Bringing adaptation home:
Citizen engagements with climate change
at home site scales in Ottawa and Halifax

by

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ABSTRACT

Climate change impacts are becoming increasingly evident in cities, generating hazards such as heatwaves and flooding events that may cause discomfort or trauma for residents. Climate change scholars suggest that measures undertaken on private lands provide a significant counterpart to public adaptation initiatives, and increasingly position the home site as an important scale of analysis within climate change research (Bichard & Kazmierczak, 2009; Jeffers, 2014; Pyhala et al., 2016; Wilson et al., 2014). Select scholars have also considered how municipalities may effectively engage with citizens to encourage greater home-based responses to climate-related hazards (Groulx et al., 2014; Hjerpe et al., 2014; Klein, 2014).

This thesis explores citizen perspectives of climate change impacts, risk and opportunities for adaptation that are based at the scale of the urban home site in two mid-sized Canadian cities, Ottawa and Halifax. Through a qualitative research approach of discourse analysis, this thesis explores several distinct but related sub-themes: (1) how residents understand *local places* of climate change impacts and risk; (2) how residents engage with *home site natures* within a context of emerging ecosystem-based adaptation practices; and (3) how residents conceptualize the *residential property* in situating responsibility for managing neighbourhood stormwater flows. Within these sub-themes, I argue: (1) that places of significant climate change impacts are frequently conceptualized by residents beyond the home site; (2) that residents hold multiple conceptualizations of local natures, as reducing climate change impacts (through stormwater absorption and home cooling benefits) but also potentially contributing to additional risk (through treefalls during storms) from climate-related hazards; and (3) that ideas of property autonomy and boundaries are enacted in fluid ways by residents, as they situate obligation for neighbourhood

stormwater management alternately toward individual *self-governing* efforts, wider municipal measures on public lands, or neighbouring *free-rider* private (re)development projects.

Building on these key findings, municipal adaptation agencies are advised to assist residents in recognizing climate change impacts at localized scales, communicate recommended ecosystem-based adaptation measures to incorporate diverse values among residents toward home site natures, and address residents' anxieties regarding neighbouring development activities that diminish permeable land area and stormwater management potential across neighbourhoods.

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1.1 Toward an enriched climate change adaptation scholarship at the scale of the urban home site

Amid differing assessments of the degree to which climate change is altering urban environments and influencing the severity of extreme weather (Balling and Cervený, 2003; Marsh et al., 2007), climate change impacts are becoming increasingly evident in urban areas. Climate change impacts manifest in or near cities in the form of ongoing sea level rise, changes to precipitation, unstable temperatures, or more abrupt wildfire or storm events (Bai et al., 2018; Bowler et al., 2010; Demuzere et al., 2014). These conditions may lead to inconvenience, discomfort, and even trauma for residents, as lives are disrupted. Home sites (i.e. areas comprising all physical elements within the boundaries of a residential property, e.g. house, other building structures, landscaping, etc.) may be exposed to a range of physical impacts, from minor basement flooding during rainstorms to damage from larger-scale wildfire events in forested neighbourhoods.¹ In some cases, negative physical effects on home sites (and corresponding emotional impacts on residents) may persist long after exposure to climate-related hazards (Decent & Feltmate, 2018). This situation has spurred greater attention among municipalities regarding climate change adaptation strategies to supplement existing mitigation (i.e. carbon reduction) efforts. Examples of municipal-scale adaptation measures include strengthening urban stormwater management infrastructure to deal with increased precipitation, extending seawalls to deal with sea level rise, or enhancing

¹ Intense rain events that have occurred in Southern Ontario in recent years are examples of how climate-related hazards have caused disruption to residents in Canadian cities. In July 2013, Toronto experienced a record rainfall of over 100 mm over several hours, causing power outages for tens of thousands of residents. In August 2014, an intense rainfall event in Burlington caused flooding to 3500 homes, resulting in health risks (from mould and sewage in basements), loss of valued personal items, and significant costs for cleanup for many residents (Feltmate et al., 2017; Kauri & Rogers, 2017, June 19).

the urban forest canopy to improve stormwater capture and moderation of urban heat islands (Lemmen et al., 2008; ICLEI Canada, 2011).

Climate change scholars and adaptation practitioners suggest that measures undertaken on private lands to adapt to climate change impacts may provide a significant counterpart to public adaptation initiatives (Bichard & Kazmierczak, 2009; Jeffers, 2014). Lot-level actions undertaken by residents² within home sites – for example, by adding/removing vegetation to absorb stormwater on properties, cool buildings or mitigate wildfire risk, or by reinforcing building structures to better withstand intense wind or snowstorms – may help to reduce property damage, improve resident comfort, and strengthen collective adaptive capacity among residents across neighbourhoods and wider urban areas (Elrick-Barr et al., 2014; Hall et al., 2012; Mason & Montalto, 2015; Osberghaus, 2015). Despite a significant potential for home-based adaptation activities to moderate impacts of climate change, empirical research reveals mixed degrees of willingness among households to implement recommended measures, with greater compliance often observed only among households that have directly experienced negative effects to home sites from an intense weather event (Baptiste et al., 2015; Feltmate et al., 2017; Whitmarsh, 2009). Academic literature has also revealed how individuals may pay limited attention to or display minimal concern about local climate change impacts (Jones et al., 2017; Stoll-Kleeman et al., 2001; Taylor et al., 2014a). With these concerns in mind, scholars suggest a requirement for a more nuanced understanding of individual perceptions of climate change risk and opportunities for

² This study focuses on residents who hold decision-making control over home and landscaping retrofits. All but one of the residents who participated in this study own their homes; the one individual who self-identified as a home renter completed the initial study survey but did not participate in an interview/focus group or contribute quotes to the thesis text.

action within home sites and other local areas, which may vary significantly within populations (Porter et al., 2014; Wamsler & Lawson, 2012).

Scholars increasingly position the home site as an important scale of analysis relating to climate change impacts, risk and adaptation, examining for example how understandings of climate change among households that occupy these spaces intersect with other daily concerns (such as maintaining adequate livelihoods or house upkeep) (Nyamwanza & Bhatasara, 2014; Wilson et al., 2014). Gibson et al. (2015, p. 7) suggest that households may also hold more intimate knowledge of strategies to deal with uncertainty and scarcity that have been passed through generations, potentially “provid[ing] one picture of what survival might look like when the big systems fail”. The household also provides a more immediate context within which wider-scale models of sustainable behaviour may be manifested and tested, and where home-based environmental activity may be transferred through social norms between neighbours (Thompson et al., 2008; Reid et al., 2010).

Scholars have called for more extensive empirical data to explore individual perceptions of climate change and responses to impacts at the scale of the home site (Pyhala et al., 2016; Wilson et al., 2014; Gibson et al., 2015). A large portion of the case study literature exploring home-scale perspectives of climate change is focused on rural experiences in the Global South, where promising approaches for adaptation may be impacted by factors such as limited access to basic resources or infrastructure, or by exposure to volatile economic conditions or unstable political regimes (Bohensky et al., 2013; Head, 2010; Zheng & Byg, 2014). Within the Global North, studies of household perspectives often focus either on mitigation (i.e. carbon footprint reduction) efforts by residents, or on residents’ responses to individual climate-related hazards/risks (for example, physical risks to

dwelling from specific events such as intense rain, wildfire, or coastal sea level rise) (Bruine de Bruin et al., 2014; Lorenzoni et al., 2007). Few studies consider broader conceptions of climate change influences on households that involve engagements with multiple and concurrent climate-related risks to home sites. Many studies are also situated within rural or smaller community settings, often among populations that have experienced pronounced effects from (or face direct exposure to) climate-related hazards (e.g. rural home sites experiencing coastal erosion from sea level rise) (Botzen et al., 2013; Koerth et al., 2013). There has been limited study to date of perceptions of climate change among populations living within larger and denser municipal centres that have not directly experienced large-scale climate-related events. Within the Canadian context, a modest body of climate change case studies offers important insights specific to Indigenous and other household experiences in Canada's Northern regions, attempting to document "the 'invisible losses' to culture, self-determination, knowledge, health, wellbeing, and identity" that result from climate change (Wolf et al., 2013, p. 549; see also Proctor, 1998). In research from other regions of Canada, scholars call for a greater breadth of empirical study to inform policy directed at furthering citizen adaptation activity to address physical impacts/risks to home sites within other regions and populations (Belanger et al., 2008; Dupont, 2013).

Academic literature on citizen responses to climate change and climate-related hazards reveals a range of influences on home-based action. Regarding climate change mitigation activities (for example, energy efficiency measures to reduce household carbon footprints), scholars have demonstrated how residents may be reluctant to undertake activities that involve personal sacrifice, or prioritize actions that have personal (e.g. financial payback or health) over public benefits (Lorenzoni et al., 2007; Ohler & Billger,

2014; Whitmarsh, 2009). Residents may instead undertake mitigation actions to address wider issues of community wellness and social justice (Howell, 2013). Within the context of dealing with climate-related hazards, scholars have shown how residents act to limit physical impacts within home sites according to anticipated costs and financial returns, social pressures, perceptions of current and future climate change risk, or perceived responsibilities for action accorded to municipal and other levels of government (Kovacs et al., 2014; Lawrence et al., 2014; Porter et al., 2014). In processing local climate change risk, residents may focus on aspects beyond physical threats to home and property, encompassing value-based or other concerns regarding personal and community health, and financial security (Henry, 2000; Kasemir et al., 2000; Stoll-Kleemann et al., 2001; Wolf et al., 2013).

Households may undertake adaptation actions that correspond with their perceptions of effectiveness in reducing climate change impacts and risk (Botzen et al., 2013). Residents may act in a reactive, rather than proactive, manner, or may employ short-term adaptive practices that diminish long-term adaptive capacity or reduce mitigation potential (e.g. wood burning for heat, or air conditioning for cooling) (Belanger et al., 2008; Porter et al., 2014). Others may be in support of paying extra costs associated with adaptation if this will allow them to maintain existing property care practices (e.g. incurring extra municipal costs to be allowed summer lawn watering in times of drought) (Dupont, 2013). Scholars have also demonstrated how actions to protect home and property from climate-related hazards – thereby reducing the potential for evacuation, discomfort/injury, or associated stresses – are preferred by some residents over relying on property insurance protection (Botzen et al., 2013; Osberghaus, 2015). Overall, this body of research offers varied insights regarding resident motivations for action to reduce climate-related risks to home sites, but could be

enriched through more in-depth case study analysis of other frames through which residents process local climate change risks and situate opportunities/responsibilities for adaptation action.

Within urban contexts, predominant influences on climate change action are commonly situated at local scales. As compared to mitigation strategies – framed within larger global contexts and often regulated by wider levels of government – adaptation-related initiatives frequently fall within the domain of municipal agencies, which hold at least partial control over local environmental issues, and within which initiatives to spur action may be perceived as more immediate and tangible by residents (Bugliarello, 2006; Dale, 2007; Lu & Stead, 2013; Pincetl & Gearin, 2005). Scholars portray urban areas as sites for innovation that hold significant concentrations of social capital³, and where there often exist venues for direct access to citizen insights regarding local experiences and responses to municipal policy (Corfee-Morlot et al., 2011; Gordon, 2013; Gore & Robinson, 2009; Shaw et al., 2014).

Scholars examining municipal climate governance have commonly explored municipal involvement in multi-level arrangements with regional or national stakeholders, or participation in transnational city networks (e.g. *Cities for Climate Protection*, C40 networks) (Betsill & Bulkeley, 2006; Krause, 2012; Gordon, 2013). Across these levels of engagement, scholars reveal several challenges for cities in addressing climate change concerns among diverse members and priorities. For example, Bauer and Steurer (2014) suggest that multi-level governance approaches face obstacles in producing coherent or consistent framings of adaptation policy within a context of “different backgrounds, rationales and languages”

³ Bhandari and Yasunobu (2009, p. 480) describe social capital as “a collective asset in the form of shared norms, values, beliefs, trust, networks, social relations, and institutions that facilitate cooperation and collective action for mutual benefits”.

among partners (Bauer & Steurer, 2014, p. 127). Scholars also critique a predominance of neoliberal discourses focused on technological solutions and economic co-benefits, which “[do] not argue strongly that prioritising climate change is also about saying ‘no’ to unsustainable development” (Lindseth, 2004, p. 333; see also Krause, 2012, p. 588; Gordon, 2013). In general, these studies provide important insights regarding a plurality of needs and perspectives related to climate change existing across cities, as well as about requirements for greater incorporation of these concerns into contemporary urban development issues; however, these discussions are situated beyond the context of direct engagements between municipalities and residents.

Select scholars have considered how municipalities may effectively engage with citizens to respond to climate change concerns or climate-related hazards. Municipal agencies address climate change issues through policy and regulation related to aspects such as land-use and infrastructure planning, and may engage directly with residents through public education or incentive programs (Anguelovski & Carmin, 2011; Gore & Robinson, 2009). Within this literature, scholars have frequently focused on examining municipal discourses and policy related to climate change mitigation programs for residents, over emerging issues of dealing with experienced or future climate change impacts (Edwards & Bulkeley, 2017; Rice, 2010; Rutland & Aylett, 2008). Prescriptive policy discussions within literature examining citizen responses to climate-related hazards note that effective delivery of initiatives may be impeded when local risks are not fully communicated to residents, or when approaches to developing or communicating policy are not inclusive (Hjerpe et al., 2014; Klein, 2014). This literature also suggests greater rates of participation and likelihood of success when programs include easily implemented measures and financial incentives for

action (Bichard & Kazmierczak, 2012; Whitmarsh, 2008); when they incorporate solutions specific to local contexts and value-based perceptions among residents (Groulx et al., 2014; Susser, 2018; Wolf et al., 2013); when they draw on lived experiences of past intense climate-related events (Baptiste, 2014); and when they involve neighbours or local leaders in communication of initiatives (Brenkert-Smith et al., 2012; Whitmarsh, 2008). Despite the many relevant policy insights that may be found within this literature, this field of scholarship could be enriched by exploring policy implications related to other influences on home-based adaptation action by residents (for example, influences related to how residents value local environments, or to how they attribute responsibility for managing local risks), and by considering more extensively how municipalities may respond to residents' perceptions of multiple and concurrent impacts of climate change at the home site scale. This thesis examines these issues within a comparative case study of resident experiences and policy responses related to varied climate change impacts in Ottawa and Halifax.

