation plans for New York City?

1.2 Overview of Thesis

This thesis is structured in four main sections addressing its framing (Chapter 2), data collection and analysis (Chapter 3), major findings (Chapter 4-6), and conclusions (Chapter 7). Chapter 2 outlines literature on climate adaptation in cities, followed by the theoretical framing of the thesis. Chapter 3 describes the methods employed to collect and analyze data, which included the two methodological approaches of archives and interviews both analyzed using discourse analysis. The results of the empirical research are discussed in three separate chapters. The first (Chapter 4) provides political context of climate adaptation strategies in New York City with three main objectives: tracing the emergence of scientific discourse on adapting the city to climate change, examining the development of plans, legislation, and regulations addressing climate adaptation, and outlining New York City's institutional structure of adaptation governance. Chapter 5 discusses the socio-environmental narratives of climate

adaptation, focusing particularly on the risk-management strategy based on techno-scientific expertise that has emerged. Chapter 6 examines the governing technologies, such as mapping, quantification, and risk communication that have enabled New York City to develop and implement climate adaptation plans. Chapter 7 summarizes the significance of the results and offers insights to future research on climate adaptation in cities.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter serves two main purposes: first, it provides a review of the literature on climate adaptation in cities and, second, it describes the theoretical frameworks employed to analyze climate adaptation planning in New York City. The literature review includes a discussion of the framings of climate adaptation that are often employed by scholars and city planners, including notions of resilience, vulnerability, and adaptive capacity, along with the planning, policy, and knowledge gathering measures cities are currently undertaking. Case studies of New York City are emphasized here as the background upon which this research builds. Because this literature tends to focus on specific policies, climate modeling techniques, risk management evaluations, and technical critiques of information used for climate adaptation planning, I also discuss a wider theoretical orientation that draws on urban political ecology, science studies, and government with science to examine the dominant socio-environmental narratives (such as risk, vulnerability, and resiliency) along with the forms of expertise and governing technologies utilized for climate adaptation planning.

2.2 Literature Review: Urban Climate Adaptation Planning

Although environmental governance of climate change mitigation has undergone in-depth scholarly research, Bulkeley (2010) identifies climate adaptation in cities as a relatively new area of inquiry:

> "To date, research on urban politics of adaptation has received relatively little attention, but…there is a pressing need to understand how, and with what implication, adapting to climate change is taking place in the city" (Bulkeley 2010: 244).

The literature that does exist on climate adaptation falls into two categories. The first focuses on conceptual frameworks for analyzing the logics and motivations for urban climate adaptation programs. The second body of literature includes empirical case studies that evaluate potential climate impacts as well as the range of actions and foci of existing urban climate adaptation policies.

2.2.1 Conceptual Literature on Climate Change Adaptation

Scholars have outlined different approaches to climate adaptation policy. First, there is urban resilience. Leichenko (2011) argues that urban resilience "generally refers to the ability of a city or urban system to withstand a wide array of shocks and stresses" (164). She identifies three major themes emerging within the urban resilience literature specifically related to climate change: 1) urban resilience requires addressing an increasingly wider array of shocks and stresses due to climate change; 2) resilience relies on such concepts as diversity, flexibility, adaptive governance, and innovation to foster sustainability; 3) resilience must be bundled with long-term development plans. Resilience is especially important to New York City because the government has discursively used this concept in place of adaptation in efforts to plan for climate change.

A related concept is vulnerability, which Adger (2006) defines as the "state of susceptibility to harm from exposure to stresses associated with environmental and social changes and from the absence of adaptive capacity" (268). He argues that vulnerability is especially important in determining the people and environment most exposed to the impacts of climate change, which has resulted in climate change studies frequently integrating some form of

vulnerability assessment. Three limitations that he notes with vulnerability are: 1) the inability to develop a vulnerability measurement metric that properly addresses human well-being and risk perception, 2) an emphasis on quantifying vulnerabilities over understanding human perceptions of the concept and 3) difficulties overcoming the fact that the most vulnerable populations tend to have less access to the political decision-making process. In New York City, vulnerability has become codified in climate change adaptation planning efforts, as the New York City Panel on Climate Change (NPCC) and Climate Change Adaptation Task Force are compelled to address vulnerable populations in their climate impacts assessments and policy recommendations.

Resilience and vulnerability should not be viewed as separate concepts. According to Engle (2011), adaptive capacity conceptually links vulnerability and resilience, and he defines adaptive capacity as "the ability of a system to prepare for stresses and changes in advance or adjust to the effects caused by stresses" (647). In other words, adaptive capacity refers to a system's ability to cope with the unpredictable patterns of future socio-environmental hazards. For example, city governments would have adaptive capacity if they were to prepare for more extensive flooding due to sea level rise. In addition, Engle (2011) uses adaptive capacity to critique resilience and vulnerability, arguing that resilience tends to be an insufficient approach to dealing with the social aspect of socio-ecological systems (SES) and that vulnerability tends not to sufficiently analyze the environmental aspects of SES. As a result, he argues that adaptive capacity can be used conceptually to bridge these shortcomings in resilience and vulnerability analysis to consider both the social and environmental parts of SES. Although adaptive capacity is not emphasized in city documents, adjusting infrastructure to the future systemic threats of climate change is a major motivation of New York City climate adaptation planning.

Adaptive capacity may only somewhat resonate in planning strategies, but this research examines the prominent socio-environmental narratives of climate adaptation planning; in other words, approaches and concept that the city privileges in its planning process. Resilience and vulnerability feature prominently in official New York City discourse on climate change adaptation. The city even favors the term climate resilience over adaptation in promoting how it plans to cope with the threats and stresses of climate change. In addition, vulnerability has entered the official city climate adaptation lexicon as concerns for neighborhoods and people especially exposed to climate change have become more central to planning efforts.

2.2.2 Case Studies on Climate Change Adaptation in Cities

Several scholars have provided overviews of the ways in which climate adaptation planning is taking place in cities. Hunt and Watkiss (2011) examine scholarly publications and white policy papers on climate adaptation and climate impacts to evaluate the current state of cities in quantifying and valuating the risks of climate change. They find that quantification efforts tend to focus mostly on the impacts of sea level rise and warming while downplaying the role of infrastructural risks, although they note climate impact quantification exceptionally comprehensive in analyzing risks to infrastructure, public health, and other sectors in New York City and London. Poyar and Beller-Simms (2010) compare climate adaptation planning strategies in seven cities in the United States. According to them, current urban climate adaptation policies emphasize “no-regrets”, reversible, and relatively inexpensive strategies that have been developed by downscaling global climate projection models and in absence of wide-scale public participation, except for Miami which claims to have engaged 250 stakeholders in its planning process. A third study examines climate adaptation planning in Quito, Ecuador and Durban, South Africa to understand the role of external and internal urban governance forces in

developing such policies (Carmin et al. 2012). They hypothesize that, as a new policy initiative, climate adaptation tends to be driven by pressures within city governments to blend these new climate-related priorities with existing policy agendas.

Other studies focus on climate adaptation in one metropolitan area. Some of the earliest research was conducted in Hamilton, New Zealand. Examining the potential impacts of climate change on water supply and consumption in Hamilton, New Zealand, Ruth et al. (2007) argue that climate change will likely lengthen drought but put less stress on the regional water supply than population growth. Two separate studies have been conducted on climate adaptation in Boston, United States. Kirshen et al. (2007) assess the potential impact of climate change on energy, health, water supply, river flooding, and sea level rise, noting the interdependencies of these issues. Using a quantitative risk-management assessment, they find that Boston would benefit more from building hard infrastructure to ward off climate change—such as building sea walls or barriers—or a more "soft" green strategy (such as increasing water infiltration in pavement) than maintaining current infrastructural policies. Focusing on two environmental justice communities in the Boston metropolitan area, Douglas et al. (2011) argue that local knowledge and engagement in adaptation is woefully insufficient, and improving local education as well as government strategies to solicit cultural knowledge would lead to a more fair and equitable outcome. This literature review has shown that urban climate change adaptation planning is mostly in its infancy, often relies on technical climate projections and risk-assessment models more than extensive community engagement, and attempts to integrate climate change into existing planning efforts as inexpensively as possible.

In contrast to many other cities, a considerable amount of literature has examined climate impacts and adaptation planning in New York City (some of which is revisited as part of the

analysis provided in Chapter 4). In 2001, Rosenzweig et al. published *Climate Change and a Global City: An Assessment of the Metropolitan East Coast Region*, which used downscaled climate change projection to quantify its impacts on sea level rise, coastal flooding, wetlands, water supply, public health, and energy demand in the New York City metropolitan region. Valuations included the annualized cost of flooding on the regions infrastructural assets based on 2080 climate projections (Jacob et al. 2000). In addition, a section outlined the institutional decision-making process, government stakeholders, and strategies to address climate change (Zimmerman and Cusker 2001). A full collaboration of experts from climate scientists, to social scientists, to lawyers, and to insurance risk-management experts in the New York Panel on Climate Change (NPCC) produced a comprehensive report outlining New York City's risks to climate change and potential adaptation strategies in 2010 (Rosenzweig et al. 2010). Members of the NPCC collaborated on a 2011 article to discuss coastal adaptation strategies, and they found that New York City adaptation planning efforts benefit from discussions between scientists and stakeholders. Scientists provide knowledge about the latest climate change literature and models, and the stakeholders identify key infrastructural sectors at risk to help with the prioritization of policy initiatives. The article also identifies a set of potential adaptation strategies, such as raising the height of wastewater treatment plants, improving the infiltration rate of the stormwater management system, and potentially building a storm surge barrier. Horton et al. (2011) provide a technical critique of the downscaled models used to project climate change in New York City, arguing the need to move forward on adaptation strategies even as scientists localize data collection and their associated models. Research has yielded a wealth of information on future projections, the potential financial and environmental costs, adaptation strategies, as well as policy recommendations and assessment of climate change, but no study

has examined the dominant socio-environmental discourses, the politics of the knowledge apparatus, and the governing strategy used by New York City to adapt to climate change.

2.3 Theoretical Framework

This thesis adds to the preceding literature on climate adaptation in New York City, but the focus of this investigation is on the ways that scientific and policymaking communities have come to understand the problem of climate change adaptation and how the specific governing strategies become part of the wider landscape of urban environmental governance. The three theoretical frameworks used in this study are urban political ecology, science studies, and government with science. Urban political ecology provides an insightful lens to approach the "metabolism" and "circulation" of material (water, waste, energy) and discursive (risk, vulnerability, resilience) socio-environmental elements in the city that produce highly uneven and unjust urban landscapes. Science studies more explicitly engages the political context in which a group of experts has gained the authority to advice the city government on this new environmental problem, often to the exclusion of other relevant knowledge or experience. Finally, government with science approaches examine the ideologies, practices, and power relations of the city government in developing the mechanisms to control and regulate climate adaptation strategies. The frameworks help identify the dominant socio-environmental ideologies, knowledge apparatuses, and techno-scientific government practices that have made climate adaptation a central part of New York City governance strategies.

2.3.1 Urban Political Ecology

Urban political ecology is used as a lens to understand how urban environments are produced by complex historical, cultural, political, and economic process in which social and environmental outcomes are codetermined (Heynen et al. 2006). It distinguishes itself from other

narratives of urban nature by examining the role of these social-natures in developing urban space. Urban Political Ecology also focuses on the production of urban natures as it asserts that there is nothing unnatural about a city environment (Heynen et al. 2006). Thus, it provides a critique of tendencies in mainstream academic literature to separate the social and natural environments of the city, and, in contrast, it conceives of the city as a socio-natural system embedded in a political, economic, and environmental history. Urban nature, or the complex socio-ecological systems that emerge in cities, are materially and discursively produced by uneven power relations. According to Heynen et al:

> "…Urban political ecology…recognizes that the material conditions that comprise urban environments are controlled, manipulated and serve the interests of the elite at the expense of marginalized populations. These conditions, in turn, are not independent from social, political, economic processes and from cultural constructions of what constitutes the 'urban' or the 'natural'" (2006: 6).

In other words, the ability of certain people to produce and frame the separation of "nature" and "the city" is directly related to uneven power relations. For example, in New York City climate adaptation planning, the dominant ideological apparatus that includes the mayor's office, city agencies, and research scientists frames the so-called natural and social systems that will be most affected by climate change. Urban political ecology is part of the broad conceptual framing of this thesis, but in the context of climate adaptation planning, its most useful concepts are the metaphors of "metabolism" and "circulation" that it employs to understand the city as a socio-ecological system. Preserving the rapid pace of these "metabolic" and "circulatory" processes is an important motivation for the city to develop climate adaptation strategies; otherwise, people, matter, capital, and goods could grind to a halt under the increased systemic pressures of climate change (such as more extreme storms, heat waves, flooding events, and droughts).

Metabolism and circulation are two interrelated metaphors useful in framing the complex material flows that produce cities. Metabolism refers to the exchanging and processing of energy, waste, and other materials (Swygendouw 2006). In the context of urban natures, it describes how humans produce nature through the activities of labor. Thus, metabolism can be understood as a process where labor transforms nature into something that has use-value and can then be sold on the market for exchange-value (Heynen et al. 2006).

Circulation more specifically addresses the rapid movement of things, such as money, commodities, and people, in the city. It refers to rapid flows and exchanges. As a result, it provides a useful metaphor for the modern city dependent on swift and easy movements and exchanges to run properly. As Swyngendouw observes: "Modern urbanization, highly dependent on the mastery of circulating flows, was linked with the representation of cities as consisting of and functioning through complex networks of the circulatory system" (2006: 27-28). The circulatory metaphor crucially extends to any disruption in flows of materials, goods, ideas, people, and other functions of the city, as clogging of these so-called veins or arteries would be detrimental to its vitality. After all, important features of the modern city, such as live-ability, governance, and continued economic growth, rely on the ever-present circulation of goods, materials, and ideas. In New York City, climate change has the potential to disrupt systems of metabolism and circulation, thereby slowing the flow of global capital and pace of urban development.

Swyngedouw combines these metaphors into what he terms the socio-metabolic circulatory processes of the city. He argues that viewing these two concepts together is important. After all:

> "the things, the products used by labour in production always enter the metabolic processes as already configured assemblages, collective networks that, in turn, through

> socio-metabolic circulatory processes, mobilize new human and non-human "actant" and produce new assemblages and collective" (Swygendouw 2006: 25).

Here Swyngedouw directs his attention to two important features of this socio-metabolic circulatory process. First, labor must produce the things and materials that rapidly enter, are consumed, are transformed, and exit or are re-introduced into the complex networks of the city. He argues that these circulatory and metabolic processes are rapid in modern cities, as the speed of capital flow transactions, matter, and people must be fast to keep the city as an urban space and its political economy expanding. Second, the process is neither explicitly "social" nor "natural" as humans and non-humans play crucial roles in what happens to products in the city. Take the example of handling stormwater. Water eventually infiltrates into the soil, runs into a stream or body of water, or becomes a puddle, but cities build material infrastructures and networks of expertise that direct and evaluate these "natural" flows. Metabolism and circulation provide conceptual metaphors for understanding material production, consumption, and movement in cities and the way that the city directs and consumes these flows is through its infrastructure. Climate adaptation planning must be seen as a key aspect in mediating and mitigating this problem, with an understanding that adaptation planning will inevitably serve some interest more than others.

Although he engages other sets of literature (including technology studies and urban governance), Monstadt (2009) provides a useful critique for applying urban political ecology to the study of urban infrastructure. In his view, the main strength of urban political ecology is that conceptualizes urban processes, urban resource flows, and their environmental impacts as interrelated networks. He critiques urban political ecology, though, for not paying enough attention to the embedded history of infrastructure in shaping the city. Thus, he argues:

> "To use urban political ecology as an analytical study for the study of urban infrastructure would require paying more attention to the character of socio-technical systems and their inherently ambivalent and long-lasting impact on the shaping of cities and their socio-ecological environment" (Monstadt 2009: 1934).

Renovating existing infrastructure to new climate change threats and potentially building new "climate resilient" infrastructure are important and highly contested processes that New York City must address to adapt to climate change. This study examines how urban planners and government workers use a network of scientific experts to evaluate these infrastructural priorities.

2.3.2 Science Studies: Co-Production and Boundary Work

While urban political ecology emphasizes the material and discursive functions of nature in the production of urban environments and maintenance of urban political economies, science studies literature allows for a fuller understanding of the role of knowledge in this process. Understanding how New York City uses expert opinion and scientific evidence for climate adaptation purposes requires an engagement of two concepts central to science and technology studies: co-production and boundary work. Jasanoff (2004) argues that co-production should be seen as an idiom describing the simultaneous production of technology, science, and social order. In her view, "technology does not, when all is said and done, drive history. Legal and political institutions lead, as much as they are led by, society's investments in science and technology" (16). Such an observation does not entail that there is no knowledge to be gained in the bio-physical worlds, but knowledge is always produced in a politically contingent social setting (Forsyth 2003). Jasanoff identifies the four most common instruments of co-production as making identities, making institutions, making discourses, and making representations. These different ordering mechanisms help produce the social and political realities in which new sciences and technologies come into existence—a viewpoint especially important for framing

politically controversial areas of inquiry such as climate change. In addition, co-production provides a useful framework for critiquing the conventional views of making science and technology by addressing their messy and complex development (Jasanoff 2004: 42). It does so by examining the production of science and technology, exposing their contingent origins and framing and asking traditionally normative questions. For example, the New York City Panel on Climate Change (NPCC) was a body of experts formed by the Mayor with the expressed purpose of assessing the impacts of climate change on the city's critical infrastructure. As a result, dominant political forces heavily influenced the research direction of this "independent" group of experts.

Boundary organizations are more visible examples of co-production, referring to organizations that act as intermediaries between science and policy on controversial topics. As a result, "[they] set the goalposts of environmental political debate by providing definitions or approaches to contested science that are used as fact" (Forsyth 2003: 142). Miller (2004) adds that boundary organizations may also provide legitimacy to public policies that are negotiated among scientists, government officials, citizens and other actors. Using the International Panel on Climate Change as a case study, he argues that these organizations give a certain authority to specific institutional bodies in defining and framing science, and they tend to define scientists as politically neutral actors (Miller 2004: 61). For climate adaptation in New York City, the NPCC can be understood as a boundary organization that works to frame climate impacts through the use of expert knowledge, setting the stage for possible policy and technology strategies for the city. Such boundary organizations are examples of the way governments employ scientists and scientific principles to conceive and exercise its central authority and control over territory. Boundary organizations and co-production help frame the politically contingent privileged

knowledge and technology used by the city to adapt to climate change, such as originally including climate scientists and risk management experts over engineers and public health experts on the original NPCC.

2.3.3 Government with Science

The state plays a powerful role in simplifying and defining "nature". First, the state is a complicated entity forged from an array of bureaucracies, legislatures, and governments that constitute an "ideological state" (Whitehead et al. 2007). The state has basic (although contested) claims to a centralized authority and the administration of a certain territorial extent (Whitehead 2009). Such claims mean that the state must create codes to standardize and simplify reality in order to achieve legibility of its territory and authority over its population (Scott 1998). Partially in support of this process, the state relies on the use of specific scientific concepts and technologies (Whitehead 2009). It is relevant to explore the relationship between the state and nature through the lens of local governments because they, like federal states, make claims to territory and a central authority, but, more important for this thesis, cities have played a vital role in spearheading climate governance initiatives in the United States (Andonova et al. 2009; Anguelovski and Carmin 2011; Bulkeley 2010; Rice 2010; Seto et al. 2010). Recent literature on the state and nature has done this through a specific form or governmnentailiy termed

Governmentality refers to Foucault's notion of government power and practice that emerged in liberal western states in the seventeenth and eighteenth century emphasizing pastoral care of land through a scientific knowledge apparatus best able to oversee management strategies (Whitehead 2009). This notion is combined with a newfound approach to statecraft that monitors the health and well-being of its citizens while maintaining a monopoly over state violence, such as warfare. Foucault terms this notion *biopower*, which Whitehead describes as follows:

> "As a strategy of power that seeks to govern each and all within the administration of life, biopower is essentially a context within which it is possible to discern the rise of a whole range of 'great technologies of power' (including sexuality, economics and even nationalism" (2009: 21).

Biopower has two important implications. First, it underlies the motivation for a state to regulate the so-called *conduct of conduct*, which refers to the way states foster obedience from their citizens by cultivating the behavioral patterns of its subjects. Although more diffuse than direct, it nonetheless functions as a way for the state to control what its citizens do (Whitehead 2009). Second, the state must maintain socio-economically tolerable conditions, a notion that Foucault refers to as *bandwidth of governance*. On *bandwidth of governance*, Whitehead notes:

> "Foucault claims that that the security society is based upon a less overt form of power that attempts to supervise tolerable *bandwidths of existence*, only intervening when optimal socioeconomic conditions are under threat" (2009: 22).

As a result, the state must intervene to mitigate any force that may have a dramatic effect on human life, such as climate change. For example, future climate stresses pose too great a threat to population and infrastructure in New York for the city ignore, which partially motivates continued climate adaptation planning efforts.

The modern state also simplifies reality for its own purposes. Scott (1998) argues that the state measures, codifies, and standardizes the regulations of its territory to develop a simple and abstract reality that can be monitored by a distant entity. Using these simple codes, the state collects "facts" that allow it to understand and exercise authority over its territory. Scott argues that such "legibility implies a viewer whose place is central and vision is synoptic" (1998: 78). Thus, Scott sees the goals of the modern state as (1) controlling and (2) being able to regulate every activity within its territory. To achieve these goals, the state strives to find the easiest way to monitor, count, assess, and manage the infinite complexities of its people and territory (Scott

1998). The standardization techniques employed by states often resemble scientific data collection.

The result, therefore, is that modern states have tended to form a strong link with science. Whitehead (2009) describes this relationship as *government with science*, which refers to both government support of science to maintain its own power as well as use of scientific principles in government bureaucracies. In his description of this notion, Whitehead argues:

> "government with science is suggestive of set of historical processes in and through which certain forms of scientific practices have supported a governmental ethos with the state, and certain governmental decries have fostered the formation of new, and reconsolidation of older, scientific networks of knowledge production" (2009: 35).

These shifting scientific networks are part of an ever-present process in which the state chooses to privilege and render objective certain scientific information over other, usually non-scientific, information. Even though what science is privileged remains in flux, science often plays a central role in state bureaucracies (Whitehead 2009). A characteristic of this flux is the shift towards environmental science and preserving the ecosystem in recent decades.

Using British atmospheric governance as a case study, Whitehead (2009) discusses this relationship between the state and nature by emphasizing the way in which governments increasingly use ecological science for management policy purposes. This also includes a vast and complex bureaucratic apparatus that measures, calculates, and codes the physical environment in ways compatible with state goals. Discussing new ecological, scientific, and governmental frameworks, Whitehead notes:

> "At the heart of these analyses is the belief that the environment constitutes a new arena of care and calculation within governmental activities, and that this nexus of care and calculation can be discerned in a new era of environmental ministries and ecological specialist employed by the government" (2009: 183).

These new practices have resulted in extensive codification and measurement of the environment, which has led to a discussion of states practicing *ecopolitics*. Whitehead notes three underlying principles of ecopolitics: it applies the diffuse power networks of biopolitics to environmental management, it extends state concern to the global, and it means that the government knowledge gathering apparatus now includes collecting ecological data (Whitehead 2009). Governmentalized ecopower and practices apply to New York City climate adaptation planning, as strategies have required gathering detailed and localized climate knowledge.

2.4 Conclusion

This chapter outlines the empirical and theoretical work in which this research on New York City's climate adaptation planning is embedded. Empirically, the thesis builds on work that has conceptualized or analyzed climate adaptation as a new and important feature of urban environmental governance. Thus, climate adaptation terms, such as resilience, vulnerability, and adaptive capacity, are equally as important as empirical case studies of climate adaptation in cities, as these conceptual lenses reveal the way existing empirical studies have been evaluated.

The three conceptual lenses frame the questions that this research will investigate. Urban Political Ecology highlights the way climate change can be viewed as a potential threat to the "metabolic" and "circulatory" processes of cities, such as New York, with large and rapid circulations of matter, capital, and people continually moving through them. With more emphasis on the social context in which science is produced, science studies conceptualizes the co-production of science and politics and the existence of boundary organizations, which frames the way political initiatives as well existing and produced scientific network have provided the knowledge needed for cities to pursue climate adaptation. Thus, urban political ecology and science studies inform the investigation of *the socioenviornmental narratives that underlie the*

development and implementation of climate adaptation planning in New York City. Government with science frames the mapping, climate coding, self-assessment, and diffuse communication strategy undertaken by the New York City government to make climate adaptation planning possible, contributing to the second research question: *What forms of knowledge and technologies of government are used for climate adaptation planning in New York City?* The next section outlines the methodologies used to answer these two questions.

CHAPTER 3

RESEARCH DESIGN

3.1 Study Site

New York City (See Figure 3.1) serves as the case study for this research for several reasons. First, New York City is widely recognized as one of the leaders, if not *the* leader in municipal climate change adaptation planning. As part of this effort, the city has created an extensive number of official documents, policies, and plans related to climate change adaptation, with the 2007 *PlaNYC* as its notable centerpiece (discussed in more detail in Chapter 4). Furthermore, this effort has been ongoing for more than a decade, starting with the 1996 report *The Baked Apple* published by the New York Academy of Sciences. This report marked the first effort by the City to engage with research scientists to better understand the climate change impacts specific to the New York City region and a set of possible adaptation strategies. Third, New York is considered a "global" city with extensive connections to international discussions on climate change policy. This means that the actions taken by New York City are often seen as potential strategies to be adopted by more governments. Fourth, New York City has proven vulnerable in recent years to climate related stresses, including record breaking heat waves in the summers of 2011 and 2012 and costly tropical cyclones (notably Hurricane Sandy in 2012 and Tropical Storm Irene in 2011). With climate predictions suggesting that these severe weather events will become more frequent in the future (Rosenzweig et al. 2010), the need for climate adaptation strategies is becoming increasingly important.

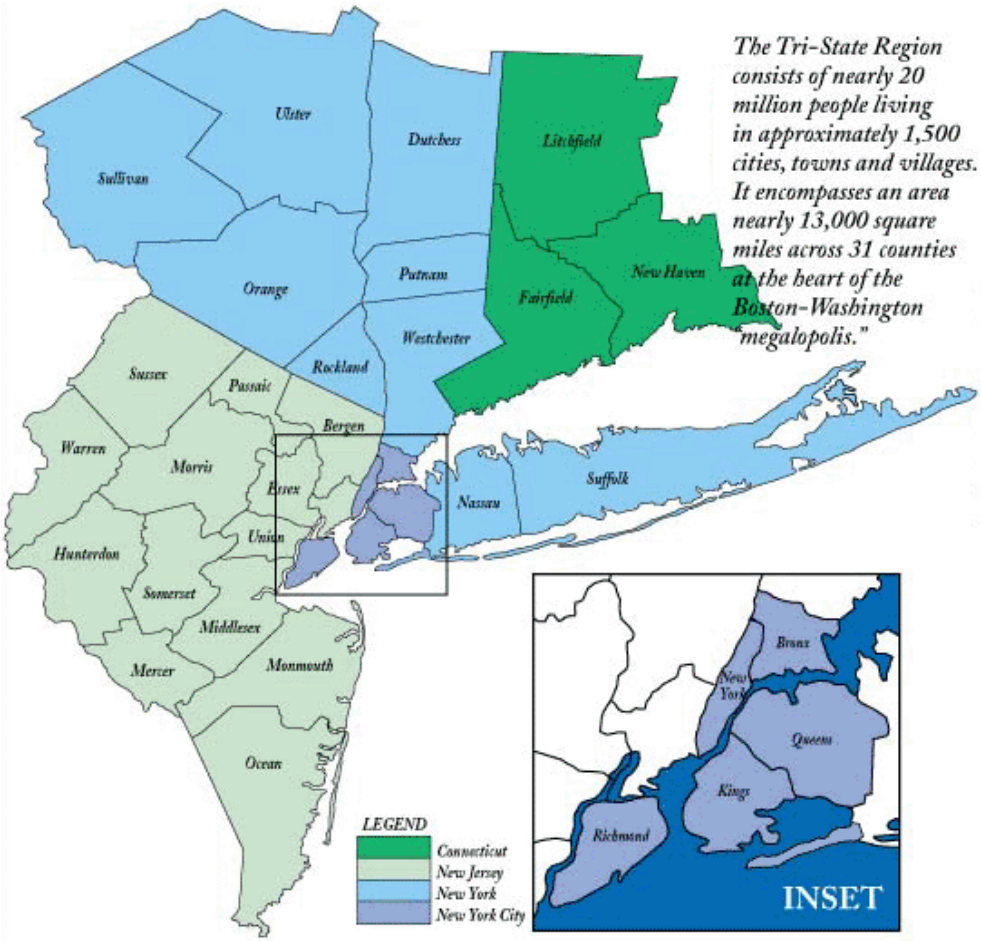

Figure 3.1. Map of New York City embedded within its metropolitan area (from Rosenzweig et al. 2001).

New York City is also an excellent site to investigate theoretical questions related to the socio-environmental narratives, forms of knowledge, and technologies of government involved in climate adaptation planning. For Urban Political Ecology, the city acts as a socio-environmental system with an extensive, expensive, and complex infrastructure overseen by an economic and political system embedded in uneven power relations. Thus, there is a select group of key decision-makers deciding how to maintain the metabolic-circulatory processes potentially threatened by the impacts of climate change. An identifiable group of "independent" scientist (such as the New York City Panel on Climate Change) and experts within the bureaucracy make the science studies an appropriate way to analyze the social and political context of technologies

and scientific information contributing to climate adaptation planning. Finally, as a global leader in climate adaptation planning, New York City has used specific forms of knowledge, plans, legislation, codes, and other technologies of government to compel an inquiry on how it governs this planning process.

3.2 Data Collection

This research employed a multi-method approach to collect data on New York City's climate change adaptation planning, including archival research and interviews (each described in detail below). The two methods provided a way to identify converging lines of inquiry, enabling the production of a more robust data set that identified common findings from multiple sources (Yin 1994). Archival data was used to illuminate the historical and contemporary narratives of the planning process. Interviews centered on the way city officials and scientific experts understood and spoke about climate change adaptation planning, as well as the techniques New York City used to achieve climate-related goals.

3.2.1 Archives

Archival data consisted of a variety of written documents, including plans, reports, policies, ordinances, newspaper articles, and official city government transcripts discussing climate adaptation. Archival research was examined for the historical and present-day discursive articulations of climate change impacts and climate adaptation planning in New York City. Thus, archival research tracked two major threads related to climate adaptation planning: 1) policies and plans directed by the city government to adapt the city to climate change, and 2) scientific discussions regarding the local impacts of climate change and how to manage them. In addition, archives introduced the background information necessary to understand how climate change adaptation strategies became institutionalized in the city bureaucracy (the subject of Chapter 4).

Archives generally provide accurate spelling, titles, and names of organizations as well as a means of making links and new connections between different documentation of events. They also are useful in corroborating or contradicting the results of other methods (Yinn 1994).

The first focus of archival research was on government documents related to climate change adaptation to determine how the local government constructed its adaptation narrative. Archival material for this purpose centered on reports produced either directly or indirectly from the 2007 *PlaNYC* report, which was developed by the Mayor's Office of Long-term Planning and Sustainability (OLTPS). Other city reports included information related to climate adaptation, such as the *Climate Change Program Assessment and Action Plan* of the city's Department of Environmental Protection (DEP) that began in 2004 but was published in 2008. Other documents reviewed included yearly progress reports of and the 2011 *PlaNYC* update, which provided a more comprehensive section on the city's approach to climate change. Climate-related reports and plans produced by city agencies included the 2011 Waterfront Plan by the Department of City Planning (DCP) and the *High Performance Landscape Guidelines* by the Department of Parks and Recreations (Parks). Legislation, regulatory guidelines, and ordinances related to climate change adaptation planning provided additional relevant archival material. Important legislation included the Wetlands Act of 2008 and the 2012 bill to institutionalize the New York City Panel on Climate Change (NPCC) and the Climate Change Adaptation Task Force. The main regulatory guideline examined was the ongoing process to update DCP's *Waterfront Revitalization Program* to include climate adaptation sensitive components. Finally, I read city council and community ordinances referring to climate adaptation strategies, which included 2011 ordinances by Manhattan Community Boards 1 and 4 to examine the possibility of building a storm surge barrier. These bills, regulations, and

ordinances exemplified the way the city institutionalized climate and revealed ongoing debates regarding the framing and priorities of climate adaptation planning. Reading this variety of documents directly and indirectly related to climate adaptation planning allowed for engagement of how the city discursively articulated climate adaptation priorities, as well as what forms of expertise and "technologies of government" were central to this process.