1.2 The study context

This study was undertaken within two municipalities in Canada: the City of Ottawa and Halifax Regional Municipality (HRM). These two cities were chosen as they differ in their physical geography and, to some extent, their exposure to climate change impacts (given Ottawa's inland and HRM's coastal location)⁴. The selection of Ottawa and Halifax for this study – with their distinct governance structures and concerns relating to mid-sized cities – is also intended to extend the current North American urban climate change literature, which is often situated in larger municipal centres.

⁴ One prominent difference involves the visible exposure of Halifax to sea level rise – a recognizable impact often cited within discussions of climate change – versus arguably less visible exposure to impacts in Ottawa (for example, vulnerability to flooding from intense rain events).

Both cities fall within a range of mid-sized urban centres in Canada, though Ottawa has a considerably larger population; according to 2016 census data, the population of the City of Ottawa is approximately 934,000 while HRM lists just over 403,000 residents (Statistics Canada, 2017a&b). Both municipalities incorporate considerable rural areas within their urban boundaries as a result of amalgamations carried out in 1996 (Halifax Regional Municipality) and 2001 (Ottawa). They have also experienced intensification within inner-urban areas in recent decades, supported by municipal smart growth/compact city measures, strategic zoning and economic incentives for developers. Inner-urban densification strategies have been associated alternately with the preservation of outer green space and reduction of costs associated with sprawl, improved community livability, lower carbon transitions, as well as neoliberal growth paradigms emphasizing urban redevelopment over socially-inclusive planning (Grant & Gregory, 2016; Grant & Leung, 2016; Leffers & Ballamingie, 2013; McLean, 2018, August 30; City of Ottawa, 2006; HRM, 2014).

Ottawa and Halifax have experienced altered physical conditions from climate change. Both cities are becoming warmer, with periods of intense heat during summer months becoming more frequent (Dyer, 2014, May 12; OCCIAR, 2011; Province of Nova Scotia, 2017). Increases in average temperatures over time have been most pronounced during winter months; in Ottawa, this trend has been evident in part during shorter skating seasons on the Rideau Canal⁵ (Janzer, 2018, February 6; Spears, 2017, February 22; Tumilty, 2017, March 13). Average annual temperatures are projected to rise in both cities over the coming decades,⁶ along with mid-winter freeze-thaw events; conversely, the number of frost

⁵ This trend exists despite some occasional occurrences of lengthier Rideau Canal seasons over this period ("Rideau Canal record broken", 2015, February 25).

⁶ The average annual temperature in Ottawa is projected to increase by 2.5-4°C by 2050, with summers 2-4°C warmer and winters 3-4°C warmer. A recent report also suggests Ottawa may face an increase of as much as

days and ice days are expected to continue to decrease. This condition may disrupt travel in both regions and increasingly impact winter recreation, including skating seasons at neighbourhood outdoor rinks (Beer, 2018, February 7; Damjanov et al., 2012; Jeong et al., 2016).

Ottawa and Halifax are also projected to experience increased precipitation in future years, with more pronounced increases expected during winter and spring seasons. The proportion of precipitation that falls as rain is projected to increase while the proportion of snow is projected to decrease⁷ (Bourdages & Huard, 2010; OCCIAR, 2011; Province of Nova Scotia, 2017). Over the last several decades, Ottawa has seen increased precipitation during warmer seasons, with reduced snow accumulations in winter (Dyer, 2014, May 12). In general, more pronounced seasonal and yearly variations in precipitation are expected in both cities, with rainfall events of greater intensity possibly becoming more frequent⁸ (while periods without precipitation potentially becoming more prolonged) (Dyer, 2014, May 12; Expert Panel on Climate Change, 2009; Province of Nova Scotia, 2017).

Ottawa and Halifax may also experience more frequent occurrence of intense weather events such as summer wind storms and winter snowfall/ice storms over future decades. Summer heat waves may last longer, and periods of drought may become more frequent.

2°C by the 2020s (Bourdages & Huard, 2010; Burgess, 2018, March 9; Dyer, 2014, May 12). In Halifax, an increase of just over 2°C is projected in mean annual temperature between the 1980s and 2050s, with a slightly higher increase in mean temperature projected for the winter season. (Province of Nova Scotia, 2017).

⁷ In Ottawa, annual precipitation is projected to increase by 5-15% by 2050. While precipitation in summer and fall are projected to increase by 0-10%, winter and spring precipitation are projected to increase by 10-15% and 15-20% respectively. There is a 41.3 mm increase in mean annual precipitation projected for Halifax by the 2050s, with much larger increases projected in the winter and spring seasons (22.9 mm and 16.6 mm respectfully) than in summer and fall (2.8 mm and 0.5 mm respectfully). By the 2050s, it is projected that there will be 10.3 more days with rain per year, and 6.8 fewer days with snow (Bourdages & Huard, 2010; Expert Panel on Climate Change Adaptation, 2009; Province of Nova Scotia, 2017).

⁸ A municipal representative in Ottawa indicated that the frequency of future individual intense rainfall events is challenging to determine within general climate simulations projecting increased yearly rainfall volumes in Ottawa overall (D. Conway, personal communication, November 16, 2018).

Drought conditions may lead to greater incidence of wildfires affecting forested residential neighbourhoods in the Halifax area (City of Ottawa, 2014a; Dyer, 2014, May 12; HRM, 2010; Whitman et al., 2013a&b; Vasseur & Catto, 2008).⁹ Halifax faces additional impacts from sea level rise; sea level in Halifax Harbour is projected to rise by 0.73 m over the next century, with some experts suggesting this may be an underestimate (Forbes et al., 2009). In addition, due to higher sea surface temperatures, some researchers project that the Halifax region may be impacted by more hurricanes over the next century, though there exists some uncertainty within this projection. Hurricanes that impact HRM may have more intense wind speeds and higher storm surges¹⁰, with the potential to flood wider areas in the region than have previously been flooded (Forbes et al., 2009; Vasseur & Catto, 2008; Xu & Perrie, 2012).

Until fairly recently, Ottawa has experienced rather limited exposure to severe climate-related events as compared to other regions of the country (for example, repeated intense rain events that caused significant basement flooding in Southern Ontario communities over the past several years, or a severe wildfire in Fort McMurray in 2016 – erupting after a period of prolonged drought – that led to widespread damage to properties and evacuations for residents) (Climate Atlas of Canada, 2018; Feltmate et al., 2017). The 1998 Ice Storm in Eastern Ontario resulted in widespread power outages and discomfort for many residents (Steuter-Martin & Pindera, 2018). Several record rainfall events over the past

⁹ Wildfire risk in the Halifax area is projected to decrease over the next century as forest species compositions shift from fire-prone conifers to deciduous species. Over the short term however, wildfire risk is projected to increase as extended hot and dry periods in summer and fall seasons become longer (as projected), and as dying conifer stands and dead branches from severe storms increase potential fuel loads for wildfire (Whitman et al., 2013a&b).

¹⁰ A storm surge is the additional height that water may reach over sea level during a storm, which for a 50-year storm event has been projected at 1.74 m (Forbes et al., 2009).

decade have caused flooding in various Ottawa neighbourhoods, including one over-100 mm rain event affecting west end areas in 2009 which resulted in almost 1500 basements being flooded (City of Ottawa, 2011b; “Flood-affected areas”, 2014, April 12; Gillis & Laucius, 2017, October 31; Lofaro, 2017, October 30). A more significant flood event that occurred in Spring 2017 in Eastern Ontario and Quebec (during a period of extended rain and snow melt) affected some residential neighbourhoods in outer areas of the Ottawa region along the Ottawa River, and resulted in extensive damage to river-edge properties and evacuations for residents (Hansen, 2018, April 22). More recently in September 2018, multiple tornados affected areas in and around Ottawa, causing widespread power outages and leaving hundreds of homes damaged and several destroyed (“6 tornadoes hit”, 2018, September 25)¹¹.

Halifax residents have been exposed to climate-related hazards through their experience with large-scale weather events such as Hurricane Juan in 2003, and a significant winter storm nicknamed “White Juan” that occurred the following winter. Exposure to subsequent offshore hurricanes/tropical storms has resulted in several intense rain events in the region, with wind storms and power outages affecting thousands of residents in some neighbourhoods (HRM, 2010; Team Green Analytics, 2015; Vasseur & Catto, 2008). In addition, a severe winter snow/ice storm that struck the city in 2015 produced greater snowfall than the “White Juan” event, and resulted in structural damage to some commercial buildings, widespread snow-covered and icy roads, and restricted travel for many residents (“Halifax storms dump”, 2015, March 19). Some neighbourhoods have also been exposed to wildfire; in 2009, 1200 residents were evacuated, eight homes were destroyed and ten homes

¹¹ Most of the data assembled for this study was gathered prior to the 2017 and 2018 flood and tornado events affecting the Ottawa area.

were damaged when a wildfire spread to the edges of the Spryfield neighbourhood of Halifax (“Halifax wildfire controlled”, 2009, May 1).

Recommended adaptation actions within home sites

Home sites may be exposed to various physical impacts from climate change and climate-related hazards. Potential impacts to residential sites include home flooding or structural damage from severe summer or winter precipitation events and windstorms; frozen pipes, water leaks and roof damage from colder temperatures, heavy snowfall and ice build-up during winter storms; and damage to homes as well as trees, food gardens and other landscaping from drought, periods of intense heat or wildfires (City of Ottawa, 2014a; Institute for Catastrophic Loss Reduction, 2011, 2012a&b; Vasseur & Catto, 2008). Associated impacts for residents include stresses to physical/mental health, increasing insurance claims, or significant rebuilding expenses¹² (“B.C. and N.B. floods a warning”, 2018, May 24; Feltnate et al., 2017).

Residents may employ a range of measures to reduce impacts to home sites from climate change (to varied degrees of effectiveness, depending on the severity of the hazard). Table 1.1 on the following page lists a selection of recommended home-based adaptation practices that have been assembled from Canadian sources (Institute for Catastrophic Loss Reduction, 2011, 2012a&b; Kovacs et al., 2014).

¹² For example, the average cost of restoration from basement flooding in Canada is \$43,000 (“B.C. and N.B. floods a warning, 2018, May 24).

Table 1.1 Suggested adaptation practices within home sites to reduce physical impacts of climate change

Suggested Adaptation Practice	Potential Benefits
Strengthen roof structure, install roof heating cables, seal attic air leaks	Winter & summer storms, hurricanes: <ul style="list-style-type: none"> • Protect against high winds, water damage, snow loads, ice dams
Select pressure- and impact-rated entry & garage doors	Winter & summer storms, hurricanes: <ul style="list-style-type: none"> • Protect against high winds, water damage
Install/maintain backwater valve at foundation drain	Intense rainfall events, hurricanes: <ul style="list-style-type: none"> • Reduce basement sewer backups and flooding
Disconnect downspouts from foundation drain, install downspout extensions	Intense rainfall events, hurricanes: <ul style="list-style-type: none"> • Reduce basement flooding
Install green roof	Intense rainfall events, intense heat: <ul style="list-style-type: none"> • Retain stormwater to reduce flooding, shade nearby structures, reduce heat island effect, support local biodiversity
Plant trees	Intense rainfall events, intense heat: <ul style="list-style-type: none"> • Retain stormwater to reduce flooding, shade nearby structures, reduce heat island effect, support local biodiversity
Increase permeable surfaces/vegetative cover (lawns, grass-covered swales, rain gardens ¹³ , food gardens)	Intense rainfall events, intense heat: <ul style="list-style-type: none"> • Retain stormwater to reduce flooding, reduce heat island effect, support local biodiversity
Xeriscaping (drought-tolerant plants)	Intense heat & drought: <ul style="list-style-type: none"> • Conserve water, reduce heat island effect, support local biodiversity
Lot grading (slope away from structures; swales to collect rainwater)	Intense rainfall events, summer storms, hurricanes: <ul style="list-style-type: none"> • Reduce flooding
Trim branches and shrubs, remove dead or rotted vegetation	Winter & summer storms, hurricanes, wildfires: <ul style="list-style-type: none"> • Reduce damage from flying debris, reduce flammable materials adjacent to homes

Note. Compiled by M. Goemans, based on information from Institute for Catastrophic Loss Reduction (2011, 2012a&b), Kovacs et al. (2014).

¹³ Rain gardens are landscaped areas filled with gravel and plants that are designed to absorb stormwater (CMHC, 2011).

Municipal engagements with citizens and climate change in Ottawa and Halifax

Within Canadian cities, municipal programs to engage residents have historically more often been focused on mitigating climate change by reducing household carbon footprints, rather than on adapting home sites to changing climate conditions (Lemmen et al., 2008; Richardson & Otero, 2012). The City of Ottawa and Halifax Regional Municipality (HRM) have employed various strategies to encourage residents to undertake home-based activities to respond to climate-related hazards¹⁴, though most of these efforts do not fall within any comprehensive climate change adaptation program¹⁵. In Ottawa, municipal strategies specifically geared to communicating climate change concerns to residents, including the City's *Energy and Climate* web page and *Air Quality and Climate Change Management Plan*, are focused more on measures to reduce carbon footprints rather than adapt home sites to climate change impacts. The *Management Plan* includes general statements to encourage residents to make changes to their properties to mitigate storm, heat and flood risks by strengthening building structures and modifying landscaping (City of Ottawa, 2014a; City of Ottawa, 2018a). Other programs in place, such as the City's *Are You Ready?* campaign, focus on emergency management immediately following severe weather events, rather than on efforts to build long-term climate change adaptive capacity within households/home sites (City of Ottawa, 2018k).

¹⁴ Additional information on many of these municipal strategies may be found in Chapters 3, 4, and 5.

¹⁵ As of Fall 2018, Halifax Regional Municipality is initiating an 18-month-long engagement and development process around a new Community Energy & Climate Action Plan (CECAP) initiative. According to HRM, CECAP "provides an inclusive, collaborative opportunity to address community-wide climate change adaptation and mitigation measures in all sectors... This approach will establish short and long-term goals for energy transformation and greenhouse gas reductions for the community looking out to 2050". HRM *Energy & Environment* staff plan to produce a draft plan by late spring 2019 (Duncan, 2018).