In addition, transcripts of city council meetings were used to provide insightful information of the way city officials articulated climate change adaptation as well as how other groups and individuals contested or supported this official vision. The transcripts came from meetings of the Environmental Committee of the New York City Council between December 2011 and August 2012. The meetings discussed the 2012 bill to institutionalize the NPCC and the Climate Change Adaptation Task Force. The transcripts also included broader debate on the city's climate adaptation strategies.

Archival research was also useful in uncovering the lineage of local scientific discourse on climate adaptation. I used contemporary reports on climate adaptation in New York City, a Lexis Nexis search on newspaper articles related to climate adaptation, and major citations in the earliest reports to develop this narrative. The most important contemporary source was the 2010 *Climate Adaptation in New York City: Building a Risk Management Response* by the NPCC, which included a detailed history of climate change reports focusing on New York City. Using the citation in the earliest reports, *The Baked Apple* written in 1996 by the New York Academy of Sciences, I found some of the earliest articles discussing climate change adaptation. In addition, the Lexis Nexis search yielded discussions and reports of climate adaptation in New York City during the 1980s, starting with a 1986 report *Thirsty New York: a plan of action for the New York City water supply*, which supported adapting the city water supply to "greenhouse

gas warming." Tracing this scientific narrative allowed analysis of the emergence of contemporary scientific discourse on climate adaptation strategies in New York City.

3.2.2 Interviews

Interviews provide insights and interpretation from informants involved in events. They can be used to corroborate or find inconsistencies in other methods. In this study, eleven semi-structured interviews were conducted with government officials and scientific experts from June to August 2012 (Table 3.1). The semi-structured nature of the interviews meant that they followed a pre-determined list of questions, but were allowed to veer from the scripts when providing relevant insight on the case study. Both government officials and scientific experts answered a series of questions related to the following themes (See Appendix A for a list of questions):

- Public and private actors involved in the planning process
- Major priorities of climate adaptation plans
- Most valuable forms of expertise/information for plans
- Instruments and methods used to develop plans
- Current and proposed climate change adaptation regulatory mechanisms

Government officials interviewed were involved (directly or indirectly) in the development and/or implementation of New York City's climate adaptation plan, and work in a wide range of government bureaucracies and departments. Their level of involvement in climate change adaptation depended on their agencies and titles. For example, OLTPS and DCP staff was more directly involved in day-to-day climate adaptation planning than the employees of the Office of Emergency Management (OEM) and Parks and Recreations, even though all agencies played some role in climate adaptation planning. All of these interviews were vital to engaging the way that the city articulated and developed its climate adaptation agenda. These interviews

were additionally useful in determining the progress of implementing climate adaptation strategies.

Table 3.1. Dates, category of person, and duration of interviews

Interview	Date	Category of person	Duration
1	6/8/12	Government Worker 1	Approx. 30 minutes
2	6/11/12	Government Worker 2	29:16
3	6/12/12	Government Worker 3	33:20
4	6/13/12	Scientific Expert 1	33:13
5	6/19/12	Government Worker 4	26:18
6	6/20/12	Scientific Expert 2	15:14
7	6/22/12	Government Worker 5	Approx. 1 hour
8	6/29/12	Government Worker 6	26:10
9	7/10/12	Scientific Expert 3	59:05
10	7/12/12	Government Worker 7	38:22
11	8/2/12	Scientific Expert 4	32:38

The scientific experts interviewed held various doctoral degrees in fields related to the social or physical dynamics of climate change, and they mostly participated in advising the city government on various climate adaptation related projects. Some played more intensive roles than others, but they all provided climate change adaptation research downscaled to New York City and the surrounding metropolitan region. Their insights were important in understanding the forms of knowledge and role of researchers in New York City climate adaptation planning.

3.3 Data Analysis

I analyzed these data using critical discourse analysis to identify where understandings about climate change adaptation planning crystallize into more or less unified narratives that are both reproduced and contested. Gill (2000) argues that "the term 'discourse' is used to refer to all forms of talk and texts, whether they be naturally occurring conversation, interview material or written texts" (141). As a result, she identifies four major themes for using discourse analysis: understanding discourse as language in its own right, analyzing language as a constructive

medium, examining the functionality of language, and using language as a rhetorical device. Keeping in mind the complex and sometimes contradictory nature of a text, discourse analysis enables engagement of key phrases, words, information, symbols, narratives, and counter-narratives related in this case to climate adaptation planning. Even though the reader ultimately decides the analysis produced, successful discourse analysis requires the analyst to partake in a nuanced and rigorous reading of texts.

This research employed critical discourse analysis, a sub-type of discourse analysis concerned with power relations embedded in and obscured by a text, speech, interview transcript, or any other discursive medium. Paltridge (2006) argues that "critical discourse analysis examines the use of discourse in relation to social and cultural issues such as race, politics, gender and identity and asks why the discourse is used in a particular way and what the implications are of this kind of use" (178). This analytical technique was useful in this case study, as I examined the power dynamics that contributed to the official political discourse of New York City climate change adaptation planning. It also enabled the investigation of language and approaches favored by the city government to understand and adapt to climate change.

Critical discourse analysis was the end result of data coding and organization process. Each method involved a similar approach to coding and data organization. For my archival research, I carefully read each relevant document paying attention to the main themes expressed in them and how they addressed the major themes of the investigation. I then coded these results and kept detailed notes on the relevant findings in each documents. I recorded all interviews except two that expressly declined, but, in every interview, I kept detailed field notes on the major themes covered. I transcribed each recorded interview and then read and re-read both my transcriptions and field notes multiple times. In this process, I developed general codes for

organizing information, and then I divided them into more specific sub-codes with each new reading (Table 3.2). I compared these codes to the ones found in my archival data, looking for converging and diverging themes produced by these two methods. As of using multiple methods, the data revealed ongoing narratives, debates, and actions taken regarding climate change adaptation planning in New York City.

Table 3.2. Examples of coding categories for discourse analysis

Original Codes	*Socio-environmental Narratives*	*Technologies of Government*
Subcodes	Privilege critical infrastructure	Voluntary programs to educate citizens and define risks
	Define climate hazards in terms of monetary risk to infrastructure	Model risk in terms of cost to infrastructure
	Technical and scientific experts required	Quantify infrastructural benefits
	Public/private partnership	Mapping wetlands and significant maritime industrial areas
	Hazard mitigation/resilience	Making climate information available to public
	Risk management focus on flooding	
	Water infrastructure first analyzed	

3.4 Conclusion

A multi-method case study of New York City's climate adaptation apparatus appropriately investigated the two major themes of this thesis. First, understand the major socio-environmental narratives were obtained from a mixture of interviews with scientists and government officials as well as archival analysis of climate adaptation related plans and official transcripts. In addition, the conceptual frameworks of urban political ecology and science studies characterized the direction of the analysis towards the materiality and discursive articulations of climate adaptation. Second, as informed by the lens of government with science, these same

methods were useful in determining the forms of expertise and "technologies of government" that the city used to pursue climate adaptation planning.

The next three chapters develop a narrative of climate change adaptation in New York City. Chapter 4 discusses the scientific and policy discourses that have led to an institutionalized climate adaptation structure. Chapter 5 analyzes the socio-environmental narratives underlying this planning process. Finally, chapter 6 explores the specific tools and strategies employed by the city to govern climate change adaptation.

CHAPTER 4

INSTITUTIONAL CONTEXT OF CLIMATE ADAPTATION PLANNING IN NEW YORK CITY

4.1 Introduction

New York City's climate adaptation program is the product of a multi-decadal effort by regional scientists and local officials to understand and manage the effects of a changing climate. Adaptation planning in New York City includes an extensive bureaucratic structure, involving the Mayor's Office, several city departments, and private infrastructural owners, which draws on regionally specific scientific evidence and reports. This chapter describes this historical development, focusing on events and discussions that led to the institutionalization of climate adaptation planning. Beginning with a description of climate knowledge and expertise in New York City, this chapter outlines the history of scientific and technical reports that helped shape climate adaptation discourse in New York City starting in the 1980s and culminating in a series of reports in the 1990s and early 2000s. These reports reveal the socio-environmental discourses and political network of experts that have become central to climate adaptation planning. This chapter then outlines the role of PlaNYC, the planning document central to climate adaptation policy created in 2007, in organizing climate activities through the Mayor's Office and several other city departments. The plan outlines political and governmental strategies to adapt to climate change, such as framing adaptation as resilience or mapping the extent of wetlands. The information presented here provides the context for understanding the socio-environmental

narratives that underlie climate adaptation planning in New York City (Research Question #1) and the governing technologies that make such policies possible (Research Question #2).

4.2 Scientific Discourse on Climate Adaptation Planning in New York City

Scientific discourse on climate change adaptation helped define the prioritized projects and political network of experts involved in advising later plans by the city government. Not surprisingly, the first documentation of climate risks and city administered case study focused on the threat of climate change to water supply, which then expanded outward to concerns for other infrastructural sectors and eventually population vulnerabilities. Discussions regarding climate change adaptation in New York City date to the 1980s (Figure 4.1). The 1986 Citizen Union Foundation publication, *Thirsty New York: a plan of action for the New York City water supply*, warned that "greenhouse gas" warming would stress the water supply and called on the city government to prepare adaptation measures (CUF 1986). According to a 1987 *New York Times* article, the report argued that the threats of sea level rise could cause groundwater aquifer depletion leading to extra-stress on the upstate reservoir system (Melvin 1987).

The first academic endeavor specifically focusing on climate change in New York City was the 1994 *Baked Apple Conference*. It produced the 1996 report *The Baked Apple?: Metropolitan New York in the Greenhouse*. Although it relied on projection from models of Climate Change in North America, the proceedings warned of more public health problems due to increased ozone formation in hotter weather, water supply concerns from greater salt water intrusion due to sea level rise, elevated risks of waterfront flooding and coastal erosion, likely increases in energy demand, and a potential disruption in the global economy on which New York City depends for its own economic prosperity (Hill ed. 1996). It also marked the first collaboration of scientist and academics on adapting the New York Metropolitan area to climate

change (Rosenzweig et al. 2010). Other reports soon followed, showing the growing scientific interest in understanding the effect of climate change on the New York region, critical city infrastructure, and urban development. One example was the 1998 report by the Environmental Defense Fund, *Hot Nights in the City: global warming, sea level rise, and the New York Metropolitan Region*, which projected the following climate change impacts for New York City: a significant increase in days over 90 degrees Fahrenheit, a likely increase in periods of drought, sea level rising from 0.75 to 3.5 feet by 2100, increasing risk of storm surge, greater exposure of humans to ozone gas, and increased predicted stress on the New York City water supply (Bloomfield et al. 1999). Two years later, the Metropolitan East Coast Assessment was published entitled *Climate Change and a Global City*. It concluded that the main human impacts would be increased storm surge, health concerns from more frequent heat waves, and disruptions to the international economy due to increased vulnerability of a global hub to extreme weather (Rosenzweig et al. 2001). The report also included discussions of possible adaptation measures and called for the development of climate awareness programs to inform stakeholders and the general public of climate risks (Rosenzweig et al. 2001). Together, this series of scientific reports highlighted how climate change would disrupt the "metabolism" and "circulation" of goods, people, and capital in New York City, potentially straining the allocation of vital resources, reducing economic growth, and posing a threat to human health. In addition, the group of climate and infrastructural experts began to emerge between late 1990s and early 2000s, as many of the same scientists became major players in later directly New York City sponsored climate adaptation assessments.

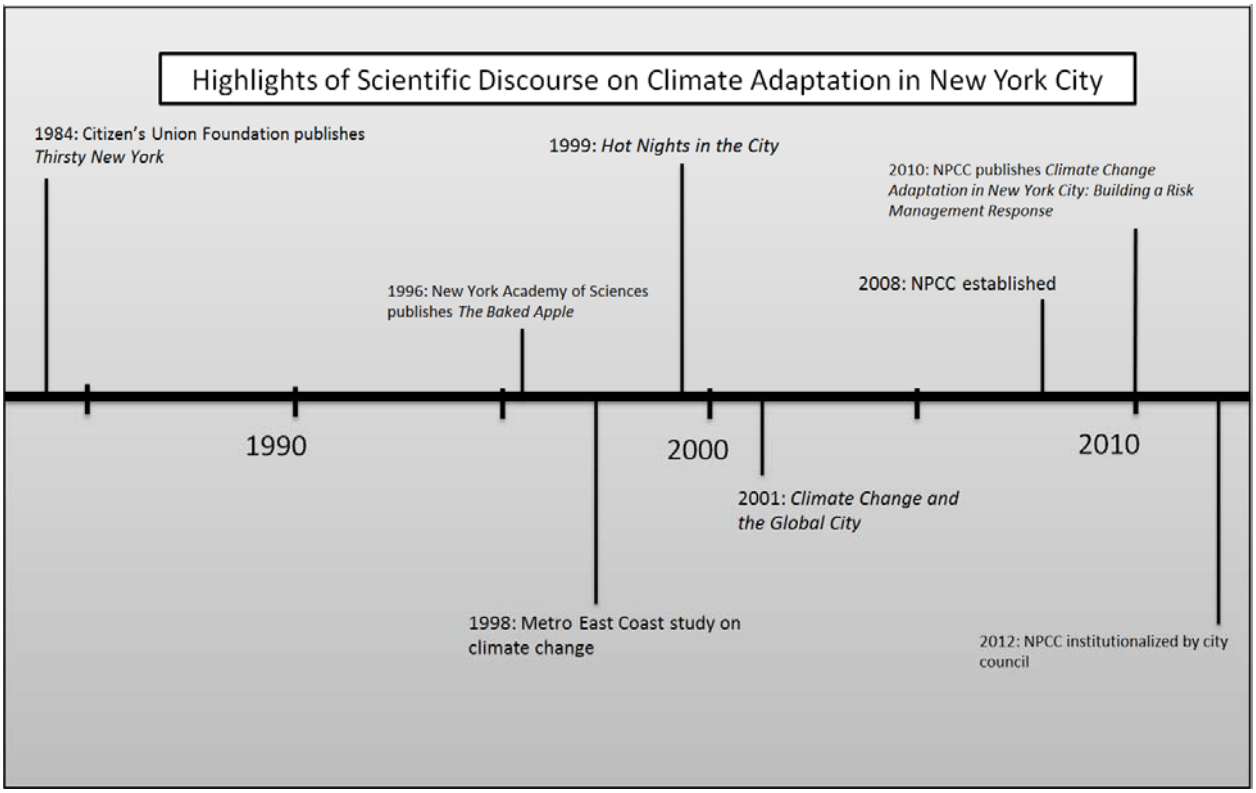

Figure 4.1. Timeline of scientific discourse on climate adaptation in New York City.

The New York City government has also commissioned a series of infrastructural assessments of the impacts of climate change. The Department of Environmental Protection (DEP) created the first task force to assess the impacts of climate change on the city water supply and wastewater infrastructure in 2004, which resulted in the 2008 *Climate Change Program Assessment and Action Plan.* The report warned that climate change could result in greater uncertainties about the quantity and quality of the city water supply. In addition, it found that city wastewater systems could become more vulnerable to flooding and sewer overflows due to sea level rise and potential increases in the frequency and severity of coastal storms (DEP 2008). Local government officials saw this as a serious threat to the economic productivity of the region, which led to the commissioning of more scientific studies of the impacts of climate change on critical infrastructure. The most comprehensive climate adaptation report for the city

was the 2010 *Climate Change Adaptation in New York City: Building a Risk Management Response* by the New York Panel on Climate Change (NPCC), a panel of climate scientists, social scientists (including economists and geographers with experience in vulnerability, risk, and resilience assessments), risk management experts, infrastructural experts, and lawyers commissioned by Mayor Bloomberg in 2008 to advice city officials and stakeholders on local climate impacts. The report emphasized adapting the city's critical infrastructure sectors (including water, waste, energy, transportation, and communications) to three specific climate challenges: higher temperatures, increased frequency of high-intensity rainfall events, and rising sea levels (Rosenzweig et al. 2010). As a result, the report conceptually outlined an adaptation strategy, relying on a cycle of feedback between city stakeholders and scientific information. It also created workbooks for the city on climate risk information, adaptation assessment strategies, and standards and design for climate protection levels (Rosenzweig et al. 2010). Technical reports, land use plans, and legislation have evolved concurrently with the more locally focused impacts of climate change on New York City, starting with the unveiling of PlaNYC in 2007.