The City of Ottawa employs other efforts directed at strengthening resilience within home sites to specific climate-related hazards. Regarding residential stormwater management and the reduction of home site flood risk, the City requires that backflow valves be installed in basements in all new residential construction, and through its *Residential Protective Plumbing Program* provides subsidies to residents for installing backwater valves or sump pumps in homes that have been flooded or are at high risk of flooding (City of Ottawa, 2018d&i; Kovacs et al., 2014). Municipal web pages also provide information for residents about measures to manage stormwater and reduce flood risk to basements (City of Ottawa, 2018d,i & k). In addition, a recently-implemented neighbourhood-scale pilot known as the *Pinecrest Neighbourhood Rain Project* aims to engage residents in lot-level stormwater absorption measures (e.g. permeable landscaping, rain gardens) with a primary aim of reducing stormwater (and associated pollutant) flows to the nearby Ottawa River (City of Ottawa, 2018d&i).

The City has also recently completed its *Urban Forest Management Plan*, which encourages contributions to the urban tree canopy within private lands, in part to improve stormwater retention and cooling (City of Ottawa, 2017b). Tree planting and preservation are also encouraged through regulatory measures such as the City's *Urban Tree Conservation By-law*, which requires permit approval for removal or alteration of trees on residential sites, (though controls apply only to what the City describes as 'distinctive trees'¹⁶), and Infill By-laws which involve setback requirements to promote enhancement of permeable/green space within properties (City of Ottawa, 2018f&h). Other efforts include the City's *Trees in Trust* program, which provides free street trees to residents for planting in front yards along

¹⁶ The City of Ottawa classifies 'distinctive trees' as trees of 50 cm trunk diameter or greater (City of Ottawa, 2018f).

municipal rights-of-way (City of Ottawa, 2018c). The City has also expressed support for a local organization known as Ecology Ottawa and its *Tree Ottawa* campaign, which has encouraged residents over the past several years to take part in planting one million trees in the Ottawa area (Ecology Ottawa, 2015).

Within Halifax Regional Municipality, efforts to engage residents in climate change adaptation activity are communicated on a municipal web page and through its *Climate SMART Community Action Guide to Climate Change and Emergency Preparedness*¹⁷. As in the City of Ottawa, communication of climate change concerns through these venues relates largely to mitigation/carbon reduction efforts, with brief mention in the *Community Action Guide* of recommended measures for residents that include planting trees and other vegetation, sealing home foundations, and helping to protect coastal wetlands (HRM, 2010).

Specific stormwater management initiatives for residents include HRM's *Inflow and Infiltration Reduction Program*, which aims to reduce leakage of stormwater from residential sites into municipal wastewater piping (Halifax Water, 2017, July 18), and its *Site Related Flow Charge*, which calculates stormwater rates for residents based on the proportion of permeable area within home sites (Halifax Water, 2017, November 22; Halifax Water, 2018, February 28a). Lot-level stormwater management measures are also encouraged through municipal web pages (Halifax Water, 2017, November 22; Halifax Water, 2018, February 28b). While HRM has no direct engagement programs with residents around stormwater management, it supports efforts by local environmental organizations such as *Clean Nova Scotia*, the *Ecology Action Centre* and *Halifax Diverse* to encourage citizen home-based

¹⁷ HRM's *Climate SMART* program (Sustainable Mitigation and Adaptation Risk Toolkit), initiated in 2003, was intended in part to provide residents with knowledge of potential climate change risks and motivate individual adaptation activity. The program is no longer active, but the *Community Action Guide to Climate Change and Emergency Preparedness* remains on the municipal climate change website (HRM, 2017, November 24).

stormwater management activities (Clean Nova Scotia, 2016; Ecology Action Centre, 2014, 2017; Halifax Diverse, 2016).¹⁸

Regarding efforts to help coastal areas and residents deal with sea level rise, HRM has also expressed support for an *Ecology Action Centre* initiative known as the *Living Shorelines* project, which instructs residents on vegetative methods to reduce coastal erosion through a *Living Shorelines Toolkit* consisting of videos, research summaries and links to other resources for residents (Ecology Action Centre, 2017). Regarding efforts to strengthen the urban forest canopy (and foster associated stormwater management and cooling benefits from trees), HRM's *Urban Forest Master Plan* employs targeted tree planting strategies at neighbourhood scales and encourages citizen awareness and community action around forest stewardship and tree planting in residential neighbourhoods¹⁹ (HRM, 2013).

1.3 Research questions and key arguments

This thesis explores citizen perspectives of climate change impacts, risk and opportunities for adaptation action in Ottawa and Halifax that are based at the scale of the urban home site.

This thesis situates discussions about opportunities for adaptation action with acknowledgement of a multi-faceted problem, where there exists a requirement for more robust communication by municipalities to help residents recognize their own capacities and agency in addressing climate change concerns within home sites, within a concurrent situation of limited control by municipalities over actions taken on private residential lands.

¹⁸ *Clean Nova Scotia* provides a web page with recommended stormwater management actions around home sites, and has hosted community workshops that instruct residents on measures such as installing rain gardens and rain barrels (Clean Nova Scotia, 2016). The *Ecology Action Centre* has hosted a stormwater blog for residents and implemented rain garden demonstration projects (Ecology Action Centre, 2014). *Halifax Diverse* has produced a *Pipes to Parks* video, which encourages lot-level stormwater management action by residents (Halifax Diverse, 2016).

¹⁹ There are no regulatory or incentive measures associated with HRM's efforts at encouraging tree planting/preservation by residents.

This study is presented in a publishable papers format, as this format offers the opportunity for discrete examination of each of the three distinct (yet related) thesis sub-themes (see below), particularly as they relate to diverse spheres of academic scholarship. This format inevitably involves some duplication regarding discussions of context and methodology in Chapters 3, 4 and 5, where the three sub-themes are examined in-depth.

This research employs a qualitative approach focused on discourse analysis and draws mainly from primary interview/focus group and survey data, collected between 2015-2017, from 47 residents living in inner-urban neighbourhoods²⁰ of Ottawa and Halifax with varied exposure to climate change impacts and risk. This study distills additional insights from secondary data that references the perspectives of residents participating in and/or are informed about community and environmental initiatives and issues in each city (e.g. persons involved in community organizations, municipal public consultations, etc.), and from accounts from municipal and environmental organization representatives regarding resident perceptions of climate change impacts and policy. In addition to deepening understanding of resident perspectives of climate change in urban areas, this research is also directed at encouraging strengthened municipal policy and more enlightened engagements with citizens around home-based climate change adaptation activity.

Across a general theme of home-based perspectives of climate change, this thesis focuses on three distinct but related sub-theme areas of analysis: (1) how residents understand local places of climate change impacts and risk; (2) how residents engage with

²⁰ Inner-urban neighbourhoods are defined within the scope of this study as located within central or inner-suburban areas in Ottawa and Halifax. The locational framing of these neighbourhoods as falling within inner-urban areas contrasts with settlements in other outer, more rural areas within the boundaries of each amalgamated urban region. A more detailed discussion of the neighbourhoods where primary data was gathered may be found in Section 2.3 of this thesis.

home site natures within a context of emerging ecosystem-based adaptation²¹ practices; and (3) how residents situate responsibility for managing home site and neighbourhood stormwater flows (a significant aspect of climate-related impacts and policy in Ottawa and Halifax). The first sub-theme area of this research considers how Ottawa and Halifax residents' local experiences of climate change are influenced by physical aspects and visibility of climate change effects in each area, as well as by individual priorities, values and perceptions of vulnerability or control in response to climate change. This sub-theme extends scholarly literature on *place meanings* where residents process multiple climate change effects and deal with impacts in inner-urban areas. The second sub-theme area considers how framings linking the viability of home site ecologies to climate change vulnerability or resilience in residential neighbourhoods and urban ecosystems influences residents' perceptions of local natures and their willingness to implement ecosystem-based adaptation measures. This sub-theme extends academic literature relating to *discursive constructions of home site natures* within the context of adapting to climate change in urban areas. Lastly, the third sub-theme area explores how the residential site is understood as related to individual perceptions of responsibility for stormwater management within home sites and residential neighbourhoods. This sub-theme extends scholarship challenging traditional concepts of *property* through an examination of resident responses to contemporary self-governing strategies aimed at citizens and other adaptation measures. These three sub-themes are summarized in the following research questions:

²¹ Ecosystem-based adaptation refers to practices which involve modification of local ecologies for adaptation benefit (e.g. planting trees to capture neighbourhood stormwater or aid in neighbourhood cooling). A more detailed discussion of ecosystem-based adaptation practices may be found in Chapter 4.

1. How is climate change influencing perceptions among Ottawa and Halifax residents of their local places, and where do residents situate places of climate change vulnerability and risk in relation to home sites?
2. How do residents in Ottawa and Halifax discursively construct local natures in response to emerging climate change impacts and recommended ecosystem-based adaptation measures? How do residents perceive home-based landscaping activities as connected to the vulnerability or resilience of home sites, neighbourhoods and wider urban ecosystems within a climate change context?
3. How do residents situate responsibility for managing impacts of climate change – specifically, stormwater flows from intense rain – in urban neighbourhoods, and how do these impressions reflect underlying understandings among residents of property boundaries, autonomy and connectedness?

This thesis focuses on residents' perceptions of climate change as they relate to home-based *adaptation* activities (though some of these actions may have concurrent mitigation or other benefits)²². These activities take place within the residential *property*, which comprises the land area bounding a dwelling space and under decision-making control of an individual household, including home building structures and landscaping; this space is

²² Tree planting would be one example of an action that provides both mitigation and adaptation benefits (among other qualities, by reducing air conditioning needs to both reduce home energy use and improve resident comfort during hot weather periods). Home solar energy production is also sometimes considered to be another example offering both mitigation and adaptation benefits (regarding adaptation, in preventing household disruptions during power failures from storms), however this is only applicable where home solar energy systems are *not* connected to the municipal energy grid (which is not the case in many urban contexts).

also termed a *home site* within this study. While mitigation action at household scales is focused on helping to prevent further climate change, most often by reducing carbon emissions (e.g. by reducing home energy or automobile use), *home-based adaptation* activity is undertaken with the intent of dealing with the already-experienced or projected effects of a changing climate (e.g. by enhancing vegetation to absorb stormwater from intense rain, or by reinforcing building structures to withstand storms). Home-based adaptation activity within this study involves preparing homes and landscaping to deal with the physical effects of *climate-related hazards*, which include ongoing altered environmental conditions or individual physical disturbances that may be linked to climate change (e.g. increased temperatures; storms; sea level rise), as well as the effects of these altered conditions/disturbances on physical environments (e.g. coastal erosion from sea level rise; flooding from intense rain; wildfires from extended heat and drought). Direct links between the frequency/intensity of individual climate-related hazards and general patterns of human-caused climate change may be unclear.²³ Within the scope of this study, *climate change risk* relates to uncertain physical exposures within home sites to potential ongoing or future climate-related hazards; *vulnerability* involves the susceptibility of settlements to physical damage from climate-related hazards, and relates to residents' ability to cope (financially, physically, emotionally) with physical disruptions to home sites from these hazards.

This study refers to impacts and opportunities for adaptation occurring in *local* places, which are interpreted within the scope of this study to involve the home site, the neighbourhood or the wider urban area. This study also focuses on the perspectives of

²³ Within the context of this study, I acknowledge challenges that exist in directly attributing individual climate-related hazard events in Ottawa and Halifax (or the relative intensity of events) to general patterns of climate change in each city. This situation was also acknowledged within my discussions with study participants.

individual residents; these perspectives may or may not represent the views of all members of the household to which these residents belong.

Key arguments

To begin, this thesis engages with several facets of the academic literature on constructions of place, local natures, and property, and advances several lines of inquiry within a broader theme of home-based perspectives of climate change. First, this thesis advances literature on *place meanings* within urban settings in the context of climate change. Within this sub-theme, I argue that *local* impacts are frequently conceptualized by Ottawa and Halifax residents beyond the home site. Though residents are taking note of changes to valued local places, they are frequently considering these changes within the broader context of surrounding neighbourhoods or urban areas (for example, across commuting spaces, recreational landscapes, or areas of ongoing visible impact such as surrounding eroding coastlines). In addition, residents often situate places of more severe climate change impacts and risk within other distant regional or global sites, or toward future generations. Within the study context of resident perspectives from largely middle-income, inner-urban neighbourhoods, I attribute this tendency to downplay concerns about local climate change impacts and risk to the uncertain and uneven distribution of climate change impacts, a sense of guilt associated with privilege, and ready access to physical and social supports that are available within more central urban settings. This comparative case study reveals a similar resistance to focusing inward on climate change risk within home sites among Ottawa and Halifax residents, despite differing physical landscapes and exposure to impacts between the two cities.

Second, this thesis advances scholarship on *discursive constructions of home site natures*, with its focus on resident perceptions of local ecologies within responses to suggested ecosystem-based climate change adaptation measures. Within this sub-theme, I argue that residents hold multiple and conflicted conceptualizations of local natures, as reducing impacts (through stormwater absorption and home cooling benefits) but also potentially contributing to additional risk (through treefalls during storms) from climate-related hazards. In other cases, ecosystem-based adaptation measures are considered by residents when they align with neighbourhood stylistic preferences or individual eco-ethics. I also suggest that residents are challenged in linking individual management of home site natures to climate change vulnerability or resilience within broader urban ecosystems. This sub-theme extends academic literature by examining in-depth how home site natures are constructed by urban residents within an adaptation context, and by highlighting how risk perceptions toward local natures that are held by some residents may impede implementation of ecosystem-based adaptation measures.

Third, this thesis advances academic literature relating to *free-rider concerns* and *constructions of property* within the context of adapting to climate change impacts (in this case, managing home site stormwater flows from intense rain) within residential neighbourhoods. Within a neoliberal context of increasing responsibility allocated to the *self-governing citizen* in managing urban environmental concerns, I argue that ideas of property autonomy and boundaries are enacted in diverse and fluid ways by residents, as they situate obligation for stormwater management alternately toward individual home-based efforts, wider municipal infrastructure/measures on public lands, or neighbouring private residential (re)development projects. I reveal how residents frequently view neighbouring development

interests as *free-riders* that deplete permeable land area within residential sites, impeding effective stormwater management across neighbourhoods. Through these varied concerns, residents understand the residential property as both individual and linked. This sub-theme extends academic literature by: (1) framing citizen opposition to development from a novel perspective (regarding concerns about development related to effective adaptation to local climate change effects); (2) exploring a new dimension of free-rider concerns (away from a global climate change mitigation to a neighbourhood-scale adaptation context); and, (3) examining additional avenues through which concepts of property may be challenged, in this case within neighbourhood adaptation to unbounded stormwater flows.