The scientific reports discussed here have major implications in defining the priorities and scientific network that resulted in climate adaptation planning. Water infrastructure acted as a case study for climate impact assessments on other infrastructure, which suggests water supply acts as a vital lifeline for maintaining New York City as a robust political economic system. After all, once water stops flowing and metabolizing, industry cannot function properly, citizens lose access to an essential resource, and untreated waste clogs the city sewer system posing a threat to health and hygiene. Climate impact analyses of other vital infrastructural sectors (such as energy, transportation, and communications) followed partially because climate change will put increased stress on delivering these services, threatening the city's position as major global

economic, commercial, political, and cultural center. In addition, the production of each report by a specific group of climate experts, social scientists, infrastructural experts, and risk-management experts showed the city fostering a network of techno-scientific advisors, who the city government could reliably trust to develop climate impact inventories, governing strategies, infrastructural analyses, and coding mechanisms consistent with its goals.

4.3 Planning and Legislative History of Climate Adaptation in New York City

This section provides a brief overview of PlaNYC (locally spoken as "Plan NYC"), the centerpiece of sustainability planning in New York City, and other related plans, legislation, and programs pushing forwards a climate adaptation planning agenda. As a result, these plans and legislation reveal dominant discourses, knowledge requirements, planning priorities, and governing technologies that have made climate adaptation planning possible. The Mayor's Office of Long-term Planning and Sustainability (OLTPS) introduced PlaNYC in April 2007, which originally included 127 planning initiatives in six separate categories to improve the physical environment of the city. Proposed environmental initiatives included improving citizen access to parks, cleaning up brownfields, protecting wetlands, making waterways more accessible for recreational use, decreasing carbon emission by 30 percent by 2030, and *adapting the city to climate change* (OLTPS 2007). The plan outlined three climate adaptation strategies: To create an intergovernmental task force to protect the city's vital infrastructure, to work with vulnerable neighborhoods to develop site specific strategies, and to develop a strategic process to plan for climate change adaptation (OLTPS 2007). The plan has since undergone a 2011 update, which includes more specifically targeted climate adaptation goals (See Figure 4.2 for more detail on climate adaptation planning initiatives):

- Assess vulnerabilities and risks from climate change

- Increase the resilience of the city's built and natural environments
- Protect public health from climate change threats
- Use outreach and the public information to create more resilient communities

Figure 4.2. Major climate change initiatives of the 2011 PlaNYC update (From OLTPS 2011).

Originally conceived as a long-term planning document to address population growth, PlaNYC's central goal became sustainability. According to an ICLEI report, sustainability became the unifying theme to justify spending city resources to update infrastructure to the public (ICLEI 2010). With the goal of guaranteeing sustainability across diverse city agencies with different jurisdiction priorities, the Mayor established the Office of Long-Term Planning and Sustainability (OLTPS) and Sustainability Advisory Board to coordinate the plan. The

Sustainability Advisory Board was intended to advice OLTPS on content for the plan, but it had no direct decision-making power, a role reserved to OLTPS (ICLEI 2010). The seventeen members on the board included city council members, environmentalists, environmental justice leaders, sustainability experts, real estate executives, and labor leaders (ICLEI 2010). Involvement of these different groups is important because it shows that New York City included representatives from the private, public, and academic sectors as well as representatives of more marginalized people in developing PlaNYC goals, even though the ultimate direction and decision-making power was in the hands of OLTPS. Members were divided into subcommittees targeting seven key areas of sustainability: energy efficiency/green buildings, energy supply and distribution, transportation, land use and brownfields, waste management, and *climate change adaptation* (ICLEI 2010).

The goals and historical context of PlaNYC underscore some major features of New York City climate adaptation planning. First, efforts to create a long-term sustainability plan meant that governing logic in the city became increasingly concerned with the ecological. City officials deemed planning for population increases a less attractive selling point for public expenditure infrastructure than "greening" the city, which included adapting to climate change. More specifically to climate adaptation goals, the changes in priorities from the 2007 to the 2011 PlaNYC reports characterize an expanding commitment to climate adaptation as well as a shift in the city's discursive strategy. Language of risk, vulnerability, and resilience stood independent from the broad umbrella term of adaptation, a subject that will be discussed in more detail in chapter 5. Third, PlaNYC created an integrated network of city bureaucracies working on adapting different infrastructures and populations to climate change.

4.2.1 Climate Adaptation Legislation and Planning Documents

PlaNYC was the first unveiled and centrally coordinated climate adaptation plan. The Department of Environmental Protection (DEP) began the first city sponsored climate adaptation effort in 2004, resulting in its 2008 report *Climate Change Assessment Program and Action Plan* (Figure 4.3). Conducted with the aid of local climate scientists, it discussed the impacts of climate change on New York City water supply, ambient water quality, and wastewater systems, as well as recommendations to address these problems (DEP 2008). The report was a water infrastructure focused precursor to the NPCC 2010 report, which assessed climate impacts over a broader range of infrastructure (energy, transportation, and communications). Other city agencies also followed DEP in producing reports and guidelines focused on climate adaptation, including the Parks Department, the Department of City Planning (DCP), and the Office of Emergency Management (OEM), and OLTPS (Figure 4.3).

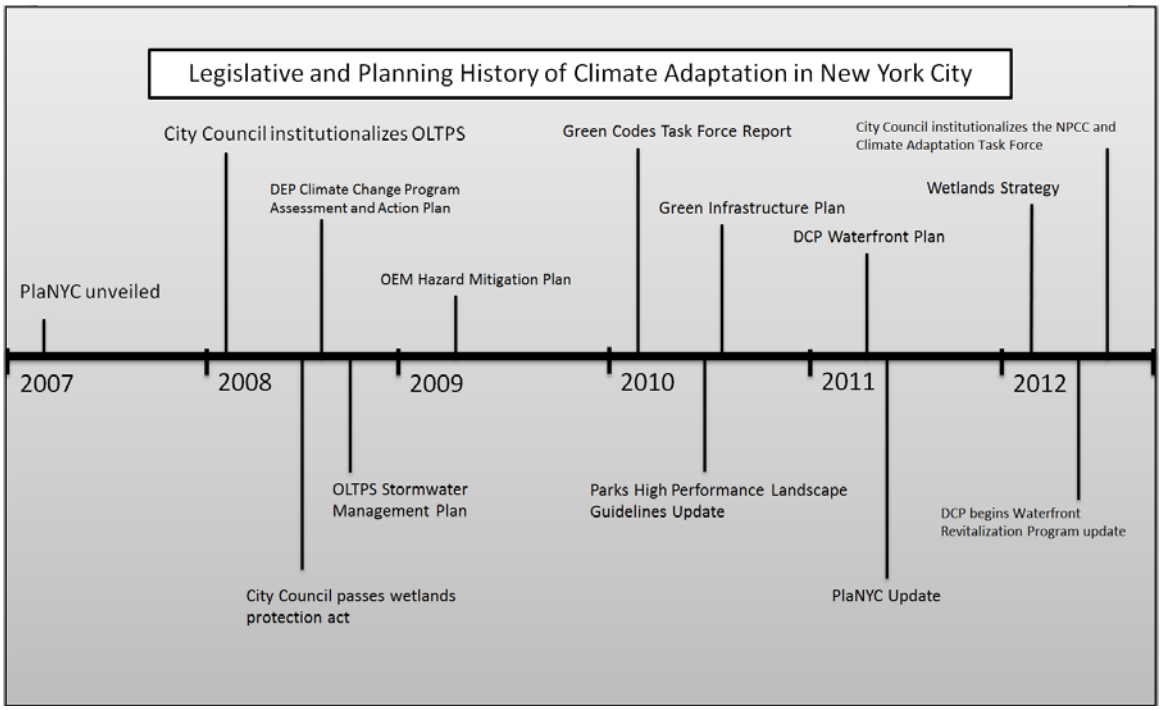

Figure 4.3. Major plans, legislation, and regulations regarding climate change adaptation in New York City.

Some of these plans show some creativity by the city in that they use plans meant for other purposes to increase the legibility of its own climate adaptation program. One example is OEM's *Hazard Mitigation Plan*, which the Federal Emergency Management Agency (FEMA) requires every five years for local hazard mitigation plan funding. New York City has integrated some its own climate adaptation goals into the plan. The 2009 plan acted as comprehensive inventory of existing proposed climate adaptation project in New York City, and the 2014 plan is expected to include climate change as a natural hazard, a framing that has implications on the way that OLTPS and thus the city views climate adaptation/resilience. That is, New York City views climate change as having similar social and political economic implications as existi natural hazard.

The New York City Council has also passed legislation to institutionalize and direct the focus of climate adaptation planning initiatives. Two bills successfully cleared the City Council in 2008, representing a formalized integration of climate adaptation planning into the governing of the city. The first act amended the charter to institutionalize the Mayor's Office of Long-term Planning and Sustainability, which established a code for the office to oversee and monitor sustainability planning in New York City (NYC Council Bill 395 2008). The city council also passed the Wetland Acts, which officially created a comprehensive wetlands strategy in New York City. The law included explicit language that emphasized the role of preserving and creating new wetlands as a strategy to respond to the challenges posed by sea level rise and climate change (NYC Council Bill 506 2008). These two acts reveal a City Council vision of climate adaptation, which includes a permanent office centrally directing these initiative and an emphasis on solving sea level rise and related flooding threats over other climate change threats. Passed in August 2012, the next major bill institutionalized the New York City Panel on Climate

Change (NPCC) and Climate Adaptation Task Force, which compels both bodies to address the impacts of climate change on communities, vulnerable populations, public health, natural systems, critical infrastructure, buildings, and the economy (NYC Council Bill 836 2012). As a result, the City Council has imposed a broader framework for climate adaptations, as the original versions of both bodies focused on the impacts of climate change on critical infrastructure. The next section examines the bureaucratic structure that has emerged in New York City for developing and implementing climate adaptation strategies.

4.4 Bureaucratic Structure of Climate Adaptation Planning in New York City

Starting with the unveiling of PlaNYC, New York City has institutionalized climate change adaptation. Figure 4.4 shows the climate adaptation structure that has emerged in New York City. OLTPS is central to this effort, as the City Council has granted the agency authority to coordinate adaptation programs, departments, and task forces. Section 24-20 of the New York City charter grants the director of OLTPS the following power:

> "develop and coordinate the implementation of policies programs and action to meet the long-term needs of the city, with respect of its infrastructure, environment and overall sustainability citywide, including but not limited to the categories of housing, open space, brownfields, transportation, water quality and infrastructure, air quality, energy, and *climate change*; and regarding city agencies, businesses, institutions and the public;" (NYC Charter 2012, emphasis added).

Many city departments and agencies take part in these plans, including the Department of City Planning (DCP), the Department of Buildings (DOB), the Department of Environmental Protection (DEP), the Department of Parks and Recreation (Parks Department), and the Office of Emergency Management (OEM). These departments often support OLTPS to plan for climate change. For example, DOB has worked with OLTPS and DCP to flood proof buildings, and OLTPS includes DCP as a partner in efforts to improve coastal resilience (OLTPS 2012). City agencies may also lead their own projects supported by OLTPS. As it oversees most of the water

infrastructure, DEP's climate adaptation goals include maintaining a sufficient supply of high quality drinking water, improving ambient water quality, and adapting wastewater systems to increased flooding threats (DEP 2008). Thus, one of its main programs is to raise the height of New York City wastewater management facilities to decrease the threat of flooding due to rising sea levels. The agencies working with OLTPS may also coordinate programs more directly with each other. DCP and the Parks Department are involved in a joint effort to plant 10,000 new trees every year to improve the cities stormwater drainage system and mitigate the urban heat island.

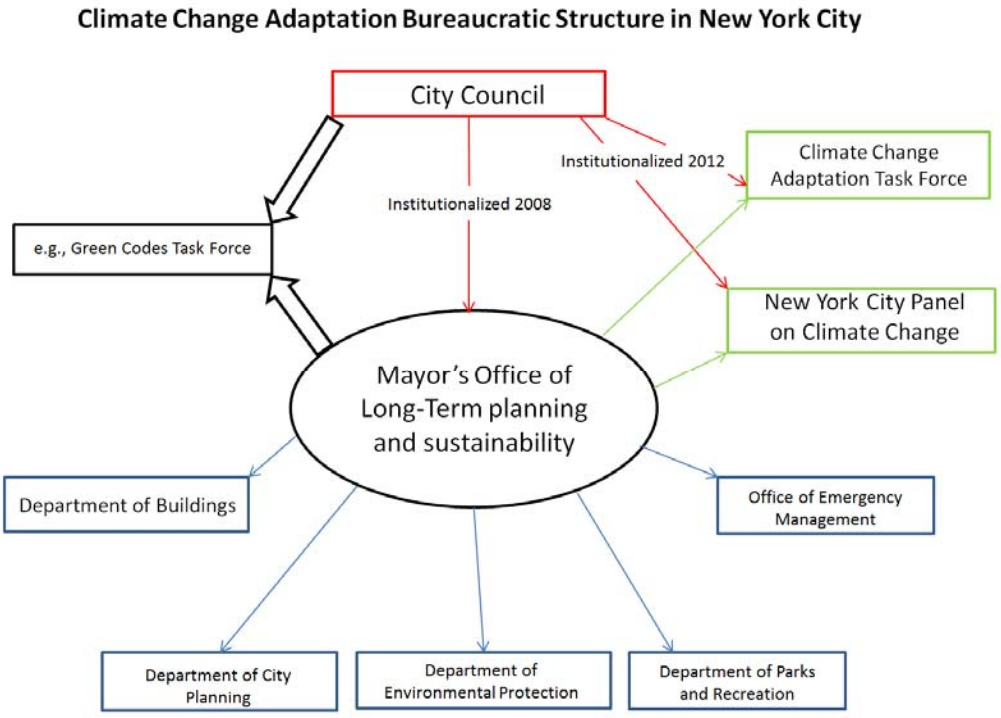

Figure 4.4. The bureaucratic structure of climate change adaptation governance in New York City. The central agency is the Mayor's Office of Long-Term Planning and Sustainability (OLTPS). Red represents institutions created by City Council bills. Green lines and boxes represent the task forces overseen by OLTPS. Blue lines and boxes point to the major city agencies involved in climate adaptation also overseen by OLTPS. The black open arrow points to organizations relevant in climate adaptation overseen by the quasi-governmental organization, the Urban Green Council, at the request of the Mayor and the City Council Speaker.

Figure 4.4 also shows the two climate adaptation task forces that OLTPS oversees. The first is the NPCC, which has two separate iterations. Mayor Bloomberg formed the original NPCC in August 2008, which was then composed of climate scientists, social scientists, as well as risk management, insurance, legal, and infrastructural experts (Rosenzweig et al. 2010). The panel was charged with analyzing the future impact of climate change on New York City's critical infrastructure, which it separated into five basic categories: water, transportation, energy, communication, and waste. Their work resulted in a 2010 report outlining climate risks faced by the New York City metropolitan regions, a risk management framework for approaching climate change, and recommendations of tools to aid stakeholders in the planning process (Rosenzweig et al. 2010).

Although the NPCC dissolved after 2010, the city council passed a bill in August 2012 to institutionalize the body. The panel has been charged with a somewhat different role and more limited role. They are expected to meet twice a year with OLTPS to communicate the latest climate change projections and impacts in the New York City region (NYC Council Bill 836 2012). It also is not as singularly focused on critical infrastructure, as public health, vulnerable populations, city communities, buildings, and the economy are all outlined in the legislations as areas of focus for the NPCC (NYC Council Bill 836 2012). Especially notable is its role in helping OLTPS develop a borough- and community-level engagement strategy (NYC Council Bill 836 2012), a feature absent in its first iteration.

The Mayor commissioned the Climate Change Adaptation Task Force at the same time as the original NPCC. The NPCC was a technical advisory board to this task force and the Mayor's office on climate adaptation. The task force was originally composed of 38 public and private

stakeholders with oversight over New York City's critical infrastructure (Rosenzweig et al. 2010). Four main initiatives of the task force were (Mayor's Office 2008):

- to create an inventory of infrastructure potentially at-risk to climate change
- to use New York City climate projections to develop adaptation plans
- to develop guidelines for designing new infrastructure to climate change impacts
- to identify future adaptation strategies for further study

Similar to the NPCC, the role of this task force expanded in the same 2012 city council bill to developing strategies to address potential impacts of climate change to public health, and natural systems (NYC Council Bill 836 2012).