Taken together, this thesis contributes additional insights within empirical research on home-scale perspectives of climate change through several frames:

- by focusing on the Canadian urban context (beyond Northern Canadian settings);
- by examining the views of residents in largely inner-urban neighbourhoods, where denser development and access to physical/social supports influence resident responses to adaptation concerns;
- by situating the study across neighbourhoods that may be located near to, but have not directly experienced, larger-scale, devastating impacts of climate change (and with varied awareness among residents regarding current climate change risks and exposure to future impacts within these areas); and,
- by considering how residents process a complex assemblage of climate change impacts to which home sites in urban areas are exposed (versus focusing solely throughout this thesis on one type of impact, e.g. intense rain/flood).

1.4 Thesis structure

Chapter 1: *Introduction*, introduces the climate change context, research sites, and literature on household perspectives of climate change within which this study is situated. This chapter also presents the research problem and questions informing this empirical study, as well as key arguments that have emerged from this thesis.

Chapter 2: *Research Methodology*, outlines the methodology informing this dissertation. This chapter presents the research objectives and rationale, and provides a description of the research settings where primary data was gathered (through interviews/focus groups conducted with residents in several inner-urban neighbourhoods in Ottawa and Halifax). This chapter also discusses the qualitative approach and methods of discourse analysis that were employed for this study, as well as ethical considerations related to my engagement with residents in Ottawa and Halifax over the study period.

Chapter 3: *Adapting in (or out of) place? Citizen perspectives of climate change impacts and risk in Ottawa and Halifax*, explores the first sub-theme of this thesis, through an examination of place meanings among Ottawa and Halifax residents as they consider local impacts of climate change. This chapter examines existing literature on place and climate change, then presents and analyzes perspectives relating to local impacts that are being recognized by residents, their impressions of these experiences, as well as frames employed by residents in situating places of significant impact. This chapter also offers suggestions to enhance municipal adaptation policy by assisting residents in better understanding how local (including home site) places may be affected by climate change.

Chapter 4: *Is adaptation in our nature? Citizen engagements with urban natures and climate change in Ottawa and Halifax*, explores the second sub-theme of this thesis relating

to constructions of local natures among Ottawa and Halifax residents in dealing with climate change impacts. This chapter offers a typology of ecosystem-based adaptation measures, then examines social constructions of home site natures in existing scholarly literature. The chapter then presents and analyzes resident perceptions of local natures within home sites and across urban areas, revealing varied influences on residents' willingness to implement recommended ecosystem-based measures. The chapter also considers implications for municipal climate change policy, including suggestions for strengthening ties for residents between home site natures and the resilience of wider urban ecosystems.

Chapter 5: *Citizen perspectives, property, and responsibility for stormwater management in Ottawa and Halifax*, explores the third sub-theme of this thesis, through an examination of how Ottawa and Halifax residents engage with various conceptualizations of the residential property as they situate responsibility for stormwater management in residential neighbourhoods. This chapter presents existing literature on concepts of property, the current neoliberal context involving the self-governing citizen, and citizen responses to climate-related hazards. The chapter also provides a brief discussion of stormwater management policy in Ottawa and Halifax. Through a presentation of Ottawa and Halifax resident perspectives, the chapter then considers how residents locate influences on and obligations to contribute to the effective management of neighbourhood stormwater flows – and links analysis of these perspectives to existing scholarship on free-rider concerns and citizen responses to infill development.

Chapter 6: *Synthesis and Conclusions*, presents key arguments and insights developed within this thesis, and discusses common themes and linkages between the three sub-themes. The chapter also presents opportunities to enhance municipal climate change adaptation

policy from these insights. The chapter concludes by summarizing contributions of this thesis to scholarly research as well as study limitations, and by considering avenues for future research to further advance the academic literature on home-scale perspectives of climate change.

Chapter 2: Research Methodology

2.1 Introduction

This study examines multiple perspectives of climate change impacts, risks and opportunities for adaptation action among residents in Ottawa and Halifax that are based at the scale of the home site, and considers associated implications for municipal policy in both cities. Various aspects of home-scale adaptation are examined within this broad theme, including: how residents situate climate change impacts and risk in local places; how residents discursively construct local natures within the context of climate change impacts and adaptation; and, how residents locate responsibility for managing stormwater and reducing flood risk within and across residential sites. Within these themes, I aimed to gain deeper understandings of the complex (and at times, conflicting) views held by residents, as they considered the varied framings of climate change employed in this study, and processed multiple impacts occurring in or projected for their respective urban areas. As impetus for this effort, this study employed a poststructural approach to analysis, acknowledging the subjectivity of both the researcher and research participants, encouraging a context where multiple worldviews may be exposed and promoted, and rejecting the notion of a single objective ‘truth’ (Hoggart et al., 2002). This study focuses on the examination of varied discursive constructions of climate change as expressed by residents, considers the material implications of these constructions, and relates these to municipal adaptation policy in each city.

Section 2.2 discusses the objectives and rationale for the qualitative case study research approach employed in this study. Section 2.3 provides a description of the study neighbourhoods in Ottawa and Halifax where primary data from residents was gathered. Section 2.4 explains the types of data employed in this study, as well as how participants

were recruited and data was collected, with a focus on ethical considerations within engagements with residents. Section 2.5 describes methods of data analysis and measures to enhance research rigour and includes a discussion of research limitations within this study.

2.2 A qualitative methodology to access citizen perspectives of climate change

This study employs a qualitative methodological approach to gain in-depth knowledge of citizen perspectives of climate change based at the scale of the home site. This qualitative methodology involves a comparative case study of climate change perspectives and adaptation practices – both existing and potential – among residents in Ottawa and Halifax, cities with differing climates, physical environments, and exposure to intense weather events. This comparative approach both reinforced similarities of resident perspectives within varied contexts (e.g. comparable understandings of local natures held by residents in Ottawa and Halifax inner-urban neighbourhoods) and helped to highlight subtle variations regarding understandings of local climate change risk within the two cities. Case studies enhance academic learning by advancing “context-dependent knowledge” (Flyvberg, 2006, p. 221), acknowledging the complexity of research environments and the richness of human experience. In comparison to quantitative methods, the qualitative research process commonly involves a modest sample of participants, with a goal of uncovering deeper and more nuanced understandings around a range of experiences rather than documenting the frequency with which they occur (Blaikie, 2018; Sim et al., 2018). Qualitative research avoids generalizations across larger populations; instead, researchers consider how findings may be applied to comparable groups or settings (Dwyer & Limb, 2001; Hyett et al., 2014). Within this study, I aimed to further understanding of the perspectives of residents living in middle-income, inner-urban environments in mid-sized Canadian cities with the means to

undertake adaption measures requiring physical modifications to home sites, with additional consideration of the views of other residents (as visible in secondary data reviewed for this study) that have demonstrated awareness of environmental issues or engagement in community/municipal affairs.

The qualitative case study approach employed in this study allowed for deep description and analysis of residents' responses to climate change impacts and suggestions for adaptation action (Gerring, 2007; Hyett et al., 2014). The case study approach offers more direct and immersive experiences for researchers within study settings, as well as more intensive engagements with participants. As Flyvberg (2006, p. 236) suggests, case study methods "can 'close in' on real-life situations and test views directly in relation to phenomena as they unfold in practice". In capturing everyday situations, qualitative case study research recognizes and celebrates the ambiguity and multiplicity of views that may be contained with individual human experiences (Peattie, 2001). This approach offers space for detailed exploration of individual narratives among participants, which can effectively capture the "complexities and contradictions of real life" (Flyvberg, 2006, p. 237; Hyett et al., 2014; McCormack & Kennelly, 2011). Deeper engagement with study participants can also help to challenge researcher assumptions and enhance research rigour within environments where researchers are "corrected by the study objects 'talking back'" (Flyvberg, 2006, p. 236).

Within this qualitative case study approach, this thesis employs a methodology of discourse analysis, examining specific discursive framings of climate change impacts, risk and adaptation among Ottawa and Halifax residents. Scholars contend that discourses shape how knowledge is constructed, conveyed and enacted (Sharp & Richardson, 2001). Hajer and

Versteeg (2005, p. 176) describe discourse as “an ensemble of ideas, concepts and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set of practices.” Differing discourses establish and communicate diverse knowledges and reveal multiple ‘truths’ (Feindt & Oels, 2005; Hajer & Versteeg, 2005).

The process of discourse analysis involves the researcher identifying subtle and repeated themes that may emerge through communication and associated action (Rose, 2001). Scholars engaging in practices of discourse analysis recognize that a multitude of understandings may surround an issue or concept even between individuals or groups with otherwise similar views (Feindt & Oels, 2005; Hajer & Versteeg, 2005, p. 176). This method of analysis is undertaken to explore the range of discourses that may be present within any given context, rather than to determine the existence of a particular ‘best’ discourse (Hajer & Versteeg, 2005). Within this study, I examined resident discourses as expressed during focus groups/interviews and in surveys, as relayed by municipal and environmental organization representatives, and as documented in texts (e.g. public records, media accounts). Within the three sub-themes of this thesis, I explored: how Ottawa and Halifax residents experience, acknowledge or fear climate change in relation to local places; how residents engage with surrounding ecologies related to these observations and concerns; and, how residents situate responsibility for adaptation action within home sites, neighbourhoods, and wider urban areas.

2.3 The research settings

Ottawa and Halifax, both mid-sized urban centres in Canada, were selected for this comparative case study as they differ in their exposure to climate-related hazards²⁴. While both cities experience pronounced urban heat island effects within densely-developed central areas, and have faced challenges in managing stormwater from intense rainfall in varied regions in each city, the coastal location of Halifax exposes the city to additional climate change impacts from sea level rise and ocean warming (in the form of coastal erosion and flooding²⁵, as well as potentially higher storm surges and increased frequency/intensity of hurricane events²⁶). Some forested suburban areas of Halifax have also experienced damage from wildfire, while some Ottawa neighbourhoods are exposed to brushfire risk (“Fire crews battling”, 2012, July 13; “Fire officials hoping”, 2016, May 1; Piliéci, 2016; Whitman et al., 2013a&b).²⁷ Ottawa has a considerably larger population and number of dwellings than Halifax, but a smaller urban land area and corresponding higher population density. While the median household income in Ottawa is substantially higher than in Halifax, the cities have comparable proportions of low-income residents.

²⁴ Halifax was originally also selected as a study city due to past efforts toward progressive municipal climate change adaptation planning, contained largely within its *Climate SMART* program. In recent years, that program has been largely dismantled; one element of the program, the *Climate SMART Community Action Guide to Climate Change and Emergency Preparedness*, remains available on a municipal climate change web page (HRM, 2010).

²⁵ None of the persons who contributed primary data for this study live within ocean coastal properties.

²⁶ There exists some uncertainty around projections of increased frequency of hurricanes affecting Halifax (Vasseur & Catto, 2008).

²⁷ Additional information about past, current and projected climate change impacts and climate-related hazards in Ottawa and Halifax may be found in Section 1.2 of this thesis.

Table 2.1 Population, density and income figures for Ottawa and Halifax, 2016

	Ottawa	Halifax
Population	934,243	403,131
Land area	2790.30 km ²	5490.35 km ²
Population density	334.8 persons/ km ²	73.4 persons/ km ²
Number of private dwellings	373,756	173,324
Median household income	\$85,981 (up 4.2% bet 2005 and 2015)	\$69,553 (up 8.6% bet 2005 and 2015)
Persons in low income ²⁸	12.5%	14.8%

Note. Data from Statistics Canada (2017a&b)

Halifax Regional Municipality and the City of Ottawa incorporate significant rural land area toward their outer boundaries, as a result of amalgamation in 1999 and 2001 respectively. Figure 2.1 below presents maps of the study cities and neighbourhoods. The study neighbourhoods for this thesis represent inner-urban regions of Ottawa and Halifax. These study neighbourhoods correspond with a focus of this research on perspectives of climate change within denser urban environments, where residents may have easier access to emergency management, physical infrastructure, and social supports, where residents may be exposed to more pronounced impacts from climate change in contrast to urban environments (e.g. urban heat island effects), and where residents in close proximity may face similar impacts across neighbourhood scales. Locating this study in inner-urban areas also helps to fill a gap in existing scholarship regarding home-based perspectives of climate change, which is frequently situated in rural areas or smaller community settings (Botzen et al., 2013; Koerth et al., 2013). As noted in Chapter 1, within the scope of this study, inner-urban areas are defined as including central or inner-suburban neighbourhoods, in contrast to settlements

²⁸ "Persons in low income" is the descriptor provided by Statistics Canada (Statistics Canada, 2017a&b).

in outer, peri-urban and more rural areas within the boundaries of each amalgamated urban region.

Figure 2.1 Maps of the City of Ottawa and Ottawa study neighbourhoods

Map of Ontario (Atlas of Canada, Natural Resources Canada, 2018)

Map of Ottawa (Google Maps, 2018)

Map of Ottawa study neighbourhoods (Google Earth, 2018)

Figure 2.2 Maps of Halifax Regional Municipality and Halifax study neighbourhoods

Map of Nova Scotia (Atlas of Canada, Natural Resources Canada, 2018)

Map of Halifax Regional Municipality (Google Maps, 2018)

Map of Halifax study neighbourhoods (Google Earth, 2018)

Central Ottawa study neighbourhoods include Old Ottawa East, Old Ottawa South and Centretown; central study neighbourhoods in Halifax include North End, South End, and Clayton Park. Most of the participants that provided primary data for this study reside in these neighbourhoods. House prices and household incomes in areas of these central neighbourhoods where most study participants reside are at or higher than city averages. All of the study neighbourhoods have encountered varied degrees of intensification in recent years (CMHC, 2018; Ottawa Neighbourhood Study, 2018; Prouse et al., 2014). Two inner-suburban study neighbourhoods in Halifax (Bedford and Spryfield) and one inner-suburban neighbourhood in Ottawa (Riverside South) were included in this study due to their relative proximity to waterways or forested areas, areas with potentially elevated vulnerability to climate-related hazards such as flooding or wildfire. Seven Bedford residents, two Spryfield residents, and one Riverside South resident participated in this study. Though settlements in the inner-suburban study neighbourhoods are comparatively less dense than those in more central study regions, these inner-suburban neighbourhoods have witnessed significant population growth, rising house prices and/or increased development over the last decade (Bundale, 2017; CMHC, 2018; Legge, 2012, August 4; MacLean, 2017, February 9). Average house prices in Bedford and Riverside South are at or higher than city averages, while the average house price in Spryfield is lower than the Halifax average (however, house prices in Spryfield have increased at significantly higher than the municipal average rate in recent years)²⁹ (CMHC, 2018; Power, 2015, February 12).

Table 2.2 provides a brief description of predominant climate-related risks to which each neighbourhood is exposed. Significantly, most homes occupied by participants in the

²⁹ Within the Spryfield focus group discussion, both Spryfield study participants indicated that they occupy homes of above-average value in the neighbourhood.

study neighbourhoods are located in visible proximity, but not immediately adjacent to, areas of pronounced climate-related risk (for example, homes are located near to but not directly on ocean coasts or at riversides exposed to flooding risk, or near to but not directly beside neighbourhood forests exposed to wildfire risk); potential influences on resident perceptions related to this distinction are discussed in Chapter 6. It is also noted that all study neighbourhoods face risk of flooding from intense rain events, urban heat island effects³⁰, or exposure to summer/winter storm events to some degree, regardless of location. All neighbourhoods in Halifax face some risk of exposure to hurricanes (see Table 2.2).

³⁰ The urban heat island effect involves localized elevations in air temperature in areas of concentrated urban development, due to increased heat absorption effects of development materials (e.g. near asphalt roads, concrete structures, etc.) (Corburn, 2009).

Table 2.2 Exposure of study neighbourhoods to climate-related hazards

Ottawa neighbourhoods	
Old Ottawa East	<ul style="list-style-type: none"> • Flooding from intense rain, snow melt (proximity to Rideau River) • Urban heat islands (dense development)
Old Ottawa South	<ul style="list-style-type: none"> • Flooding from intense rain, snow melt (proximity to Rideau River) • Urban heat islands (dense development)
Centretown	<ul style="list-style-type: none"> • Urban heat islands (dense development)
Riverside South	<ul style="list-style-type: none"> • Flooding from intense rain, snow melt (proximity to Rideau River)
Halifax neighbourhoods	
North End	<ul style="list-style-type: none"> • Sea level rise, hurricanes, storm surges (proximity to ocean coast) • Urban heat islands (dense development)
South End	<ul style="list-style-type: none"> • Sea level rise, hurricanes, storm surges (proximity to ocean coast) • Urban heat islands (dense development)
Clayton Park	<ul style="list-style-type: none"> • Urban heat islands (dense development)
Bedford	<ul style="list-style-type: none"> • Flooding from intense rain (proximity to Bedford Basin) • Sea level rise, hurricanes, storm surges (proximity to Bedford Basin) • Wildfire from intense heat, drought (proximity to forested areas)
Spryfield	<ul style="list-style-type: none"> • Wildfire from intense heat, drought (proximity to forested areas)

Note. Compiled by M. Goemans, information from Bourdages & Huard (2010), OCCIAR (2011), Province of Nova Scotia (2017), Whitman et al. (2013).

2.4 The research data: Characteristics and data collection

The data employed in this research on home-based perspectives of climate change was drawn from primary and secondary sources (e.g. focus groups with residents, municipal public consultation documents). As earlier noted, the sampling frame for primary data predominantly involved residents residing in inner-urban, middle-income neighbourhoods of Ottawa and Halifax (with most residents interviewed owning homes of average value in these neighbourhoods). Secondary data was selected according to another aim of this research – to

capture the views of residents engaged in and/or informed about municipal or environmental issues (i.e. persons potentially more likely to pay attention to municipal messaging on climate change, or to consider participating in environmental initiatives). The main focus within primary data on the experiences of persons living in middle-income neighbourhoods is a pragmatic response to the reality that measures to strengthen home site resilience frequently require modest to significant capital investment by residents with relative financial stability and access to disposable income. This situation is reflected in the academic literature, where research has commonly demonstrated a greater likelihood among higher-income homeowners to have the means to undertake structural retrofits to protect homes and properties from climate-related hazards (though they may not be more likely to participate in sustainability activities, such as composting or reducing automobile use, in general) (Lindel & Perry, 2000; Peacock, 2003; Grothmann & Reusswig, 2006). This demographic is also linked to the profile of the ‘self-governing citizen’ toward which contemporary modes of environmental governance are frequently directed (Brand, 2007; Rutland & Aylett, 2008). To expand my examination of resident perspectives, I also spoke with a small number of residents of co-operative housing settlements in central Ottawa and Halifax neighbourhoods³¹, as members of these housing communities often participate in decision-making regarding physical modifications to homes and landscaping. The home in which the

³¹ The *Co-operative Housing Federation of Canada* describes co-operative (co-op) housing communities as offering at-cost (and often, rental) housing, which is provided to individuals/families at low to moderate income levels, and “controlled by members who have a vote in decisions” (Co-operative Housing Federation of Canada, 2018). Two Ottawa residents and one Halifax resident of co-operative housing communities provided primary data for this study. The inclusion of co-operative housing members was encouraged by the thesis committee to broaden participation among households holding control over home retrofits; while this inclusion may appear at first glance to disrupt the data set, interestingly these participants frequently displayed complementary views to other (i.e. higher-income) study participants (for example, in their distancing of climate change risk and greater concern for other populations affected by climate change, as discussed further in Chapter 3).

co-operative housing members in Ottawa reside is situated in an area of above-average house values in the Centretown neighbourhood; I am not aware of the exact location of the house within the North End³² neighbourhood where the Halifax co-operative housing member resides.

This focus on persons living in middle-income neighbourhoods does not negate the significant knowledge about and interest in adaptation efforts that individuals living in other areas may possess, nor does it assume that a middle-income demographic would be more likely to undertake environmental measures in general [in fact, some studies have demonstrated that more affluent residents actually demonstrate a lesser degree of environmental concern than others and have higher environmental footprints) (Knight & Messer, 2012; Kennedy et al., 2015)]. The selection of participants living in middle-income neighbourhoods simply corresponds with a main objective of this study to explore how residents who may have the means to undertake retrofits may consider physical alterations to homes and properties, in response to municipal adaptation-related initiatives and broader suggested adaptation recommendations for households. While clearly worthy of greater depth and breadth of study, complex issues of climate change vulnerability and adaptation activity among socially or economically marginalized residents in Ottawa and Halifax falls outside the scope of this study. However, it does represent a logical extension of this research moving forward.

Resident study participants were selected through several means over the multi-year data gathering period between 2015-2017. During the first stage of recruitment, I contacted neighbourhood organizations from the selected study neighbourhoods by email and

³² The North End neighbourhood comprises settlements of varied house values, with portions of the neighbourhood undergoing significant gentrification.

telephone, to explain the study and inquire if members would be interested in participating in the research project. I also posted study notices on neighbourhood organization Facebook pages, on municipal councillors' websites, in online community newspapers, and on local library notice boards. Within this messaging, I advertised several introductory sessions that I held over this period to inform residents about my study and offer sign-up sheets for participants. I also directed interested respondents to a blog I had created for the study (see more below), which outlined the main purpose of the study and included a brief description of my research experience and goals. Engagement through social media with participants through formats where they may access personal information about the researcher has been shown to enhance recruitment success and enhance trust-building (Baltar & Brunet, 2012). During the second stage of recruitment, I applied a snowball sampling method, in which I asked the initial set of residents who had agreed to participate to send along my contact information and link to my blog to any other residents they thought might be interested in joining the study. I also solicited study participants through a mass postcard mailing, which garnered two additional participants from the selected Halifax study neighbourhoods. Overall, direct contact with neighbourhood organizations proved to be the most effective method of recruiting resident study participants. As I progressed with interview/focus group engagements over this multi-year period, I continued with recruitment efforts until there appeared to be a relative saturation of data from residents (i.e. when similar themes were repeatedly voiced within discussions with participants).

During this period, I also interviewed representatives from municipal and other supporting agencies involved with climate change adaptation-related strategies geared toward households in both cities, including the municipal Environmental Services and Planning

departments in Ottawa, the municipal Energy & Environment Office in Halifax, and the Ecology Action Centre and Nova Scotia Clean Foundation organizations in Halifax. These representatives provided additional perspectives of resident views on climate change-related issues in each city, as well as clarification on municipal initiatives that informed the implications for climate change policy presented within each of the sub-theme chapters of this thesis. Municipal and community organization representatives were recruited through email and telephone contact.

In total, assembly of primary data for this study involved communication with 62 study participants: 47 residents (25 Ottawa participants and 22 Halifax participants), 12 municipal representatives (six in each city), and three representatives of environmental organizations that had been involved in adaptation-related (largely stormwater management) programs directed at residents in the Halifax area. Resident participants included two Ottawa residents who spoke with me about neighbours' involvement in a community-scale flood risk information program in areas bordering the Rideau River in the Old Ottawa East neighbourhood (known as the *Brantwood Park 610 Action Plan*³³), and one Halifax participant who spoke with me about working with residents to apply adaptation-related (stormwater management and coastal erosion control) measures as part of her landscaping business. Among participants offering first-hand accounts, the age, gender and racial distribution of residents within Ottawa and Halifax study groups are fairly similar (see Table 2.3). While a small number of participants have recently moved to the study neighbourhoods,

³³ The Brantwood Park 610 Action Plan is described as a "community information initiative to help residents be better prepared in the event of a spring flood". The group helps to communicate flood alerts through email updates to homes situated near the Rideau River floodplain during periods of pronounced rain or snow melt along the river. Additional information about this initiative may be found at <http://ottawaeast.ca/files/2015/spring-flood-action-plan.pdf>

well over half of residents have lived in these neighbourhoods for 10 years or more (up to 67 years in Halifax and 49 years in Ottawa).

Table 2.3 Age, gender and racial distribution of resident study participants (first-hand accounts) in Ottawa and Halifax

	Ottawa	Halifax
Total residents, primary data (first-person accounts)	23	21
Age distribution³⁴:		
Younger adults (aged 18-34)	5 (22%)	4 (19%)
Adults (aged 35-59)	11 (48%)	11 (52%)
Older adults (aged 60+)	7 (50%)	6 (55%)
Gender distribution:		
Female	14 (61%)	11 (52%)
Male	9 (39%)	10 (48%)
Racial distribution:		
Persons of colour	2 (9%)	2 (10%)
White	21 (91%)	19 (90%)

Note. Compiled by M. Goemans.

As the data gathering period progressed, I also reviewed resident comments contained within secondary data in the form of: (1) records of several federal community-based climate change town halls that were held in Ottawa and Halifax in 2016; (2) minutes from municipal council meetings; (3) records of municipal public consultations related to urban forest and stormwater management; and, (4) news media accounts and opinion columns documenting resident perspectives related to climate change and/or local intense weather events. This triangulation across primary and secondary sources provided additional insights from a more extensive range of residents engaged in climate change and/or municipal issues across each city, and helped to reinforce themes that had come out of focus group/interview discussions in the study neighbourhoods (for example, concerns about impacts on neighbourhood stormwater management from development, or perceptions of increasing local climate-

³⁴ Residents were asked to self-identify within one of the three age groups.

related effects, e.g. increased freezing rain events). In addition, I employed a secondary analysis of municipal policy documents and adaptation-related programs administered by local environmental organizations, which helped to enhance understanding around adaptation and policy contexts in each city and inform discussions of policy implications for municipalities related to thesis sub-themes in Chapters 3, 4, and 5.

Primary data was collected between 2015 and 2017. Once residents had signed study consent forms, they were invited to express their views about climate change impacts and adaptation by: 1) filling out an initial online survey; and, 2) participating in a focus group or interview session (survey and interview/focus group questions may be found in Appendix 1 and Appendix 2 respectively). These methods were employed with a goal of gaining a deeper knowledge of the range of understandings of climate change and adaptation strategies that existed among residents, not to assemble a representative sample that could be applied across a wider population.

The main purpose of the survey was to access initial responses (as a baseline) from residents regarding their understandings of climate change impacts and options to adapt to impacts within home sites, prior to their exposure to framings of climate change impacts and adaptation that were introduced during interview/focus group sessions. The survey was also intended to stimulate a process for residents of thinking about their own impressions of climate change risk within the immediate contexts of their homes and neighbourhoods. Survey questions included inquiries about how participants described vulnerability and adaptation to climate change in their cities, how climate change might be affecting daily life in households, factors that might increase/decrease residents' likelihood of implementing adaptation actions, and opinions regarding if municipal government and/or residents had a

responsibility to adapt residential properties to climate change. After participants had completed surveys, I maintained ongoing communication with them over the course of several months with notifications through my study blog about items we would be discussing during interviews (e.g. projected impacts of climate change, adaptation recommendations, municipal adaptation measures in each city) as well as updates on my research progress.

I conducted focus groups/interviews with residents and municipal/environmental organization representatives in Ottawa at several points over the two-year period, and during three trips to Halifax – each several weeks in length – over this same timeframe. I tried to structure communication with residents to acknowledge and respect, as de Leeuw et al. (2012) suggest, that research participants may have intensive schedules and other commitments outside of the research process that limit their availability for in-person participation. The use of focus group and interview methods with residents allowed opportunities for what Hoggart et al. (2002, p. 205) describe as “in-depth understanding that is best communicated through detailed examples and rich narratives”. Within focus group discussions, I aimed to bring participants together – as recommended by Packer-Muti (2010) – within a relaxed atmosphere among neighbours, guiding the general discussion while making space for spontaneous exploration of alternative perspectives and ideas among participants. I arranged interview sessions with residents who chose to speak with me privately within quieter settings of their choosing, such as at library meeting rooms or within participants’ homes.