Not every climate change adaptation related task force has been overseen by OLTPS. The exceptions include the Green Codes Task Force, the Greener, Greater Buildings Task Force, and the Building Resiliency Task Force. A non-profit sustainability organization that includes the DCP Director, Amanda Burden, on its executive committee, the Urban Green Council (UGC) has administered these task forces at the request of the Mayor and City Council Speaker at the time of their formations (UGC 2013). As a result, UGC acts as a quasi-governmental organization, conducting investigations into climate adaptation with many members from the city bureaucracy while maintaining its status as an independent non-profit.

The institutionalized structure of the climate change adaptation bureaucracy reflects the planning priorities of New York City. Planning efforts that direct or manage the flow of water in the city seem to be privileged. Thus, managing drinking water, zoning to coincide with changing flood levels and frequency, and improving stormwater facilities and drainage are revelatory of these priorities. At the same time, the city has institutionalized a network of scientists and technical experts to advice on climate adaptation strategies, establishing an explicit group of experts involved in climate adaptation planning.

4.5 Conclusion

This chapter outlines the institutionalization of climate adaptation planning in New York City. The chapter discusses the history of the scientific discourse regarding climate adaptation that started in the mid-80s and evolved into multiple reports commissioned by environmental organization, the federal government, and the city government in the 1990s and 2000s. Although predated by a task force in the New York City DEP, the 2007 PlaNYC marked the first published plan to include climate adaptation. Since the development of this centrally important document, city agencies have developed a variety of plans and task forces—such as DCP's *2011 Waterfront Plan* and the NPCC—and the city council has passed three bills to address this issue. As a result, a climate change planning apparatus coordinated by the Mayor's Office of Long-term Planning and Sustainability has emerged in New York City. The next two chapters analyze the socio-environmental narratives (such as risk-management) and governing technologies (such as mapping and risk communication) used by city agencies, task forces, and the local scientific community in responding to climate change adaptation.

CHAPTER 5

SOCIOENVIRONMENTAL NARRATIVES OF NEW YORK CITY CLIMATE ADAPTATION PLANNING

5.1 Introduction

This chapter discusses the socio-environmental narratives that underlie climate adaptation planning in New York City. I use the term "socio-environmental narratives" to refer to the characterization of nature and society embedded in discussions of climate change impacts and policy responses that is the product of two interrelated processes: local officials' negotiation of wider urban economic interests and the use of science and expert knowledge in social order. This chapter shows that New York City climate adaptation planning emphasizes a risk-management framework and the use of techno-scientific expertise in its characterizations of how and why climate adaptation planning should unfold. The chapter defines the origins of the risk-management approach in the New York City Panel on Climate Change (NPCC) and examines four distinct iterations: 1) the prioritization of climate adaptation strategies that are seen as cost effective, 2) a shift in the focus of planning from adaptation to resilience, 3) a focus on the potential increase in flooding to city infrastructure, and 4) making climate adaptation planning compatible with already existing city risk-management programs. Risk-management strategies originate from the state's prioritization of knowledge from technical and scientific experts who have engaged in extensive research of climate impacts in New York City and the surrounding metropolitan area (discussed in Chapter 4). This group of "independent" experts and government workers inform the city on the best available science from which it develops its climate

adaptation plans. At the same time, the privileged position of this group is determined by its role in advising the city on plans that eventually undergo a separate community review process. In other words, "expert" and community knowledge determine the outcome of the adaptation planning process, but climate scientists and risk management experts play a more central role in initial production of planning documents. The final section of the chapter examines these two dominant narratives in relation to the contentious debate on building a multi-billion dollar storm surge barrier.

5.2 Building a Risk-Management Climate Adaptation Framework

The risk-management approach to climate adaptation came from the 2010 NPCC report, *Climate Change Adaptation in New York City: Building a Risk Management Response*, which calls for adapting and mitigating to climate change through an iterative risk-management process (Yohe and Leichenko 2010). In the report, Yohe and Leichenko (2010) provide a statistical definition of risk-management as: "risk = the probability of an event multiplied by some measure of its consequences" (31). Take the example of a 100-year flood projected to cost the city $1 billion in infrastructural damages every time it occurs. That means a risk management assessment would multiply 1/100, the probability of a 100-year flood in a given year, by $ 1 billion to yield an annualized costs of $10 million from such a flood. This statistical measure allows decision-makers a way to see how risks can be spread and diversified to improve social welfare in the context of uncertainty, such as the possible threats of climate change. Within the risk-management framework, the report focuses on developing three workbooks for the city: one produced by mostly climate scientists on climate impacts, the second developed by mostly social scientists on adaptation assessment, and the third providing a legal framework for climate protection levels. In an interview, one scientific expert describes this focus:

> "So basically the city asked us to do the three workbooks. So those are the three workbooks at the end. What the chapters provided are the basic knowledge that lies underneath the creation of the workbooks. So for example, the climate scientist contributed to the workbook on climate projections. There was a chapter on the framing climate change adaptation as a risk management issue. That was the theoretical basis for the development of the adaptation assessment steps, which is a risk management framing. Then the legal chapter was a lot of the basis for the climate protection level" (Scientific Expert 1, June 13, 2012).

These guidebooks provide perspectives on how to adapt New York City's critical infrastructure to climate change. The five main infrastructures covered by the report are communications, water, transportation, energy, and waste. Scientists serving on the panel knew that their work would emphasize adapting infrastructure. As one member notes:

> "But I think this part was very focused on infrastructure. It wasn't like let's do a general vulnerability of New York City. It was really let's look at New York City's critical infrastructure, like communications, transportation, energy, water…Then identifying who are the key entities in those infrastructure sectors, and then organizing meetings with those representatives to press them on what they see as critical areas" (Scientific Expert 4, August 2, 2012).

Managing risk to critical infrastructure—that is, structures and services that keep the economic engines and social services of the city running—is the main emphasis of the NPCC report, but the findings themselves are not specific to each city agency. Instead, the document outlines a scientific framework through which individual city agencies should understand climate change and determine policy and planning priorities within the risk management context. Employees at the Department of Environmental Protection (DEP) and Department of City Planning (DCP) both confirm that their departments advance climate change priorities based on risk assessments. At DEP, one employee described this process as follows:

> "We use in-house consultant expertise on New York City's wastewater and stormwater system and then also we've hired consultants that understand the science of probability because essentially what we want to end up with at the end of the study is sort of risk-based analysis with some sort of prioritization or our risks" (Government Worker 3, June 12, 2012).

Risk-management tools are also useful for DCP, and one employee contends that:

> "Flood resilience stuff is really risk management. How much does it cost to achieve a particular standard of safety or flood proofed-ness for a particular building or facility? What's the value or risk that you're alleviating to take that effort and how much does it cost to get there?" (Government Worker 7, July 12, 2012).

These quotes show how the risk-management framework serves as the basis of New York City's climate adaptation planning process, but further interviews revealed that there are four key elements of this risk management strategy (each discussed in detail below): cost-benefit analysis, urban resilience, flooding and storm surge, and compatibility with existing urban governance mechanisms.

5.2.1 Developing a Cost-Effective Climate Adaptation Strategy

Cost-benefit analysis is used to assess infrastructural risks to future climate. Cost-benefit analysis means developing monetized calculations of the advantages (benefits) and harms (costs) of undertaking policies and efforts to address climate change (Yohe and Leichenko 2010). The city employs cost-benefit analysis to determine the best allocation of financial resources in addressing its risks to climate change. As a result, the city analyzes the costs and benefits of projects that include retrofitting certain infrastructure (e.g., wastewater management facilities), prioritizing coastal adaptation strategies (deciding what type of coastal barriers to build, such as sea walls or a storm surge barrier, and where to build them), and improving stormwater drainage (e.g., planting more trees or making surfaces more permeable). Efficiency determines what projects are prioritized. Although the city seeks to improve the city's response to the increased environmental stress of climate change, efficiency ultimately entails achieving environmental benefits in the most cost-effective way possible, as opposed to other prioritizing strategies, such as adapting the most vulnerable people and neighborhoods to climate change or planning for the most expensive potential disaster exacerbated by climate change. This section discusses cost-

benefit analysis as a socio-environmental strategy to find ways to adapt the city's political economy to climate change without expending limited financial resources to expensive projects with little determined monetary benefits.

Articulating cost-benefit analyses of such policies as infrastructural projects, retrofitting buildings, coastal barriers, and stormwater management strategies is a central component of assessing and managing the city's climate risks. As a result, three government workers mentioned that their agencies have hired risk-management consultants, and the NPCC included risk-management insurance professionals as some of their climate "experts." For example, being able to annualize costs of climate change impacts on city infrastructure was as important as specific climate science expertise in hiring NPCC members. One member noted that he was hired to participate in city adaptation strategies because his ability to develop software that modeled and annualized the potential cost of disasters on infrastructure. In his words:

> "I came to climate by a detour making loss assessments for New York City, putting on the computer an earthquake of the city and shaking it up to see what comes out. When we showed those results to climate change concerned people, they said, 'oh can you do that for hurricanes and other weather events.' I said, 'I don't know but I can try.' And a year later take me for a climate scientist, which I never was" (Scientific Expert 3, July 10, 2012).

Whether modeling for disasters or for every day events, similar concerns for the cost of infrastructural losses underlie city agency climate adaptation programs. For example, DEP quantifies the risk that climate change poses to the infrastructure that they own as well as the costs of not updating that infrastructure on the rest of the city. That is, they are currently engaging in an effort to raise their wastewater plants to protect against future storm surge. At the same time, the agency is part of the stormwater management plan, which aims in part to reduce the impacts of the city's sewer and stormwater drainage system on its own infrastructure. Government Worker 3 expressed this concern well:

> "Again, our function is more to make sure that we're protecting water quality and drainage as it relates to changes in precipitation as opposed to storm surge. The idea of water out at the level of flooding, there's just nowhere to put it basically. There's no way to drain it. So we want to make sure that we're protecting whatever infrastructure is in that area to make sure that we get the sewer system back up and running, and that we're not causing millions or billions of dollars in damage to our infrastructure" (June 12, 2012).

DEP is not the only agency with this strategy of assessing climate risks to its infrastructure as well as the costs of doing nothing. OLTPS and DCP also partake in similar efforts to monetize the city's vulnerability to climate change. As the lead on climate adaptation, OLTPS makes their risk assessment strategy a clear part of their PlaNYC 2030 goals. Thus, they write:

> "to increase our resilience even further, we will build upon many of the planning efforts already underway. This will ensure that knowledge we have gained is put into use on the most cost-effective risk reductions. We will create a climate risk assessment tool to prioritize our actions and evaluate the effectiveness of our decisions" (OLTPS 2011: 151).

Here OLTPS reveals the importance of monetized risk analysis in their climate adaptation strategy. DCP also prioritizes risk assessment and the need to develop the most cost-effective climate adaptation planning strategies. Two employees at this agency concurred with this goal, and both mentioned that there are no easy large scale projects that would ensure protection against climate threats. Instead, city planners have to be realistic about how much climate protection that each dollar yields. One of them noted:

> "But really the goal is to find the most cost-effective set of solutions. It's not going to make sense to deploy an enormous number of public dollars to protecting a neighborhood that is going to ultimately be un-protectable. That's where the cost-benefit piece of this is really key" (Government Worker 7, July 12, 2012).

The other DCP employee expressed a similar viewpoint, noting that the job of city planner is to focus on the event that happens 99 percent of the time, not the 1 percent (for example, DCP is concerned with developing stricter freeboard standards, or heightening requirements for first

floors of buildings, to align with sea level rise projections). In other words, DCP prioritizes adaptation measures that stem from the most likely climate scenarios in a cost-effective way, instead of throwing money at a more fringe disaster prediction. The latter may seem scarier and more daunting, but DCP must most efficiently and effectively use its limited financial resources.

Although monetizing these costs is emphasized, there are other costs and benefits considered in some of these analyses. In the NPCC report, Yohe and Leischenko (2010) note that some benefits and even costs attributed to climate change cannot be put in monetary term. For example, part of the Parks Department's climate adaptation initiatives are to develop strategies that make their properties—that is, parks and other recreational facilities—more beneficial to the overall environment of the city. As a government worker stated in an interview: #

> "…parks are functional above and beyond their 14 percent of the land mass. The benefits we can provide in just 14 percent of New York help to mitigate the impact of a dense urban area by making sure you have continuous chains of spaces that pollinators can move throughout, birds can migrate through, making sure essential green spaces serve as sinks for stormwater, that we help mitigate urban heat island through our park space. But then also in expanding the canopy cover of street trees, so that even through dense paved areas, there's a component of green infrastructure" (Government Worker 2, June 11, 2012).

Here the employee describes the benefits of parks and recreational facilities as a suite of environmental services, some of which are central to adapting the city to increased stormwater from climate change or reducing the urban heat island effect. After all, New York City's climate adaptation strategies include minimizing water quality impacts to receiving waters (DEP 2008), a goal affiliated with the OLTPS-led stormwater management plan trying to significantly increase the number recreational waterways in New York City by 2030. Improving ambient water quality may improve quality of life for New Yorkers, but does not directly save the city and citizens money.

Environmental concerns that appear to have no immediate financial benefit are also part of this planning process, but using the city's limited financial resources to adapt infrastructure in the most cost-effective way has emerged as a key theme in most interviews with city officials, suggesting that monetizing risks is prioritized in the city bureaucracy. The concern here is directly related to the need for keeping the city (as a complex socio-ecological system) running the same way despite future increases in environmental stresses due to climate change. The need to keep various components of the urban landscape—people, goods, water, and energy—moving and circulating in a new socio-environmental context is supported by the city's discursive shift in framing climate adaptation as resilience. This risk to the metabolism and circulation of the city is understood in economic terms, where adaptation solutions are seen as viable if they are cost effective, which has the potential to downplay other measures of risk, such as vulnerability differentiated by socio-economic status.

5.2.2 From Climate Adaptation to Resilience

The next key point is how the city has shifted its discursive framing from adaptation to resilience. The most apparent source of this shift is the language changes from the 2007 PlaNYC report to the 2011 update. In the 2007 report, adaptation itself is never defined, but the intent on developing a comprehensive adaption strategy is clear when the report states: "we will embark on a broad effort to *adapt* our city to the unavoidable climate shifts" (OLTPS 2007: 136). The term adaptation is absent in the 2011 report. Instead, the report states that: "we've [New York City] launched one of the most comprehensive efforts of any city in the world to increase our resilience to climate change" (OLTPS 2011). It also provides a definition of climate resilience as "our ability to withstand and recover from extreme events and environmental changes" (OLTPS 2011: 15). The key here is that the emphasis of adaptation planning is *not* on reducing the

underlying causes of vulnerability for the city's residents or infrastructure, but on quickly "recovering" from dramatic weather events in a way that maintains local and regional political economies. This section discusses how resilience has become a new strategy for framing adaptation, how city agencies have internalized this shift, and the significance of making New York City climate resilient.

The city has used resilience as a new way of framing climate adaptation, suggesting an effort to maintain consistent political economic flows even in the face of increased stress from climate change. The PlaNYC website lists the NPCC reports, *Climate Change Adaptation in New York City: Building a Risk Management Response*, under the subheading climate resilience. Also, many of plans and initiative that the 2011 PlaNYC report mentions as resilience were originally conceived as adaptation strategies. It also celebrates New York City as a leader in climate resilience, even though the word resilience is never even mentioned in the 2007 report. Further suggesting this strategic shift to resilience is that the 2009 Office of Emergency Management (OEM) hazard mitigation plan includes a comprehensive inventory of programs to improve the city's climate adaptation, not climate resilience (OEM 2009).

City agencies also seem to have internalized this strategic framing of adaptation. Three of the government workers framed adaptation as climate resilience, but this was especially true for those working at DCP. Government Worker 4 stated in response to an interview question about her involvement with climate adaptation planning:

> "The money for *adaptive strategies* came from this Housing and Urban Development (HUD) grand, HUD sustainable communities program. It's overall a two year grant with a bunch of different projects having to do with building density near transit in the Bronx and Brooklyn. And then there were a few other *resilience* pieces as part of that. So HUD was very interested in having *climate resilience* as part of that grant" (June 19, 2012).

Government Worker 7's response was similar regarding DCP's role in climate adaptation strategies: "And in New York City, what we're doing is developing a *climate resilience* piece, which is focused on New York City but has regional applicability" (July 12, 2012). Other agencies also seem to be following this official OLTPS terminology shift. At DEP, Government Worker 3 mentioned in an adaptation dialogue: "It's essentially to make sure our systems are robust so they're not going to be wiped out for months at a time, because I think a huge impact in terms of *resiliency* is how fast you can get the city back up and running" (June 12, 2012).