During focus groups/interview sessions, I presented residents with visual and textual materials that were assembled from Google satellite images, municipal floodplain maps and visual representations of the urban tree canopy in each city. These materials were aimed at:

1) stimulating discussions with residents regarding their impressions of climate change risk and suggested home-based measures to adapt to weather events related to climate change (e.g. planting vegetation to capture stormwater, strengthening roof structures to prevent damage from severe wind); and, 2) situating participants' home sites within neighbourhood-scale climate change vulnerabilities (e.g. densely developed areas susceptible to urban heat islands) and urban ecosystems in each city. This method of employing available knowledge to help residents visualize impacts of climate change within their immediate contexts was aimed at drawing out personal narratives from residents (Stoll-Kleeman et al., 2001). Overall, though these survey/interview engagements involved presenting information to residents in ways that privileged particular adaptation strategies and framings of urban environmental impacts and risk – corresponding with Castree's (2001, p. 17) contention that “[w]e must live with this inability to know nature ‘as it really is’, while still remaining committed to the idea that some knowledges of, and practices on, nature are better or worse than others” – I tried to create environments for discussion where questions and expressions of alternative views were encouraged.

A primary goal of engaging with participants was to establish relationships of mutual respect, trust and respectful exchange, while acknowledging that the identities and positions of researcher and participants are fluid and may change within differing contexts (St. Martin & Pavlovskaya, 2009). In conducting my doctoral thesis research through a poststructural approach, I undertook a process of self-examination as a researcher by frequently questioning how my assumptions, biases and worldviews might impact my research and my interactions with participants. I worked towards this aim by adopting an approach of transparency and reflexivity – allowing research participants extensive knowledge about my research approach

and intent, soliciting feedback from participants when thesis drafts were produced, and adjusting when needed to correspond with insights gained upon periodic review of the research design.

Etherington (2007, p. 614) suggests that a transparent research approach holds opportunities for the researcher to “provide ongoing information as it becomes available, even when that requires the use of appropriate and judicious researcher self-disclosure, [and] to include in our writing and representations information about research dilemmas that may occur, and the means by which they have been resolved”. As I engaged with participants, this required reflection on how personal biases may have influenced my interaction with individuals and interpretation of their responses. I considered how methods of communication might influence how participants heard me, as well as how our immediate and wider contexts influenced understanding (Dowling, 2005; Seganti, 2010). This included reflection on how my perspectives regarding climate change adaptation and ecological sustainability are influenced by accepted theory (Seganti, 2010), as well as by my own identity as an active supporter of environmental initiatives.

As part of this reflexive approach, I maintained notes about, as Dowling (2005, p. 22) suggests, my “thoughts and ideas about the research process, its social context, and [my] role in it”. Recounting research experiences within these notes helped me to reflect on how the goals of my research and my impressions of research sites influenced how I communicated with participants. For example, this process helped in trying to maintain a balance within my position as interviewer/focus group facilitator as both sympathetic listener (for example, showing concern about participants’ negative experiences with past severe weather events) and neutral observer (not revealing too much about my own perspectives on climate change

issues) within discussions with residents. Overall, I aimed to maintain a position of “empathic neutrality” when communicating with participants (Seganti, 2010, p. 980). I also reflected considerably on how the ways I differed in my engagements with participants within the two sites may have had implications on how residents were responded to or treated. I have lived in Ottawa for 27 years; I had visited Halifax only once before the start of the study and had no established relationships with anyone living there. I suspect these differences may have influenced residents’ impressions of my level of comfort when interacting with them. These differences were also evident within more relaxed timings in arranging meetings with Ottawa participants as compared to more restricted scheduling windows during Halifax research visits; they may have also been evident within my varied abilities to relate to the experiences of Ottawa versus Halifax residents, resulting from a greater familiarity with local neighbourhoods, attachment to place, and awareness of climate-related hazards in the Ottawa context.

One of the most challenging aspects of interacting with participants was to convey concepts associated with climate change and other environmental issues in ways that allowed space for a breadth of understandings and interpretation among participants. For example, regarding representations of urban natures (most relevant to sub-theme discussions and analysis in Chapter 4), Grove (2009, p. 215) contends that “political-ecological analysis must be conscious of its own representational practices that inscribe ‘urban’ spaces as produced natures, or ‘hybrid’ spaces as inherently sites of resistance, for these can potentially blind analysis to embodied experiences of ‘urban natures’ that exceed these representations.” I also considered how my own motivations for addressing climate change issues might have influenced the lenses I employed throughout the research process. My research frames

climate change as a threat and direct cause of disaster and disruption to individuals' lives. In reflecting on the research process, I thought about how my own beliefs might have led me to devalue individual perspectives that I encountered during my research work – for example, in the small number of cases where participants downplayed climate change concerns – based on normative judgments about how I might think individuals *should* be responding to climate change issues. I also thought about how gender representation among participants may have influenced my interactions with residents, involving differing perspectives represented in terms of which household members participated (i.e. whose voices were heard)³⁵.

The research process opens several opportunities for risk to participants. I was aware that my discussions with residents about climate change impacts and risk might bring up strong emotions or memories for participants (Kobayashi, 2001); residents may have experienced concerns previously not considered about future impacts of climate change to home sites, have felt discomfort associated with the relative unpredictability of future climate change effects, or experienced uncertainties regarding the effectiveness of recommended adaptation measures. As one of my primary methods of participant recruitment was to contact households through neighbourhood organisation channels, I also acknowledge that there existed a potential for residents to feel coerced to participate in the study, and for residents to feel exposed to peer pressure among neighbours within focus group discussions (Hoggart et al., 2002) – though based on my observations in interacting with residents this did not appear to be the case. In addition, when presented with information about recommended adaptation measures, residents may have felt pressure to undertake actions on

³⁵ During focus group discussions I did not witness any incidents of gender groups dominating discussions or preventing others from expressing their views.

their properties, or may have felt uncomfortable about sharing negative reactions to recommendations or about being critical of government policy.

In anticipation of these concerns, I aimed to foster a welcoming and open environment for discussion with participants throughout the study. Referring to focus group facilitation, Packer-Muti (2010, p. 1025) suggests that, “the planning process must be more than preparing a list of questions. The researcher must think about the location and layout of the group session and how that location/layout might impact participation.” Within interview and focus group settings, I aimed to establish an environment conducive to relaxed engagement by supplying refreshments and setting aside a sufficient – but not too lengthy – amount of time for discussion (one to two hours). I tried to make clear to participants that my goal was to understand residents’ perspectives rather than to promote particular understandings or actions. I also tried to provide opportunities for participants to express ideas without judgement or interruption. Participants were also reminded that they could choose not to answer questions if they wished and could speak with me in separate interview sessions if they did not want to participate in focus groups³⁶. I also tried to make clear to residents, when I was providing information about projected climate change impacts or proposed adaptation measures, that I did not represent municipal government or other interests; I was simply providing information as a neutral party in order to assess residents’ responses to this material. When communicating with participants, I frequently encouraged them to discuss, if they wished, other ways of understanding climate change, household risk or options for adaptation beyond what was presented. The research design also incorporated elements of reciprocity with participants, as I consciously structured my engagements with

³⁶ Several participants in each city elected to participate in interviews in private settings (e.g. participants’ homes) rather than in focus groups.

them (within focus group/interview discussions, on the study blog, and through other conversations with residents) to offer easy access to neighbourhood-scale information about potential adaptation measures for home sites, as well as information about the state of municipal adaptation-related (e.g. stormwater management) initiatives being undertaken in each city.

In attempts to establish deeper and more extensive relationships with resident participants and to maintain ongoing communication with them – as well as to foster a research context that addressed issues of researcher reflexivity and positionality – I created a study blog to allow participants opportunities to access links to established climate change adaptation resources, post anonymous feedback comments (if desired, though no participants posted comments), and view my progress at various points in the research process. As advised by Carleton University’s Office of Research Ethics, I did not use this blog to access or assemble primary data from participants.

Blogging offers a flexible and immediate platform of communication between the researcher and research participants through an “easy interface that requires low technical competency” (Olive, 2012, p. 73). Blogs offer a format through which general information and links to resources may be relayed in ways that are permanently recorded and that may be repeatedly referred to by all involved in the research process, and information may be posted in a variety of multimedia formats that would otherwise be too large for e-mail transfer to participants (Hookway, 2008; Olive, 2012). The use of an informal tone of communication by researchers through blog posts also encourages a greater sense of familiarity that helps to balance power relations between the researcher and participants. In addition, as Olive (2012, p. 73) notes, the blog format

[...] [allows participants] to speak back to it, in their own time. Although interviews are collaborative and promote exchange, there are often time and space constraints that minimise the ways we can engage.... Blogging create[s] access, space and time for reflection epistemologically, methodologically and theoretically: always in context, always in exchange.

My research blog provided several opportunities to moderate power imbalances between myself and participants. Posting personal research notes on the blog helped to make visible my subjectivities as a researcher over the course of the research process. Inviting anonymous questions and comments from participants on the blog site³⁷ – in addition to letting participants know they could communicate with me by telephone, email or Skype – provided other options for participants to ask questions or express ideas that might fall beyond mainstream views (Olive, 2002). While study participant engagement with the blog turned out to be somewhat modest overall, some residents did employ other avenues (e.g. email inquiries) to communicate with me outside of focus groups/interviews to clarify research intent, send information about interesting climate change-related events taking place in their cities, and ask for additional detail about some of the adaptation options I had presented to them (for example, to ask me specific questions about preferred tree species selection for planting within home sites).

Lastly, I considered ethical implications for residents related to analysing research findings and writing the thesis text. For example, in keeping with my commitment to anonymize primary data from resident participants, I employed a coding system for citing direct quotes that removed potential resident identifiers (using a numbered system for focus group/interview or survey responses preceded by an Ottawa or Halifax code, e.g. OTT-SRV2 or HAL-FG8). Municipal and environmental organization representatives were made aware

³⁷ No residents opted to post comments/questions on the blog site.

that I would attribute quotes directly (i.e. non-anonymously) to them. I also sent detailed drafts of thesis chapters to study participants for feedback, so that participants could confirm if I had accurately conveyed their responses, as well as offer additional comments if desired. Participants who responded approved all quotes attributed to them and noted that they appreciated this opportunity for clarification. Upon their reviews, one resident participant and one municipal representative also offered clarifying comments that helped me to refine descriptions of climate change risk and the policy context in Ottawa within the final version of the thesis text.

2.5 Methods of data analysis, measures to enhance research rigour, and research limitations

As earlier noted, this study employed a discursive analysis of citizen perspectives to identify a range of understandings among Ottawa and Halifax residents related to climate change impacts, risk and adaptation. Within this process, I initiated a review of primary data by transcribing audio recordings of study participant interviews/focus groups, and by examining residents' responses to the study survey. I also reviewed resident comments contained within secondary data (e.g. notes from climate change town hall meetings, news reports, municipal public consultation transcripts), as well as comments from municipal and environmental organization representatives regarding their impressions of residents' awareness of and responses to climate change issues.

I manually coded primary data using the research questions related to each of the three sub-themes of this thesis (see Section 1.1 in Chapter 1) as initial guides in grouping general themes around resident perspectives. I also integrated coding themes that had been identified in the existing academic literature, such as 'resident perceptions of risk associated

with experience of past weather events’ and ‘resident valuations of local natures associated with aesthetic qualities’. In categorizing data, I identified words, phrases and ideas similarly expressed by participants. When looking for consistencies across responses, I also considered how other comments by residents differed from emerging main themes. Examples of these counter responses included moments where residents admitted resistance to or doubts about the effectiveness of implementing suggested adaptation measures, or within differing descriptions among residents of past intense weather events. Within this process, I also selected direct quotes from residents to include within the thesis text that reinforced or offered counterpoints to predominant views. To enrich findings from primary data, I then reviewed resident comments within secondary texts to assess how they corresponded with or diverged from themes identified within primary data from the study neighbourhoods. In all cases, I found that views expressed in secondary texts largely reinforced existing themes.

The action of refining themes and sub-themes involved a lengthy process of nuanced re-coding, during which I made notes of my impressions as I repeatedly revisited the original research questions and considered the multiple aims of the study. I explored links and contrasts across the data, such as differing impressions of climate change risk among Ottawa and Halifax residents, and at several points, I cross-indexed data fitting in more than one category across the three general themes (for example, responses related to the management of permeable land within home sites, which linked to themes of managing local natures and situating responsibility for neighbourhood stormwater management discussed in Chapters 4 and 5 respectively). Overall, this process involved recurrent readings of interview/focus group transcripts, survey results and secondary texts until discovery of distinct themes and subcategories appeared to reach a point of saturation. As I began writing the thesis text, I

developed an initial structure of linked concepts and expanded on participant responses captured within each theme. I developed arguments with a focus on accurately conveying residents' impressions about local climate change impacts and opportunities to adapt home sites, and on uncovering insights that would advance the current literature related to each sub-theme.

I employed several measures to enhance research rigour within this study. This included triangulating across multiple and complementary data-gathering methods and data sources (survey, interview/focus group, secondary texts, impressions stated by municipal and environmental organization representatives) with the goal of presenting a more comprehensive, enriched and multi-view account of perspectives of climate change among residents in the two cities (Denzin, 1989; Rothbauer, 2008). As part of this effort, I also employed a mixture of closed and open questions within surveys and semi-structured focus group/interview scripts, with the purpose of improving clarity and ease of completion for participants, while also offering them room to expand on comments if desired. In providing anonymity to resident participants, I also aimed to create a context for discussion where residents could challenge the information I was presenting to them and freely express alternative views. In part to encourage unrestricted responses from residents (and as mentioned earlier), I also tried to address power dynamics and enhance comfort for residents within my engagements with participants; measures toward this effort included letting residents know they had the option of speaking privately with me if preferred, that they could conclude participation in interview/focus groups at any point if they felt uncomfortable within discussions,³⁸ and that they were welcome to review thesis chapter drafts from my

³⁸ No study participants requested that interview/focus group sessions be concluded earlier than planned.

study with the option of asking that I remove direct quotes in cases where residents did not feel their views had been accurately conveyed. In addition, the time I spent within study neighbourhoods over the multi-year data gathering period, and multiple opportunities I provided research participants to contact me with questions or keep up-to-date on study progress within the research blog over this period, also helped me to become more familiar with the study sites and participants; ultimately, I believe this process enhanced my understanding and depiction of the research contexts.

This study was undertaken within specific parameters that have influenced several research limitations. For example, as the main period of data collection and analysis was structured between mid-2015 and late-2017, resident responses to intense weather conditions following this period were not included in this study (e.g. responses from many Ottawa study participants to a large-scale 2017 Ontario/Quebec flood event and from all Ottawa study participants to more recent tornado event affecting the city in Fall 2018). This limitation reflects the realities of evolving and unpredictable impacts of climate change, which may alter individuals' perceptions of risk and willingness to undertake adaptation measures in different ways that may need to be captured over time.

As discussed earlier in this chapter, this study was also intentionally designed to include primary data largely from households residing in middle- to upper-income neighbourhoods or dwellings (with the exception of the Spryfield neighbourhood in Halifax, included due to its proximity to wildfire risk, and the inclusion of three residents from centrally-located co-housing communities, intended to broaden the range of perspectives studied). As earlier noted, though this limitation was intended to place focus largely on willingness to adopt adaptation measures among residents with the financial means to

undertake recommended physical retrofits to home sites, it nevertheless precludes understandings of ways in which economic or social vulnerabilities among other Ottawa or Halifax households may impact residents' sense of climate change risk or responsibility for adaptation action. This latter context offers a crucial frame for future research. It may also be noted, however, that some of the views expressed within secondary data (e.g. municipal public consultations) may have come from persons living in lower-income neighbourhoods.

There exist other research limitations within the demographic profile of residents included in this study. Though recruitment efforts yielded a rather moderate distribution of age and gender groups among study participants, fairly consistently between the two cities, there was limited involvement of persons of colour (only two participants in each city). While the proportion of persons of colour among study participants in Halifax is similar to that of the city in general (approximately 11.5%), the proportion of persons of colour among Ottawa study participants does not reflect that of persons listed in census figures as visible minorities in Ottawa (almost 28%); this suggests another significant need to include more of these voices in future climate change research. Recruitment for future studies could be enhanced by asking for suggestions from neighbourhood organizations, municipal councillors, or initial participants in the study about how to refine recruitment methods to be more inclusive and attract interest among a more diverse population within study areas.

Elements of the qualitative research process may have also influenced study results. As this research relied largely on residents' self-reporting of their perceptions of risk or willingness to undertake adaptation measures, the responses presented may not adequately reflect a full range of views held by individuals participating in this study, or their likelihood in undertaking adaptation activities. For example, residents may have been prone to selective

memory or exaggeration in recounting their experiences of past intense weather events. In addition, despite my efforts to foster an inclusive and comfortable environment within focus group sessions, in some cases residents may not have wanted to diverge from predominant perspectives expressed among participants, or admit any unwillingness to implement suggested measures. Significantly, residents' stated willingness to implement suggested adaptation measures during interviews/focus groups may also not transfer to future action.

Lastly, and as earlier mentioned, my own researcher bias may have influenced participant responses in this study. In reflecting on the ways that I communicated with study participants, I realize that I framed most of our conversations around the negative connotations associated with climate change, often neglecting other perceived benefits (e.g. more comfortable winters for some residents, or a longer growing season). I suspect that my own sense of urgency around climate change issues and the need to act in response to climate change also influenced my discussions with study participants. Issues of bias could be addressed in part within future research with greater reflection on my part during data gathering periods, and by consulting with participants (following completion of interviews) about their impressions of these concerns.

2.6 Conclusion

This chapter presented elements of the qualitative case study research methodology employed in this thesis. I explained the poststructural and qualitative discourse analysis approaches that I applied in this study to explore diverse discursive constructions of climate change that exist among Ottawa and Halifax residents. The comparative case study framing of this research allowed for in-depth examination of varied resident understandings of climate change within a specific context (mainly focusing on middle-income areas of inner-

urban neighbourhoods), and allowed me to uncover points of connection and divergence between resident perspectives in the two cities. The next section of this chapter provided information about population demographics and physical exposure to climate-related risks in the research cities and study neighbourhoods.

Within this chapter I also described how primary data (collected from surveys and interviews/focus groups with residents) and secondary data (collected from public consultation records and news media) were collected and analysed to reveal multiple understandings of climate change held by residents. I also included an extensive discussion of how I structured the research process to promote a respectful, inclusive and participatory environment in engaging with research participants, during phases of study participant recruitment, interview/focus group discussions, and ongoing communication with residents. I then described the detailed and iterative coding process that I applied in refining the three research sub-themes forming this thesis. I concluded this chapter with a discussion of measures I employed to enhance research rigour (e.g. triangulation of data, extensive periods of communication with participants), and of research limitations within the parameters of this study (e.g. participant demographics in the study neighbourhoods, research timeframe). The next chapter of this thesis, Chapter 3, explores the first research sub-theme relating to climate change and place meanings among Ottawa and Halifax residents.

3.1 Introduction

Within the broader context of climate change impacts in cities, individual residents must process changes to valued qualities of local neighbourhoods or landscapes, or deal with the personal implications of home sites at risk from weather effects such as flooding or wind damage. As subtle and intense effects of climate change advance within urban areas, there is an emerging recognition among cities and scholars of a need to better understand how citizens process local changes. This focus is aimed in part to influence targeted adaptation strategies for residents that draw from a breadth of local knowledges and concerns (Lyth et al., 2015; Nyamwanza & Bhatasara, 2014; O'Brien et al., 2007; Susser, 2018). Scholars increasingly emphasize the context-specificity of environmental challenges (Brugger & Crimmins, 2013; MacGillivray & Franklin, 2015), and call for greater empirical research to encompass varied understandings and engagements with climate change that may manifest within specific populations and circumstances (Pyhala et al., 2016; Wolf & Moser, 2011).

Scholars advocate for expanding examination of the ways in which citizens understand local vulnerability to climate change, beyond potential property or economic losses to the ways in which residents' engagements with their valued *home places* may be altered (Adger et al., 2011; Brugger & Crimmins, 2013). There is a growing body of academic literature that considers the significance of place meanings for citizens in the context of climate change. Scholars conceptualize *place* as a location that is imbued with meaning, a distinctive setting with which individuals may foster emotional bonds (Relph, 1976; Tuan, 1977). Understandings of place may be framed through "social processes and relations" (Adger et al., 2011, p. 3), but place meanings are also influenced by the material

aspects of settings and may be reimagined by citizens when nearby physical environments are changed or threatened (Knez, 2005; O'Brien et al., 2007; Relph, 1997). A corresponding focus in the scholarly literature examines where citizens situate meaningful climate change impacts and risk in relation to local places (Jones et al., 2017; Spence et al., 2012; Stoll-Kleeman et al., 2001). This varied scholarship also demonstrates how attention (or inattention) to local impacts in relation to familiar qualities of place (e.g. changes to valued coastline settlements in the context of sea level rise, or to treasured urban forests amid wildfire concerns) influences citizen involvement in responses to climate change concerns (Fresque-Baxter & Armitage, 2012; O'Neill & Graham, 2016; Scannel & Gifford, 2013).

Within existing empirical research, a large portion of studies on perceptions of place in the context of climate change are either situated outside of Canada or focused on Indigenous household experiences in the North (Amundsen, 2015; Brugger & Crimmins, 2013; Petrusek MacDonald et al., 2013; Wolf et al., 2013). Case studies are frequently situated in areas of visible climate change risk, or involve residents that have experienced pronounced physical impacts from weather-related events (e.g. coastal areas exposed to hurricane risk, settlements devastated by flood). Studies also commonly take place within smaller municipal or rural – and often socially vulnerable – settings, framing residents' altered perceptions of place as they relate solely to community identities or livelihoods, without additional focus on physical and other vulnerabilities at the scale of the individual dwelling space (Bruine de Bruin et al., 2014; Cunsolo Willox et al., 2012; Koerth et al., 2013; Lawrence et al., 2014; Whitmarsh, 2008). What has yet to be fully explored within this literature are changing perceptions of local places that start at the scale of the home site within varied contexts of physical exposure to climate change and significant weather-related

events; an additional focus on perceptions among residents of inner-urban, middle-income neighbourhoods in larger municipal centres, where residents presumably have more proximal access to emergency management supports and the individual means to undertake adaptation activities, would address other gaps in this scholarship.

This chapter aims to contribute to a more nuanced scholarship on place meanings in the context of climate change impacts and risk, by exploring how climate change is altering perceptions of local places among inner-urban residents in two mid-sized Canadian cities: Ottawa and Halifax. This research also examines where climate change is *taking place* for residents – where residents situate places of significant climate change impacts, vulnerability and risk – in relation to individual home sites. Climate change involves various emerging, ongoing, and potentially recurring engagements for citizens with vulnerability in urban areas, which may disrupt connections to place and perceptions of risk in different ways over time. In employing a comparative case study that examines place meanings in cities with varied intensities of physical exposure to climate change impacts, this research also identifies how residents' views may diverge or connect in relation to these differing environments and vulnerabilities.

This study broadens the empirical research on place meanings and climate change among citizens within a Western, and specifically Canadian context. This research focuses on perspectives among residents that: largely inhabit middle- to upper-income neighbourhoods and/or inform themselves about and participate in community organizations and municipal consultations, believe that climate change is real, manifesting and progressing, and recognize a significant citizen role to play in addressing sustainability issues in general. In focusing the study population in this way, this research also aims to capture frames through which this

group of residents – who may hold the financial capacity and/or personal motivation to undertake adaptation activities – may notice or feel a sense of urgency to respond to local climate change impacts.

Ottawa and Halifax residents face varied physical exposures to a range of climate change impacts.³⁹ Both cities are experiencing rising temperatures during warm and cool seasons, with summer heat waves and winter freeze/thaw conditions becoming more frequent. Each city is also expected to encounter more pronounced seasonal variations in precipitation, with rainfall events of greater intensity and periods of drought expected to become more common over future years and decades. Severe wind, snow and ice storms are also projected to become more frequent (Bourdages & Huard, 2010; Province of Nova Scotia, 2017; Colombo et al., 2007; Province of Ontario, 2015). Due to its coastal location, Halifax faces additional and pronounced exposure to sea level rise and the potential for more intense hurricanes and storm surges over time (Forbes et al., 2009; Xu & Perrie, 2012). There is also a projected increased risk of wildfire in neighbourhoods bordering the city's forested areas over the next several decades (Climate Change Nova Scotia, 2015; Whitman et al., 2013a&b). Varied ways in which households may be physically affected by these types of changes in residential areas are well-documented. For example, residents may experience discomfort during prolonged periods of hot weather, particularly in homes without air conditioning or shading from trees. Extended drought may affect neighbourhood forests, home gardens and food production, or lead to home foundation cracking. Heavier rainfall events may result in increased flood risk for some dwellings. Home structures may also be

³⁹ Additional discussion of current and projected climate change impacts for both cities may be found in Section 1.2 of this thesis.

vulnerable to intense wind, snow and ice events (City of Ottawa, 2014a; Ontario Ministry of the Environment, 2014; Richards & Daigle, 2011; Vasseur & Catto, 2008).

Beyond these physical effects, this chapter also considers responses to other climate change impacts among residents within and beyond the home site (e.g. in other neighbourhoods or across urban landscapes). This research employs a qualitative approach to identify the range of perspectives that exists among the study group of Ottawa and Halifax residents. The study employs primary data from 47 residents (22 Halifax residents; 25 Ottawa residents), obtained through participation in a detailed survey and/or interview/focus group session (see Appendix 1 and 2). In most cases, residents participated in both options. The municipal areas of both cities include large rural components within their outer boundaries; in keeping with the inner-urban focus of this research, the study neighbourhoods selected were constrained to those within central or inner-suburban portions of each city. Ottawa study participants reside in the Old Ottawa East, Old Ottawa South, Riverside South, and Centretown neighbourhoods (see map of study neighbourhoods in Chapter 2). Halifax participants reside in the North End, South End, Bedford, Clayton Park, and Spryfield neighbourhoods. The Spryfield and Riverside South neighbourhoods, though comparatively farther away from urban cores than other study neighbourhoods, were included due to their proximity to urban forested areas and associated wildfire risk (Spryfield) and to the nearby Rideau River, a source of potential flooding (Riverside South).

As a first step in accessing resident perspectives, the initial survey distributed to study participants offered them opportunities to share their impressions of local climate change impacts within a largely open-ended question format, prior to receiving information on projected impacts for each city during interviews/focus groups. Within these interview/focus

group sessions, participants were encouraged to expand on perceptions of local vulnerabilities to climate change they had described within surveys, and to discuss – and to challenge – the information presented on projected impacts. During sessions many residents noted they had been aware of at least some of the projected impacts for each city. Data analysis was supplemented with a review of secondary data referencing resident perspectives of climate change impacts and/or opportunities for adaptation across both cities, in the form of: records of federal climate change town halls for residents hosted in Ottawa and Halifax in 2016; resident comments recorded in news media; as well as transcripts from municipal environment committee meetings and other municipal public consultations relating to climate change or to environmental initiatives in each city. The last section of this chapter, which offers a brief discussion of implications for municipal climate change policy in relation to study findings, also draws on primary and secondary data from 12 municipal officials (six representatives from each city) and municipal documents that reference climate change impacts, vulnerability, risk and adaptation in each city. Three representatives from two environmental organizations in Halifax that have provided adaptation-related guidance for residents (Ecology Action Centre, Clean Nova Scotia) also contributed their views on residents' perceptions of climate change impacts and risk.

Several key observations have emerged from this research. In Ottawa and Halifax study groups, *local* impacts of climate change are felt most keenly by residents across city scales, and affect personal comfort, security and urban identities at this scale; though residents acknowledge personal experiences of climate change within dwelling places, they are often likely to articulate more substantial climate change concerns beyond the immediate home site. This distancing of risk beyond the home site suggests varied influences including

a perceived buffering of risk from inner-urban infrastructure and social supports, concerns for other populations deemed at greater risk, the somewhat ambiguous and uneven nature of future events, and challenges in conceptualizing micro-effects amid overwhelming global-scale change. This situation requires that municipalities employ more sophisticated methods of communicating place-based risk to accommodate fluid perspectives among residents, particularly those resisting an inward focus on personal impacts and associated potential to undertake adaptation activities within home sites.

The next section of this chapter, Section 3.2, examines the current body of literature on place and climate change, highlighting links between place meanings, the physical effects of climate change, and near and distant perceptions of risk. Sections 3.3 and 3.4 present study findings and analysis, with a discussion of the complex and conflicting ways in which residents may process local changes and assign concern about impacts to other populations and contexts. The final section considers implications for municipal policy around effectively communicating climate change risk to citizens including at home site scales, as well as potential avenues for relating municipal messaging to valued qualities of place and for stimulating new perspectives of local risk among residents.