The importance of this discursive shift has nothing to do with how effective climate adaptation or resilience measures are. Instead, it refers to how city officials have framed the climate agenda as a way to show that the city plans to remain a robust delivery system of goods, ideas, and services in the face of an ever-changing climate. Resilience serves the purpose of making adaptation strategies a way in which services, conveniences, and other expectations of the city will not be compromised despite the new and unpredictable threats of climate change. Perhaps the city's most aggressive strategy relates to its concerns for future increases in flooding to critical infrastructure.

5.2.3 Emphasizing Adapting to Future Flooding Vulnerabilities

Whether from increased precipitation, storm surge, excess stormwater, or any other source, adapting to potential increases in flooding due to climate change is more emphasized than other possible climate change impacts in New York City's adaptation planning. The preeminence of flooding initiatives is most notable in the building resilience section of the Green Codes Task Force (GCTF). Of their nine recommendations, four are efforts to identify, manage, or project flood risks related to climate change. Making this emphasis more apparent is that flood and non-flood climate risks are separated. Thus, recommendation three is study adaptive

strategies to flooding, and recommendation four is to study adaptive strategies to non-flood risks (GCTF 2010).

Reducing flooding risk also underlies the priorities of city agencies. OLTPS has led a project to update flood risk maps to include projections of sea level rise to 2080, which is not only the first priority in the building resilience section of the Green Codes Tasks Force 2010 report but is also one the objectives of the 2011 update of PlaNYC. At the same time, the OLTPS administered stormwater management plan includes in its main goals to find ways to reduce stormwater runoff, a problem that may potentially increase flooding risks in city (OLTPS 2009). Under this plan and with some of their own initiatives, DCP, DEP, Parks, and other agencies manage projects to meet stormwater management and flooding demands. For DCP the central climate adaptation priority reflects this concern for flooding related to storm surge: they are in the process of updating the waterfront revitalization program (WRP) to include flood-proofing and building height regulation as part of coastal zoning in New York City. In interviews, Government Worker's 4 and 7 both emphasized the central importance of flooding to their agency. According to Government Worker 7:

> "And what we're doing is developing a climate resilience piece, which is focused on New York City but has regional applicability…What we're doing is looking at urban design implications and regulatory implication of freeboard, building buildings to *higher flood elevation* than is required by FEMA, and also looking into the inventory of best practices for *coastal diversity*. What can you do? It's not all about flood prevention. It's about urban coastal erosion prevention. It's in service of both that and in particular storm surge attenuation. All sorts of other techniques down to *building scaled strategies to reduce flooding*" (July 12, 2012).

Even while acknowledging the existence of other strategies, DCP's planning efforts seem to focus on increasing flood protection and prevention by improving zoning guidelines and working with other agencies to update the flood-proofing requirements of the building code. In reference to the WRP directly, Government Worker 4 described similar flood management priorities:

> "The WRP is the newest thing that we have to do. It is the first time the city has incorporated adaptation into its regulatory framework…in WRP, we're asking projects to assess risks from *current and future flood risks* using the best available science" (June 19, 2012).

Here the government worker demonstrates the centrality of flooding not only to DCP's adaptation planning efforts, but for the city government in general. As one of the first regulatory frameworks to make climate adaptation binding, the WRP reflects the larger goals and priorities of the city.

To take this analysis a step further, other agencies also incorporate flooding as one of the more important parts of their adaptation strategies. DEP has two main concerns regarding flooding: reducing stormwater runoff and protecting wastewater facilities from flooding. Government Worker 3 notes both strategies:

> "We're producing an assessment right now looking at the impacts of storm surge on wastewater treatment plan at [OLTPS's] request…Other than that, we've, as far as climate change goes, we really just work with city planning. People come to us with questions about what we should do with outfall, sizing the sewer system, stormwater management, and we provide whatever resources we have" (June 12, 2012).

As at DCP, DEP targets flooding based adaptation strategies at the request of the central authority, OLTPS. Again, their influence suggests that probably the most dominant concern is adapting city infrastructure to the potential increased flood risks brought on by climate change. After all, flooding of wastewater treatment plants, industrial centers along the shoreline, utility lines, or other critical infrastructure has two major implications. First, any time the city infrastructure is offline and flooded means that the city cannot perform its expected regulatory and economic functions. Thus, the city may temporarily shut down at an expense to its economy as well as even the health of its citizens. Second, continually mending flooding damages incurs a significant monetary cost to the city. If the infrastructure remains highly susceptible to flooding,

it becomes easier for insurers to deny flood coverage of city infrastructure. As a result, city-owned buildings could become uninsurable, especially if sea level rise makes damaging flood events more frequent for existing infrastructure. Managing flood risks may be the key priority of city adaptation planning, but implementing these changes is nothing dramatically new.

5.2.4 Managing Risk to Climate Change within Existing City Projects

The final characterization of climate adaptation in New York City is that it is already compatible with existing mechanism of urban governance, and thus, represents an extension of existing priorities and strategies. It is best to think of climate adaptation as an addition to previously existing city risk management programs, not as strategies that completely revolutionize New York City government practices. PlaNYC is the first major city initiative to include climate change as part of the city planning apparatus, but the plans, legislation, and initiatives that it has inspired tend to add a climate change component without completely altering the bureaucratic landscape. City agency initiatives provide the most notable examples of this practice. OEM plans for climate adaptation using its hazard mitigation plan. According to Government Worker 6, the Federal Emergency Management Agency (FEMA) requires a hazard mitigation report in order for a municipality to receive federal funding. So compiling the report is already a goal of New York City, but the city has started adding a climate adaptation component to it. Thus, the 2009 report incorporates climate adaptation as a risk that city agencies have started addressing. The 2014 report is expected to include climate change as a major natural hazard itself. Even as the section on climate adaptation expands in these reports, the goal of the plan remains the same: it surveys the owners of infrastructure in New York City and their main capabilities so that the city knows how to mitigate and respond to disasters. As Government Worker 6 notes:

> "What we do is to coordinate and lessen the impact from a hazard on New York—whether that's the built environment, the people, or the coordination agencies. So our job is to know all the key players and core competency of everyone out there and the stakeholders. So when something happens, we can bring the right people together at the right time and the right place and bring the right stuff there to help lessen that impact" (June 29, 2012).

In a similar vein, DCP and the Department of Environmental Conservation (DEC) have started updating their previously existing regulatory frameworks to the challenges of climate change. Thus, DCP's updating of WRP to include climate adaptation strategies can be seen as a way for the agency to include this risk without removing existing regulations. DEC has moved to include climate change as a component in City Environmental Quality Reviews (CEQR) for any new buildings. Such CEQRs are an existing mandate for any development, but plans suggests that climate change must now be included in already long list of environmental hazards (GCTF 2010).

The Department of Parks also employs this strategy. Managing existing and developing new parks has always included a number of considerations and guidelines. Climate adaptation assessments only became a consideration in Park's 2010 guideline updates. Government Worker 2 expressed this policy well: "I think that when you're thinking about things like climate change in a way that's one more thing to add onto a very long list of plans" (June 11, 2012).

Describing climate adaptation as only an addition to the bureaucratic structure does not make New York City's concern for it any more trivial. Instead, it shows that city agencies have to find practical ways to incorporate climate adaptation into a previously existing array of plans, strategies, and regulation guidelines. Climate adaptation may even become central to concerns of city planners—which it has in some cases—but the fact remains that ridding the city of established frameworks and practices is not easy, cost efficient, or even at all practical, even against a threat conceived as potentially disorienting to the processes and flows of the city as

climate change. As a result, the best way for the city to make climate adaptation a visible regulatory strategy is to institutionalize it into already established frameworks for regulating property and the environment. To this point, the discussion has focused on New York City's risk management strategy, whose implementation depends on a group of "independent" and city employed experts including climate scientists, social scientists, risk management experts, and insurance experts.

5.3 Techno-Scientific Expertise in Climate Adaptation Planning

Techno-scientific experts refers to the climate scientists, social scientists, as well as law, risk management, infrastructural, and insurance experts that advise the city on climate adaptation planning. As noted in the previous chapter, discussions of climate impacts in New York City date to 1986, but the city did not directly hire climate experts until the 2004 task force to adapt DEP infrastructure to climate change. Three years later, PlaNYC established a goal to develop a New York City climate change advisory board that would include scientists, engineers, insurance experts, and public policy experts to assess risk in cost-benefit terms and offer possible solutions to future increases in storm surge and flooding levels (OLTPS 2007). The Mayor's Office eventually appointed a group of experts that became known as the New York City Panel on Climate Change (NPCC) in 2008. The purpose of the NPCC was to project the latest climate change predictions for the city, to develop a framework for city planners to understand how to approach this issue, and to examine possible changes to codes and regulations that would help the city meet its goals.

The NPCC reflects a reliance on a diverse group of experts that became the first stage of New York City's climate adaptation planning strategy. Members of this original group received clear instructions from the city about the purpose of the NPCC. According to Scientific Expert 4:

> "The leaders came in with that perspective. We want to have the latest scientific information. What's the latest body of scientific knowledge that we can bring to bear on this issue? It was through that discourse and language of science and the role of scientists to provide the most accurate and up-to-date information and then the policymakers use that information" (August 2, 2012).

The city also gave the panel explicit instructions on what types of expertise to include on this panel. Scientific Expert 1 described the need to have specific expertise for each of three workbooks created in the study:

> "In the discussions with the city, there were three aspects that they wanted us to focus on. One was the climate change scenarios, the projections of climate change for the New York City region. So that means we needed to have climate scientist on the NPCC. The second part was adaptation assessment guidelines. That meant that we needed social scientists as well as risks management experts…So that explains the insurances experts and consultations on risk management. And the third area was on standards and regulation. So that explains why we have lawyer with us as well. Because the task force focuses on critical infrastructure, we had infrastructure specialist with us as well" (June 13, 2012).

The crucial point to take away from these passages is that city had specific expectation of who it wanted to advise the city on climate change. They sought these experts to gain the most up-to-date theoretical information on climate adaptation strategies, the most precise projections of climate change and its impacts in New York City, and an inventory of their impacts on existing city codes and guidelines. This group of experts has acted as a boundary organization. The scientists and other experts serving on the panel were considered independent and separate from the political process, yet they developed a document outlining specific climate impacts, a framework to approach these risks, and way to codify this framework that has become influential in city planning efforts. Their recommendations cannot be conceived as policy, but the group was hired explicitly by policy-makers to advise them on the latest information on adapting New York City to climate change. As a result, the NPCC sat at the boundary between science and

policy-making, not pushing a binding agenda but nonetheless influential in molding the strategies and concerns of New York City policy-makers and planners.

City agencies now employ climate change experts of their own. According to Government Worker 3, DEP has hired experts with knowledge of New York City's wastewater and stormwater systems as well as risk management experts. Their goal is to examine these systems for areas most vulnerable to flooding or wastewater overflow and develop strategies to resolve these problems. DCP does have zoning and development experts, but they defer to other agencies on central issues, such as flood protection. According to Government Worker 7: "When it comes to flood protection, we don't have a lot expertise. The city has a certain amount of in-house expertise among the agencies, like in DEP and OLTPS, they have engineers that know about some of this stuff." (July 12, 2012). Although their main missions have not changed dramatically, city agencies have started employing their "experts" towards climate adaptation initiatives. Of course, they have hired new experts, such as risk management experts in many agencies, but they have not necessarily overhauled their core function for a specific climate adaptation purpose. Instead, they have used their existing in-house experts to examine climate adaptation issues as needed. Then, when these experts do not serve their needs, they utilize what appears to be an open interagency network to obtain the desired data or analysis.

A more telling sign of the central role of techno-scientific expertise, though, is the direction of climate adaptation legislation. The 2012 act to institutionalize the NPCC and Climate Adaptation task forces is probably New York City's most important climate adaptation legislation to date. The bill mandates that the NPCC meets twice a year to update the city on the latest climate change projections and to review data on the impact of climate change on communities, vulnerable populations, public health, natural systems, critical infrastructure,

buildings, and the economy (NYC Council Bill 836 2012). In this bill, the NPCC has a more comprehensive function than its original role of analyzing adaptation potential of critical infrastructural, but the philosophy remains the same. The city will continually seek advice from a group of techno-scientific experts to provide the most reliable and up-to-date advice on climate adaptation strategies.

The central role of experts in climate adaptation planning does not mean the city has not developed a community engagement strategy. In fact, one of the original goals of PlaNYC was to bring climate adaptation to the neighborhoods and the 2011 update also expressed the need for neighborhood-based climate resilience strategies (OLTPS 2007; OLTPS 2011). Such efforts, though, are separate from the expert planning phase. DCP is one the leader this community strategy. As Government Worker 4 described:

> "Then I also think what's important in terms of what planners do is talking to communities and being this liaison between communities at risk and policy going on through the city, state, and federal government, and trying to use people's expertise because people know where they live pretty well and understand needs they may have" (June 19, 2012).

This passage suggests that communities play a role in the final planning decisions at the neighborhood scale, but there is a distinction between what role the community plays versus scientists. The city separates the collection of technical and community-based knowledge, with the city trying to gather the latest climate science and technical assessments of infrastructure before engaging the community. According to one expert working on the NPCC:

> "I would definitely say that there were comments made, when is the public going to be involved in this? Where is the possibility for public involvement? And the response of the city was that's the next stage. This is our technical stage of the process. Once we finish the technical phase. We're going to start the next phase with a lot of public input (Scientific Expert 4, August 2, 2012)."

Such discourse indicates two aspects of New York City climate adaptation planning. First, community feedback is a vital part of the planning process, as DCP and other agencies set up workshops to have conversations about climate planning goals. Second, scientific information is privileged in approaching more general climate adaptation strategies and creating the latest knowledge and data on climate change impact in New York City. As a result, "experts" and "non-experts" both play roles in climate adaptation planning, but city officials makes a clear distinction between the functions of these groups in the process. The next section examines the articulation of risk-management and scientific expertise through a brief discussion of a disagreement among community activists, different experts, and the city government regarding a proposal to build a multi-billion dollar storm surge barrier.

5.4 A Storm Surge Barrier in New York City

All the socio-environmental narratives regarding climate change adaptation discussed in the previous section inform the debate on the New York City storm surge barrier. The city has made no decision to move forward on a storm surge barrier, sea walls, or other protective measures, but one proposal recommends building three sea gates at an estimated $17 billion at Jamaica Bay, the Verrazano Narrows, and the East River (Stutz 2012; Figure 5.1). Not every "expert" is convinced the multi-billion dollar barrier would be effective. Scientific Expert 3 depicts the barrier as follows:

> "So my bid for New York City is, if they consider barriers and levees at all, like London has or Venice is building and St. Petersburg is doing, then only and only if you have an exit strategy…I'm not excluding barriers but only complicit with an exit strategy. You have to do all your stuff behind your barriers that you should do without the barriers. It's just a delay tactic. It's not solution" (July 10, 2012).

Others have placed pressure on the city to build a storm surge barrier. Following Hurricane Sandy, the Huffington Post quoted distinguished researcher, Malcolm Bowman, advocating for

the barrier, “The time has come. The city is finally going to have to face this” (Svennson and Pletz 2012). Building a barrier can be framed as a cost-benefit and resiliency issue. First, the city needs to determine whether the actual monetary benefits of such a project as well as whether storms that breach existing measures will be frequent and costly enough to justify favoring a multi-billion dollar barrier over another less expensive project. Second, the city must decide whether a storm surge barrier is the best way to guarantee that there is no disruption to flows of matter, people, and capital in the city due to the more extreme storms predicted by climate change.

One New York storm protection plan proposes a system of barriers and sea walls that would protect the city's most vulnerable shore lines. (Wikimedia Commons/*Yale Environment 360*)

Figure 5.1. Proposed location of multi-billion dollar storm surge barriers in New York City (Stutz 2012).

Even though public pressure has mounted on the city to build a storm surge barrier, the city has waited for risks management experts to determine the cost-effectiveness of the project. Thus, the debate reflects the city's reliance on specific risk-management and climate science expertise over local expertise. There are several examples of public pressure to build a storm surge barrier. Both community boards 1 and 4 in Manhattan have issued separate resolutions for the city to do more to investigate building a storm surge barrier (Community Board 4 Manhattan 2010; Community Board 1Manhattan 2012), and neighborhood activists have gone to city council adaptation meetings to advocate this cause. At a hearing for the bill to institutionalize the NPCC and Climate Adaptation Task Force, Robert Trentlyon, a self-described community activist, advocated this position: "Everyone is talking about spending money on infrastructure, setting up infrastructure banks. There would be no better infrastructure project than storm surge barriers that would protect our beloved city" (Committee on Environmental Protection, April 25, 2012). Meanwhile, the response by the city government has been more careful and reflective of their proposed risk management strategy. OLTPS has not taken an explicit position on a storm surge barrier, but they have commissioned a task force to investigate the potential costs of a barrier versus other projects, not just in expenditures, but to the environment of New York City Harbor. City agencies have also followed this cautious approach. At DCP and DEP, employees discussed the philosophy of their agency and the government in general towards such a project. According to Government Worker 7:

> "From my perspective, the core of the issue—and one that is often missed when people approach the issue—it's often a desire of total thoughts. You have to do this, everyone should be a certain distance away from the water, or you should build a barrier. Those are decisions that have to be made on real information, on what are the costs, what are the benefits? Is this the most sensible way to spend 10,000 dollar or 10 billion dollars? And if now, what are the alternatives? That's really the crux" (Government Worker 7, July 12, 2012).

Government Worker 7 reflects the narrative that a storm surge barrier may not end up being the most cost effective way to approach adaptation, meaning the city has to comprehensively study this project before making a decision to proceed. On the surface it may appear to be the perfect engineering solution. It could dramatically reduce storm surge threats in the future, but the city views this option as one of many.

Whether New York City builds a storm surge barrier remains to be seen. There is plenty of public pressure to pursue such an option, but powerful voices in the city planning and scientific community are skeptical of the idea. Thus, the storm surge barrier is still undergoing the review process.

5.5 Conclusion

The storm surge barrier debate exemplifies the socio-environmental discourses that have characterized climate adaptation efforts in New York City, as it focuses on risk management narrative and advice from techno-scientific experts. The risk management strategy has become a way for the city to find the most cost-effective way of adapting the city infrastructure to climate change, especially infrastructure most vulnerable to increased threats due to flooding. The city has sold these initiatives as resilience, implying that it intend to find the least expensive way for the city to prevent increased environmental stress due to climate change from disrupting urban metabolic-circulatory processes, such as consistent and increasing flows of matter, people, and capital in the city. At the same time, certain experts, including climate scientists and risk management experts, have become privileged in determining and prioritizing these cost-effective "climate-resilience" strategies. This chapter has focused on the major narratives of climate change adaptation in New York City, but the next will describe the specific government

technologies—especially mapping, quantification efforts, and risk communication strategies—that have made climate change adaptation possible.

CHAPTER 6

MAKING CLIMATE ADAPTATION LEGIBLE IN NEW YORK CITY

6.1 Introduction

This chapter analyzes the technologies of government that New York City uses to understand, code, and regulate climate adaptation, which exemplifies the state's efforts to simplify complex environmental issues in ways compatible with management goals and priorities. Three primary governing technologies are used by New York City for climate change adaptation. First, maps show the potential effects of sea level rise and other climate impacts, which work to render visible, in an explicitly spatial way, the city's climate adaptation priorities. Second, New York City relies heavily on downscaled climate projections to the city and regional level to help quantify potential costs and benefits of climate adaptation. Though necessary for the city to govern these risks, attempts to quantify climate impacts have also complicated regulatory action. Third, the city is developing a risk-communication strategy, which emphasizes disaster and hazards education as well as making climate risks and adaptation plans publicly available. Together, the analysis in this chapter shows how New York City uses mapping, quantification, and risk-communication strategies to simplify and enact climate adaptation so that it can move forward on regulatory plans and policies, even though it runs into a messy social and technical reality that complicates this process.

6.2 Mapping Climate Adaptation

Mapping is a central way that New York City renders visible its climate adaptation priorities. One of the main goals of climate adaptation is to map the probability of natural

hazards due to climate change. To do so, the city government has prioritized updating Federal Emergency Management Agency (FEMA) flood maps. One of the major initiatives in the PlaNYC 2011 update was to partner with FEMA to create more contemporary flood insurance rate map (OLTPS 2011). In addition to FEMA map updates, the city plans to develop in-house maps that incorporate future sea level rise projections. The first recommendation of the Green Codes Task Force (GCTF) report for building climate resilience, which is yet to be completed, is to develop flood maps that project sea level rise to 2080, which have become known as the New York City Climate Change Maps (GCTF 2010). The FEMA updates based on contemporary flood plain levels are not necessarily as useful as maps with sea level rise projections, as rising sea levels entails an expanding area at risk of flooding. Thus, the 100-year flood (the flood level with 1/100 probability of occurring each year) could become the 50-year or even the 10-year flood as sea levels rise. Mapping sea level rise has the additional advantage of showing the city where it may need to mandate insurance coverage, freeboard, or other regulatory efforts in the context of future climate projections. Current flooding impact maps are an improvement from the former 1983 base-level, but they would not take into account projected changes in the climate system in comparison to maps that include sea level rise projections. Thus, the 100-year flood of 2050, 2080, and beyond would impact a totally different—and likely larger—area than the 2013 100-year flood, and all indications suggests that New York City wants to base its policy and regulatory decisions off expected sea level rise projections.

Another way New York City uses mapping is to prioritize key areas for climate adaptation. The best examples are maps that DCP have developed as part of its 2011 waterfront plan update, which includes an appendix with maps of neighborhood strategies, significant maritime and industrial areas (SMIAs), and waterfront redevelopment sites. Although all these

priorities are important, SMIAs are especially emphasized and they are a major discussion point of the ongoing effort to update the WRP. SMIAs include the Kill Van Kull area of Staten Island; Sunset Park, Red Hook, and Brooklyn Navy Yard; Newtown Creek, spanning Brooklyn and Queens; and the South Bronx (DCP 2011; Figure 6.1).

Figure 6.1. Prioritized commercial and industrial waterfront areas in New York City. Included among these prioritized areas are the six Significant Maritime Industrial Areas (from DCP 2011).

These areas provide some of the city's major industrial and municipal functions, including acting as sites for waste management facilities and ports for container and cargo operations. What places them squarely in discussions on climate adaptation is that SMIAs are vulnerable to flooding and contain some of the city's most toxic chemicals. Without proper facilities to protect these chemicals, they pose a risk to the surrounding community and the city. Not surprisingly, a recommendation of the GCTF for building resilience is to secure toxic waste within the 100-year flood plain, which the WRP now cites as an important regulatory initiative (DCP 2012).

Figure 6.2. Map of minimum extent of wetlands in New York City (from Small 2010).

Protecting and expanding wetlands are also a priority. The 2008 Wetlands Act has ensured the development of a comprehensive wetlands plan and assessment of the extent of current wetlands and where to build them in New York City. Published in 2010, the wetland assessment includes maps giving a range of the extent of wetlands in New York City (Figure 6.2; Figure 6.3). By producing these maps, the city has made visible the range of areas where wetlands exist and where it can develop new wetlands. The maps also provide a way for the city to target specific areas for wetland development, a major priority of both PlaNYC and the wetlands plan.

Figure 6.3. Map of maximum extent of wetlands in New York City (from Small 2010).

Wetlands and SMIA maps are only two examples of ways the city has rendered its climate adaptation planning priorities visible. Whether they are comprehensive, in the case of wetlands, or more targeted, in the case of SMIA, they show where and in what sectors the city prioritizes adaptation initiatives. If they appear simple and all-encompassing, that is their intended purpose. They ecologically code and put order to the complex and messy reality of achieving climate adaptation—otherwise, administering such a policy in a city as large as New York City would be difficult and unwieldy.

6.3 Quantifying Climate Adaptation

New York City employs several quantification techniques to make climate risks legible. First, the city relies on an apparatus of external and internal scientists to downscale climate impacts to New York City, an effort most notably completed by the original NPCC. Second, it

has used climate models and projections to develop internal cost-benefit calculations, which has either influenced recommended actions or justified programs already in place.

One of the original goals of PlaNYC was to create a New York City Climate Change Advisory Board (OLTPS 2007). Intended to gather information on climate impacts specific to New York City and its surrounding region, this initiative produced the NPCC. Although a history of climate projections and impact assessment dated to the *The Baked Apple* in 1996, the NPCC provided the city with the most up-to-date city level climate impacts in their 2010 report. They found by 2080 that temperatures would increase by 4 and 7.5 degrees Fahrenheit, sea level would likely rise 12 to 23 inches without a rapid ice melt scenario, and high intensity rain fall events would become more frequent (Figure 6.4; Horton et al. 2010).

	Baseline 1971–2000	2020s	2050s	2080s
Air temperature				
Central range[b]	55° F	+ 1.5 to 3.0° F	+ 3.0 to 5.0° F	+ 4.0 to 7.5° F
Precipitation				
Central range[b]	46.5 in[3]	+ 0 to 5%	+ 0 to 10%	+ 5 to 10%
Sea level rise[c]				
Central range[b]	NA	+ 2 to 5 in	+ 7 to 12 in	+ 12 to 23 in
Rapid ice-melt scenario[d]	NA	~ 5 to 10 in	~ 19 to 29 in	~ 41 to 55 in

Figure 6.4. Table of climate change variable projections for the New York City metropolitan region (from Horton et al. 2010).

These findings have become the baseline for climate adaptation strategies, but the city no longer relies on a city appointed body to get its climate change information. Much of its climate impact quantification comes from external sources. Expert 1 mentioned that the National Oceanic and Atmospheric Administration (NOAA) is developing a regional integrated scientific assessment for climate change impacts in the urban northeast (June 13, 2012). Also, in testimony regarding the 2012 bill to institutionalize the NPCC and the climate adaptation task force,

OLTPS senior policy advisor, Adam Freed, voiced concerns that using the new NPCC to create scientific projections would be redundant as OLTPS already updates itself on the latest climate related information from other sources (NYC City Council, April 25, 2012). Even if it is not directly from a New York City agency, government workers, in addition to Adam Freed, have mentioned using the latest scientific information to develop adaptation plans. In fact, four out of seven government workers interviewed noted using the latest science as central to their city planning efforts, a process that has entailed the collection and measurement of increasingly more detailed information on climate change impacts in New York City. As climate adaptation initiatives progress, the city requires experts to quantify a broader scope of information. For example, local sea level rise and warming projections are well-established, but the city now wants to know more detailed information, such as the diurnal warming patterns and areas of the city receiving the most precipitation. Scientific Expert 1 expressed this need to answer more specific questions about climate:

> "[The City] are *[sic]* in its fourth generation sets of questions and research needs. So these involve more detailed characterizations of climate variability, for example, within diurnal variability within days, rather than just daily or monthly. Also heavy downpours are often short duration events, the climate science of those. Continuing work on wind, which was related to of course hurricanes but also the variation around the city. The urban climatology of the city is so complex where cooler spots were, where hotter spots were, where the heat island were, explaining the difference between the surface temperature, and the three meter temperature, let's say. So these are much more third and fourth generation question as opposed to what will the mean temperature be in 2030" (June 13, 2012).

Scientific Expert 1's statement reveals that the city remains intent on quantifying every potential impact that climate change may have on the city, so that it can know the specific sectors and areas where it should pursue policy. Even though the city does not necessarily produce all this science on its own, understanding and applying the latest science at ever more fine and specific scales is important for city planners and policymakers.

Another part of this process is quantifying the best policy for the city to pursue. As mentioned in Chapter 5, the risk management framework influences these quantification efforts, as the approach has been utilized for assessing the viability of a project or justifying a pre-existing approach. As a result, many city agencies collect data to quantify the benefits of their climate adaptation program. An overarching program that compels agencies to develop these mechanisms is the stormwater management plan, which has a major initiative to improve infiltration of stormwater in order to reduce both its potential impacts on flooding and the urban heat island effect. Both the Parks Department and DEP have developed ways to quantify potential ways for their infrastructure that they oversee to achieve this goal. Government Worker 2 discussed the importance of stormwater for the Parks Department:

> "So within the parks department, our groups are the main people focusing on stormwater, quantifying stormwater, or working across different division of parks that do design and construction within parkland…a focus on stormwater, and an agency goal of quantifying the benefits that we provide for New Yorkers" (June 11, 2012).

Making the benefits of soils and plant visible through quantification technologies is also a part of this initiative. Specifically, Parks has partnered with Drexel University in Philadelphia, Pennsylvania to find ways to quantify these benefits. DEP is also involved in stormwater management, but they focus on targeting areas where they can reduce Combined Sewer Overflow (CSO), a byproduct of stormwater runoff. DEP and Parks are not the only agencies involved in stormwater management, but their quantification initiatives represent an effort to put a value on how much a specific program—such as increased porous pavement, more tree planting, or CSO reduction—can mitigate the impact of climate change.

Other city agency quantification efforts are used to determine the most effective strategies. Although multiple agencies use these assessments, OLTPS as the lead coordination agency puts particular emphasis on such initiatives. One project it leads is the development of

climate risk assessment tools, which it uses to quantify the potential climate risks the city faces by hazard, sector, time-slice, and geography and then develop the most cost effective adaptation strategies (OLTPS 2012). Distinctly missing in these risk-assessment tools is to address the most vulnerable populations to climate change. Whether these assessment tools change with new City Council legislation that compels the city to address vulnerable population remains to be seen. OLTPS also partners with DCP to develop an inventory of coastal protection strategies, which provides cost-benefit analysis for management plans including the controversial storm surge barriers. This careful quantification of risks influences strategies in other city agencies. DEP is especially concerned with the costs and potential benefits of raising the fourteen wastewater management facilities it oversees. For DCP in partnership with DOB, their quantification efforts are focused on finding the best practices to either flood proof buildings or make them more resilient to flooding. There are many other examples of these strategies, which all emphasize a similar goal: use numerical calculation to determine the most cost effective adaptation strategies. There is one overarching problem, though: How does the city choose the most mathematically cost-effective strategy without knowing exactly what the future climate impacts are and where they will occur?

6.5.1 Contradictions of Quantification

City climate quantification efforts have a difficult time portraying with certainty the complex reality of the future climate system, which amounts to what I term a contradiction of quantification. What that means here is that the city needs to quantify information—such as climate projections or the cost-benefits of an initiative—in order to understand a phenomenon and proceed with some policy, regulatory, or planning initiative. This information, though, is always incomplete, unwieldy, or even contradictory, which makes it difficult for city planners

and policymakers to know the so-called best management practices. Such quantification contradictions are especially relevant for climate adaptation because planning relies on future projections, which can vary tremendously based on the type of data produced. They are also agglomerations and cannot at all predict day-to-day weather stress on infrastructure for over a week, much less out to 2080.

Although they do not use this term explicitly, government workers are well aware of these complexities in developing a climate adaptation strategy for New York City. Three of the government workers interviewed mentioned the complexities of developing a sound adaptation strategy. According to Government Worker 3:

> "You know, you begin to implement even though it's not completely proven and tested, but you monitor it, and you reassess, and adjust it as necessary. And I think there's explicit mention in the green infrastructure plan about climate change, because that is one of the opportunities that this new approach gives you is that you're not planning for stationarity. It's as the system changes you adjust with it."

Government Worker 3 captures the fact that climate adaptation must be an ongoing strategy, as today's projections cannot perfectly depict the future climate. Even though he notes the tangible price of not pursuing an adaptation strategy, he also indicates some wariness in pursuing just any strategy. After all, the city could suffer a significant loss of money and credibility employing a strategy that ends up being seen as ineffective. Yet is it even possible to develop a reliable enough climate projection to justify a specific policy that is not adapted over time? Government Worker 4 voices some of the ways quantification is both a boon and burden to city planners:

> "We're asking projects to assess their risks and, to the extent practicable, reduce their risks. The idea being that since we have range of climate, sea level risk projections, we don't necessarily have a way of determining the future flood level elevation. So without that, we can't require such a strict standard, but we're asking projects to think about it. It may not make sense at all to build a bulkhead ten feet higher than you would, so how about building the bulkhead two feet higher that you would. We're trying to encourage that sort of decision-making. We don't have a way of strictly requiring any of them" (June 13, 2012).

In this passage, Government Worker 4 discusses the contradictory reality of climate adaptation. The city needs data on climate change projections in order to understand and regulate climate change; but it also needs some degree of certainty before it can require any strict regulations regarding future climate. Climate scenarios, though, do not provide such certainty. Instead, they include varying scenarios with different degrees of probability and likelihood. Take the example of building height requirements. DCP can only require developers to make assessments for climate risks because the agency itself cannot provide a reliable enough sea level rise projection to justify specific building bulkhead guidelines.

Even if climate projections could reliably depict average climate, an unforeseen extreme event may complicate the planning process. It may put pressure on using resources for a project that may prove reliable but only protects the city on rare occasions—even if it does that effectively. Government Worker 6 discusses this concern:

> "But the thing is with climate change is that it's very long range and there's a lot of variation in the climate change numbers. It's more about scaling our plans if something more severe were to happen, a more severe storm than we'd ever considers, how would we scale our plan up?" (June 29, 2012).

All these passages show that planning for climate adaptation is difficult and full of complexities. City planners and policymakers can strive to get the best possible science or risk analysis, but these predictions or numbers could prove ultimately unsatisfactory. Climate projections may show a number of different scenarios based on unpredictable contingencies. For example, what happens if the rapid sea ice melt scenario in Greenland does happen? Also, how does a model capture how fast these scenarios will occur and what type of sea level rise it will produce? Then basing risk analysis off these projections is even more difficult because such assessments compound the uncertainties of the climate models with the uncertainties of the risk analyses. The

city can only strive for strategies to address the most probable outcome, and then there is a still a potential a low frequency, high risk event will occur—e.g., a category five hurricane. The point here is that city planners need to have quantifiable evidence to pursue the best possible management strategy, but the numbers that they base this evidence on will always have inherent uncertainties. On top of these decision-making difficulties, the city must find a way to communicate climate risks and strategies to the people of New York City.

6.4 Communicating Climate Adaptation Risks and Strategies

New York City has developed many strategies to communicate climate risks to its citizens. These strategies include hazard education programs, making planning documents and information available online, and developing community workshops. All these mechanisms may be effective and transparent in their own right, but they ultimately rely on the voluntary actions of citizens for their effectiveness. This section discusses these programs and how they attempt to make climate adaptation information more available to citizens.

The first strategy is educational programs. OLTPS by law is mandated to develop an education program to communicate climate change risks to New Yorkers. No such program exists administered by OLTPS, but the agency has started co-opting OEM's Ready New York program (OLTPS 2012). This FEMA funded program is intended to communicate current natural hazard risks and disaster preparation to New Yorkers. It functions by compelling OEM to send its employees to any place that requests the program—whether it is a community fair, a school, or even corporate event. The program educates the population in different hazards currently facing New York (such as floods, heat waves, hurricanes, fires, and carbon monoxide), and what people should do to prepare for them, which includes developing a disaster plan and having a disaster kit with flash light, a first aid kit, and other basic supplies (OEM 2013). OLTPS intends

to use this program to educate community members in their climate risks as part of its PlaNYC initiative to “create resilient communities through public information and outreach” (OLTPS 2012). In 2011, the program did reach over 400 events, including 296 that were attended by seniors, children, people with special needs, immigrants, and low income populations (OLTPS 2012). Four hundred events, though, for a city of over 8 million people barely reaches a fraction of the population, but New York City has started solving that problem by making climate information—including several Ready New York pamphlets—publicly available online.

Information on climate adaptation planning is relatively easy to find for those searching for it. The PlaNYC website (www.nyc.gov/planyc2030) has a PDF copy of the plans latest update and a link that allows anyone access to a whole lineage of documents related to sustainability, many of which address climate adaptation. For those who do not speak English, copies of PlaNYC are available in Spanish, Japanese, and Chinese. Of course, accessing this information still entails having a computer, internet, and knowledge of how to use both, something that the most vulnerable populations to climate change would be less likely to have. Such public information campaign is not unique to OLTPS. All agencies participate in making their publications available on their websites. For example, DCP includes information on what it is doing to increase “climate resilience” on its home page and makes it waterfront plan readily available. As a result, climate adaptation information is accessible to the curious.

Community outreach is a central focus of DCP to make residents aware of the city’s climate adaptation efforts, but it has its complications. DCP sees itself as a liaison between the community and city government, and, as part of its waterfront plan and WRP public review, it has developed workshops to communicate its projects to the community. For climate adaptation, Government Worker 4 describes the workshop as framed by a series of questions about city

vulnerabilities that then narrow into a conversation about addressing them. These workshops have sometimes encountered difficulty in building a dialogue between community members and the city about adapting for future climate risks. Government Worker 4 described this problem in the waterfront plan: “People either wanted to talk about the existing flood risks, how we can address those distinct flood risks in that time frame…or it was little bit dramatic in saying that I guess we’ll have to leave the city. There wasn’t much in between” (June 19, 2012). The City has used these workshops to create a somewhat difficult dialogue with communities on climate change, but there are still problems with these outreach efforts that are also reflected in other risk communication strategies. Yes, New York City has developed several ways to communicate climate change, a subject difficult to conceive past its impact on existing natural hazards. There is, though, pressure on individual people to identify their own susceptibility to climate risks, develop a disaster plan, gather the necessary materials to prepare for the disaster, and execute the plan when a climate disaster strikes. The problem with this logic is that not everyone has the same financial resources and time to learn and prepare for climate related hazards, especially the poor, minority, elderly, and disabled that are most vulnerable to these climate risks.

6.5 Conclusion

This chapter shows the process that New York City has undergone to govern and code climate adaptation. Mapping, quantification, and risk communication are the three governing strategies employed, all of which have different implications on the priorities and success of these plans. The City has mapped its climate adaptation priorities, which stresses making it a more robust ecological system (e.g., using wetlands, parks, and other “natural” features to mitigate hazards) and maintaining waterfront industry. As a result, the focus is on improving the city’s ecological design and maintaining a waterfront economy over explicitly identifying and

protecting the most vulnerable people. Quantification efforts have a similar emphasis on identifying climate impacts and ways to improve the city as an ecological system, while downplaying the simultaneous need to adapt the city as a social system to climate change. Although knowledge of climate change plans and risks are readily available in many different languages, the risk communication strategy tends to assume that every citizen has equal ability to understand climate change, identify his or her risks, and prepare for them. Thus, these risk communication efforts ignore the socio-economic inequalities that may leave the most vulnerable unable to prepare for projected increases in natural hazards due to climate change.

CHAPTER 7

CONCLUSION

The current body of literature on climate adaptation planning in New York City discusses climate change impacts, planning strategies, and some analysis and critique of plans already in place (e.g., Rosenzweig et al. 2001; Rosenzweig et al. 2010; Rosenzweig et al. 2011; Horton et al. 2011). This research moves beyond these technical assessments to evaluate climate adaptation from a broader socio-environmental framework that considers climate adaptation planning as a central feature in the making of urban natures and social (in)equality. This includes an examination of the political and social context within which experts advising these plans work, and the implications of the methods employed by the city to measure and code climate adaptation. This chapter examines the main contributions of this study to understanding the articulation of social-environmental narratives and the types of technologies of government employed in climate adaptation planning in New York City, successes and limitations of the program, and some ways future studies can expand on this research.

This thesis integrates the frameworks of urban political ecology and science studies by examining the implications of the existing socio-environmental narratives of climate adaptation planning. For urban political ecology, climate adaptation can be seen as a socio-ecological strategy embedded within the structural inequalities of the city. Thus, not everyone has equal access to making these plans, and climate adaptation in practice ignores the unequal access to resources among the city population, which makes some less able to prepare for increased systemic stresses related to climate change. At the same time, climate adaptation planning is

articulated as “resilience,” meaning that it is a way for the city to prevent future climate threats from disrupting the rapid “circulation” and “metabolism” of the people, matter, and capital that keep the city growing as a material and economic space. For science studies, it identifies a politicized and consistent network of techno-scientific experts involved in climate adaptation in New York City. Despite claims of seeking the advice of “independent” scientists, it is a network whose composition (i.e., sought of types of expertise) and findings are determined by the prioritized strategies of the city. The knowledge developed in the network is also privileged over local knowledge or every day experience in molding climate adaptation plans. Local knowledge gathering might include asking individual people who live in New York City what they feel their greatest vulnerabilities to climate change are and what resources the city could use to address them, but the current privileging of scientific and technical expertise makes it difficult to speculate what constitutes local knowledge.

Urban political ecology and science studies, together, help highlight who the beneficiaries of climate adaptation plans are, as well as those individuals and groups less served by climate adaptation planning. In short, beneficiaries tend to be those organizations, people, and entities able to articulate their potential risks and vulnerabilities to climate change using technical and scientific language. These languages are used by the city to make priorities, regulations, and plans for climate adaptation, meaning any entity versed in such technical and scientific practices can better voice their climate adaptation concerns in ways that the city understands and can be adopted into practice. Those less served by climate adaptation planning, however, are people that may be equally or more vulnerable to climate change who cannot communicate their potential risks and vulnerabilities in a scientific or technical enough way to integrate them credibly within the adaptation planning process.

For the government with science framework, New York City has developed an ecological coding process to governmentalize climate adaptation planning. The process includes developing detailed inventories of future climate impacts on city infrastructure, mapping potential areas for wetland expansion, and developing a means of communicating risk to citizens, which has resulted in a strategy that prioritizes maintaining infrastructure and making the city a more "ecological" system than aggressively addressing social vulnerabilities. In consequence, even though eco-coding has become centralized in the city bureaucracy, the city has diffused the responsibility of becoming educated and prepared for climate related impacts to each individual citizen.

Adaptation planning in New York City has some positive impacts on the city's socio-environmental system. First, climate adaptation planning addresses the very real and mounting problem of climate change. There is currently a scientific consensus that climate change is human caused and will dramatically disrupt the planet in the future. Meanwhile, there is no international or national policy to address climate change in the United States, making cities sites for climate adaptation planning. New York City has proved exceptionally willing to develop climate adaptation programs that plan for long-term events, are centrally coordinated, and are codified in the city charter. To prevent future increased climate stresses from disrupting the flows and metabolic processes in the city, it has invested resources into making infrastructure ready to absorb increased climate shocks—e.g., raising heights of wastewater facilities, expanding wetlands, improving stormwater drainage, and maintaining an adequate supply of drinking water. Although imperfect in practice, the fact remains that the city considers climate change to be a real threat that requires expenditures of public dollars on updating infrastructure.

This serious approach to climate change has also enabled New York City to create climate adaptation priorities. As a result, they have made improvements in coordinating city agencies and infrastructure to reduce their vulnerabilities to future climate impacts. Prior to 2008, there was no office to coordinate long-term planning, and climate change had been temporarily sidelined due to terrorism concerns. PlaNYC developed an institutionalized structure that allows zoning, environmental assessments, and city infrastructure to be more sensitive to climate change. These priorities are an attempt to maintain the city's status as a global commercial and economic hub, as continued infrastructural disruptions from climate impacts (such as chronic black-outs, poor water delivery services, and waste in the streets during every severe storm or heat wave) would undermine the city government's credibility. Thus, the city has maintained (or is working to maintain) an image of resilience to climate change that enables it to claim itself to be a leading urban ecological innovator.

This analysis leads us to consider other issues as well, which highlight some of the limitations of New York City's approach. Most importantly, adaptation plans have *not* addressed socio-economic difference. Language in the most recent City Council bill to institutionalize scientific and planning networks to advice on adaptation program does mention the need to address climate impacts on vulnerable populations, but such an emphasis is new to climate adaptation efforts and not fully implemented. Instead, the city has favored approaches to maintain its critical infrastructure in the cheapest way possible. For example, in the original New York City Panel on Climate Change (NPCC), scientists were given explicit instructions to assess climate impacts on city infrastructure and not to a do a more general vulnerability analysis. There has also been no legislation to address climate change simultaneously with political economic inequalities in New York City, such as identifying and allocating resources to populations most

vulnerable to climate change. Social welfare has been de-emphasized in favor of rhetoric to keep the city "climate resilient"; in other words, find ways for city infrastructure to remain up-and-running despite the shocks and stresses imposed by climate change. Maintaining this infrastructure may aid the most vulnerable—such as providing inexpensive public transportation or public cooling stations—but it appeals more directly to the system of guaranteeing that capital, matter, people, and ideas remain flowing in the city, the very system that produces socio-economic inequalities in the first place.

New York City's efforts to become "climate resilient" also tend to reflect Engle's (2011) critique of the concept: that it emphasizes adapting the ecological over the social to climate change. It is not surprising that many plans (such as stormwater management, park development, and coastal adaptation strategies) attempt to make the city act more like an ecological system, with more permeable surfaces, wetlands, and trees. Making the city act more like "nature" de-emphasizes the role that the "social" plays in developing this system. It also obscures the structural inequalities embedded within the process of making these ecological plans. As a result, this ecological emphasis may make certain population *more* vulnerable to climate change. After all, the city can improve drainage, raise building height requirements, increase the wetland buffer, and reduce the urban heat island, but a population remains exposed to the climactic risks these projects try to mitigate due to the fact that they still do not have the resources to properly prepare for the inevitable severe weather event projected to become more frequent due to climate change.

A third problem with New York City adaptation planning is that its emphasis on quantification may actually render some realities of climate change *less* visible. The goal of the city is to use numerical analysis—such as climate projections, the probabilities of certain flood

magnitudes, and cost-benefit analysis—to understand climate risks and confidently identify its priorities. For example, New York City may say that a storm surge barrier will cost billions of dollars but only provide an annualized benefit of $50 million to citizens and infrastructure, but a system of sea walls costs only $500 million dollars and has an annualized benefit of $40 million. Although an over-simplified example, the city would probably choose the cheaper option in this scenario even if it keeps vulnerable populations more exposed to climate risks. Such numerical analyses, though, cannot easily depict every aspect of a complex socio-ecological system, especially how people perceive, understand, and react to climate risks. It may also be difficult use cost-benefit analysis to assess the impact of projects on ecological and social issues because favoring one way of analyzing costs and benefits would obscure other non-financial considerations. The point here is that numbers always highlight certain aspects of the city—such as the potential financial benefits of doing certain projects—while simultaneously obscuring other considerations—such as how people will perceive climate risks or how the local ecology will cope with climate adaptation motivated projects.

There are several future research directions on which this project could build. First, this study only focuses on climate adaptation governance in New York City, a broader genealogy of risk-management governance in the city would better investigate how governing techniques have changed or remained stable as the city has prioritized adapting to different risks (such as climate change, natural disasters, terrorism, economic depression etc.) over time. Second, this research was limited to New York City, which sees itself as a leader in urban climate adaptation planning. Using similar frameworks to analyze climate adaptation strategies in other cities would determine whether New York City is exceptional in its planning efforts or truly acts as a model that other cities are following. Comparative research on separate urban adaptation plans may also

be useful in making the strategies that cities employ more generalizable to other places besides New York City. In addition, this study examines the institutional structures that have emerged to support climate adaptation; thus, a future study could assess the mundane, every-day experiences of individuals in the face of climate impacts. Such a study would be more useful in identifying and engaging perceptions of different types of vulnerable populations, such as minorities, the poor, the elderly, and the disabled. There is also a "public-private partnership" that has emerged around climate adaptation that this thesis does not examine. Researching the extent and implications of such a partnership would further expose the dominant logic, priorities, inequalities, and contradictions that exist in urban climate adaptation planning.

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APPENDIX A

INTERVIEW QUESTIONS FOR GOVERNMENT WORKERS AND SCIENTIFIC EXPERTS

Background about the interviewee:

Could you take a few moments to describe your job and your role in the New York City climate change adaptation program (or any related climate programs)?

How did you get involved in climate change planning and/or policymaking in New York City? Were you hired into this position or is it something that has evolved over time? How long have you been in this position?

What is your educational and professional background? What do you consider your primary area of expertise? How does this relate to your position in the New York City government?

Questions about how the New York City adaptation plan developed:

Can you describe your role in the creation and implementation of the adaptation plans? Who did you work with? What were the primary outcomes of your work?

What public and private actors are involved in the process of developing climate change adaptation plans and policies in New York City? What was the method of selection for inclusion in the planning / policy development process?

What are the main priorities of the adaptation plan and how were they selected? Can you talk a little bit about how different / conflicting viewpoints were handled in the planning process?

What information / forms of expertise were most valuable during the planning process? Which ended up being less valuable or difficult to incorporate?

What types of regulatory mechanisms has the city started implementing to address climate change adaptation? What other mechanism do you expect to implement in the future?

Do you think current city climate change adaptation initiatives are sustainable and / or equitable? How might these initiatives be improved? What parts do you think are the most successful?