3.2 Place, climate change and situating environmental risk

Scholars have demonstrated how small or profound disruptions to nearby physical environments from climate-related hazards alter experiences of local places for residents. Communities have noticed impacts, and new variabilities in weather have begun to transform the character of surrounding urban areas (Brugger & Crimmins, 2013; Petrusek MacDonald et al., 2013). Place meanings for residents evolve as valued surrounding landscapes are reshaped, for example, as coastlines erode or forest structures are altered (Cunsolo Willox et

al., 2012; Groulx et al., 2014; Lyth et al., 2015). The effects of climate-related hazards for individuals extend beyond direct physical damages to property, to more intangible losses relating to disrupted bonds with the unique aspects of local places, prompting emotional responses (Adger et al., 2011). Proudely (2013) has observed how disturbance to familiar landscapes through the loss of local vegetation and wildlife from wildfire disrupts connections to place in ways that may not be fully recovered; in her account she references how residents may experience what Albrecht et al. (2007) have termed ‘solastalgia’, which is described as “...a form of homesickness one gets when one is still at ‘home’” (Proudely, 2013, p. 5).

Climate change may also disrupt individual and collective engagements with valued local places. Changes may restrict traditional subsistence and recreational activities, as for example in areas of permafrost melt in the North (Petrasek MacDonald et al., 2013; O’Neill & Graham, 2016). As resources diminish, loss of industry affects livelihoods, influencing the identities of local populations with regard to their ability to cope with stresses (Lyth et al., 2016). Requirements to adapt to changing conditions affect the multi-generational history and “sense of belonging” of populations within regions, often provoking various negative effects on physical and emotional health among citizens (O’Neill & Graham, 2016, p. 5; Cunsolo Willox et al., 2012).

Attachments to place have been demonstrated to influence citizen responses to climate change concerns. Awareness of impacts to local places may prompt more intensive carbon reduction activities (e.g. energy efficiency practices) within households, in attempts to mitigate further climate change (Susser, 2018). Amundsen (2015) describes community adaptation responses that aim to maintain connections to place amid changing climate

conditions, through such measures as modified cultural events, social infrastructure supports, or innovative economic development projects. The degree of environmental action taken within communities may vary according to how nearby landscapes are valued among diverse populations, for example within differing physical environments such as urban versus rural areas (Anton & Lawrence, 2016; Kopsel et al., 2017; Scannell & Gifford, 2010). Petrasek MacDonald et al. (2013) describe how support for adaptive measures in Northern Indigenous communities in Canada has been determined in part by the degree to which these measures correspond with or diverge from cultural traditions connected to the land (for example, adopting new modes of travel by speedboat rather than snowmobile to maintain valued hunting practices). Conversely, Groulx et al. (2014) suggest that place attachment may have no or limited influence on adaptation activities within communities in the absence of targeted public messaging that helps residents understand how they may maintain valued qualities of place.

Scholars have also examined how adaptation responses include efforts to maintain security and protection from physical risks in particular places. Residents may aim to reduce climate-related vulnerabilities such as flood risk by participating in such measures as supporting levee construction by municipalities in coastal areas or purchasing private home insurance (Susser, 2018). In general, individuals who experience significant physical effects from climate-related hazards, such as through direct exposure to severe storms or wildfire events affecting residential neighbourhoods, are frequently more willing to undertake subsequent carbon footprint reduction or adaptation activities to protect homes and local sites of significance (Adger et al., 2013; Brenkert-Smith et al., 2012; Broomell et al., 2015; Koerth et al., 2013; Lawrence et al., 2014).

Individuals situate places of vulnerability to climate change through varied frames. Climate change is perceived as a local phenomenon when populations are attuned to local changes such as seasonal shifts, increasingly intense weather conditions or visible changes in local flora and fauna. This awareness may evolve through direct experience (such as aforementioned flooding affecting individual dwellings) or through repeated exposure to media coverage of impacts (Akerlof et al., 2013; Koerth et al., 2013). Biased perceptions of local vulnerability may persist, even when differing significantly from historical climate records or physical evidence (Jeffers, 2014). Individuals may alternatively process impacts through a lens of ‘psychological distance’, conceiving of climate change as “a set of uncertain events that might occur far in the future, impacting distant places and affecting people dissimilar to themselves” (Jones et al., 2017, p. 331; see also Spence et al., 2012; Weber, 2016). They may hesitate to undertake mitigation or adaptation activities as they struggle to link present action to often intangible climate change risks perceived to be substantially more impactful in other areas or for future generations. There may also exist substantial uncertainty over where and how intensely climate change impacts may manifest from year to year in each place (Pahl et al., 2014; Stoll-Kleeman et al., 2001; Taylor et al., 2014a; Williams et al., 2010).

This current study builds on several facets of the academic literature on meanings attributed to place and climate-related hazards as discussed above, by examining influences of physical disruptions from climate-related hazards on residents’ perceptions of local places, and by considering how residents’ activities within and engagements with local environments may be altered from subtle or ongoing climate change effects. This study also extends a more in-depth analysis of where and how residents situate climate change risk in relation to home

sites and other local places. In contrast to much of the literature presented above (which assesses changes to place at community scales, focuses on individual climate-related hazards, or frames perceptions of place within more rural settings), this current research explores home-based place meanings for residents as they consider multiple local impacts of climate change within inner-urban and densified neighbourhood environments.

3.3 Citizen perspectives of climate change impacts and risk in Ottawa and Halifax

Experiences of climate change within local places

Ottawa and Halifax study participants frequently articulated local experiences of climate change at city scales. Ottawa residents often related direct experiences of climate change associated with rising temperatures, such as longer and more intense days of summer heat, or winters with decreased periods of freezing temperatures. Residents noted that higher and at times “unbearable” (OTT-FG3) summer temperatures affected personal comfort, and restricted warm weather activities in the city such as cycling. One resident recounted their experience of extended heat during the summer of 2015, during which “there would be days that would be so dry and hot, that it scared me... you feel, this is not normal” (OTT-FG16), with another resident recounting, “with those really warm days in August, there were hardly any people walking around. It’s almost like the cold, or the rainy days, it was too hot to be out. I hadn’t noticed that before” (OTT-FG9).

Halifax study participants also made comments about warmer summer temperatures, though in general expressed concerns were not as pronounced as among Ottawa residents. In referencing more frequent home air conditioner use, one resident commented that, “now, it seems normal to want the cooler air, which wasn’t needed in Nova Scotia in the past” (HAL-SRV14). Many of the interviews with Halifax residents were conducted over the summer of

2016, during a period of unusual heat and drought in Nova Scotia which resulted in multi-week fire bans and a complete restriction of recreational trail use in Halifax Regional Municipality. The drought situation was expressed as a very unusual experience for many residents, with some also voicing new concerns about associated wildfire risks that they had not previously considered. Referencing the 2009 Spryfield wildfire⁴⁰, one Spryfield neighbourhood resident spoke of concerns about the potential for future wildfire events near their neighbourhood, stating, “right up here...there’s a row of trees. So, those fires jump, and we could easily be right in the middle of it. So, that’s the scariest thing for me” (HAL-FG9).

Several residents noted impressions of milder winters in each city, particularly among Ottawa residents. One Ottawa resident suggested, “if I compare it to winters of my youth, it’s different. I don’t think I could say quite exactly what makes it different. But, it’s different. Like winter just feels sloppier now than it did when I was a kid” (OTT-FG18). Ottawa study participants repeatedly described how rising winter temperatures were affecting access to the recreational activities they typically enjoyed, with fewer days available for skating on the Rideau Canal, for taking part in outdoor hockey at local rinks, or for cross-country skiing in nearby Gatineau Park.⁴¹ These limits on traditional outdoor activities were described as unfamiliar and unwelcome experiences for residents that had grown up in the area. Similar concerns were also described in local media among residents that are advocating for mechanical cooling of some outdoor Ottawa skating rinks, to deal with consecutive years of mid-winter melt (Pfeffer, 2018, February 4). One study participant described how

⁴⁰ A wildfire in 2009 in forested areas near the Spryfield neighbourhood of Halifax resulted in eight homes destroyed, ten homes damaged and 1200 residents evacuated (“Halifax wildfire controlled”, 2009, May 1).

⁴¹ Historical climate data for Ottawa shows that winter seasons have on average become warmer over past decades. There has also been a general trend toward shorter skating seasons on the Rideau Canal (Dyer, 2014, May 12; Janzer, 2018, February 6; OCCIAR, 2011; Spears, 2017, February 22; Tumilty, 2017, March 13).

maintenance of an outdoor rink across the street from their house made them aware of how valuable this recreational space is to neighbours, also noting, “you have these conversations with people, like well why is the rink not open today, can’t we skate? Well no, because it’s mush” (OTT-FG18).

Residents also noted concerns about the possibility for increased rainfall in each city, and about associated stresses on storm sewer systems in their neighbourhoods. Some Halifax residents recounted their alarm at the intensity of individual rainfall events they had witnessed over the past several years, which had caused flooding in the nearby areas of the Sackville River and Bedford Highway (areas not directly affecting study participants’ homes, but often in the news). Several study participants living in the neighbourhoods of Old Ottawa East and Old Ottawa South, as well as other residents profiled in local media, described how water from the nearby Rideau River advances toward neighbourhood backyards⁴² – flooding some basements among properties at lower levels or close to the river – every few years during the spring melt period. One resident spoke about kayaking within neighbourhood backyards due to higher water levels every fourth or fifth year. For some of these residents, backyard flood events appear to be on the rise in recent years⁴³, with some also hearing similar concerns from neighbours. Other Ottawa residents noted that they take these types of

⁴² Portions of these existing neighbourhoods are situated within the Rideau River floodplain, which would not be permitted for new construction under current municipal land use standards. In general, these areas are vulnerable to flooding with or without climate change impacts (D. Conway, personal communication, November 16, 2018).

⁴³ Data on historical peak flows of the Ottawa portion of the Rideau River from 1933 to present, supplied by a representative of the Rideau Valley Conservation Authority, does not indicate any pronounced upward trend in flooding events in this area over the last several decades. The representative also noted, however, that somewhat erratic conditions along the river have occurred in recent years (for example, areas of river flooding in locations previously not experienced) (P. Larson, personal communication, November 29, 2018).

events, which they consider to be part of a “spring ritual”, in stride (Rideau River overflowing, 2017, April 7).⁴⁴

In recalling perceived impacts of climate change in each city, Ottawa and Halifax residents also referenced snow and freezing rain events they had experienced over the past several years, along with concerns about the potential for future snow/ice events. Halifax study participants often described the significant scale of snow removal on neighbourhood streets that had been required during previous winter storms, along with unpleasant experiences of being confined to their homes during these periods. Ottawa residents expressed concerns about more frequent freeze/thaw and freezing rain events which to them were changing the character of Ottawa winters, and which reduced the safety of urban commuting by foot or bicycle on icy sidewalks and along potholed roads.⁴⁵ One resident commented that “it really constrains my feeling of being able to get around in the ways that I’m used to” (OTT-FG6), and expressed concerns about increasing difficulty in negotiating icy sidewalks as an elder in future years. Another resident noted,

In the last three years we’ve had more ice storms, like frozen freezing rain than I can remember in the [last] 30 some odd years – we get it here and there but we’re getting it all the damn time now. Because I walk, so I notice it more... I have to walk on this sidewalk, on sheets of ice, it’s dangerous... And in the last few winters, Jesus, it seems like it’s all the time. (OTT-FG13)

Regarding future climate change impacts, many Halifax study participants expressed pronounced concerns about risk to the city associated with sea level rise, hurricanes and

⁴⁴ Most interviews with Ottawa residents took place prior to a significant 2017 flooding event impacting communities in Eastern Ontario and Western Quebec (mainly affecting homes in outer areas of the region along the Ottawa River), which caused major structural damage within dwellings, associated financial stress and reliance on community support for residents in affected areas (Hansen, 2018, April 22). When a subsequent email was sent out following the flooding to ask study participants if they had any additional comments to contribute to an original interview question, “What does climate change mean to you?”, residents made limited mention of the 2017 event.

⁴⁵ Biswas et al. (2018) note that, “in cold climatic regions, potholes generate from water penetrating into the top layer of asphalt through the cracks, which is accelerated by freeze-thaw cycles.”

associated storm surges. This perspective matches those of residents that took part in a Halifax climate change town hall in 2016 (Filmore, 2016). Some Halifax resident comments shared online and in news media reveal a substantial awareness of hurricane-related flooding events that have occurred in previous years around the downtown boardwalk and neighbouring coastal businesses (Demont, 2010, October 1; ECoAS, 2018). One study participant from the North End neighbourhood, whose home site has not been directly affected by sea level rise or hurricane events, commented, “I live down the end of [street] where I can just see the water, and I’m thinking, you know if anything bad happens and the water comes up, I’m right there... you just never know, right? I think about that often, living close to the ocean, being surrounded by water” (HAL-FG2).

Situating places of climate change vulnerability and risk in relation to home sites

As noted above, several Ottawa and Halifax residents displayed broad awareness of changing climate conditions that were affecting varied qualities of place at city scales, and in many cases, residents’ perceptions align with recorded climate conditions in these cities.⁴⁶ As previously noted, Ottawa residents described how changing conditions affected their enjoyment of valued recreational activities, making commutes in icy conditions more treacherous and in summer heat more unpleasant. Halifax residents emphasized a general sense of risk to the coastal city from sea level rise and future hurricane events. Residents in both cities also described other ways in which local experiences were being altered across urban areas, including growing concerns among several residents about increasing exposure to ticks carrying Lyme disease, about risks to the urban energy grid from severe weather, or

⁴⁶ As mentioned earlier, a detailed discussion of past and projected climate conditions for the Ottawa and Halifax areas may be found in Section 1.2 of this thesis.

about higher costs of local agriculture that might come with periods of drought, extended precipitation or a cooler growing season.

However, despite the multiple ways in which these residents noted vulnerabilities to climate change in each city, there were many other study participants (particularly among Ottawa residents) that expressed that they do not feel their cities are at immediate risk of experiencing detrimental climate change impacts. For Ottawa residents, this was often attributed to what they considered to be the city's privileged geographical location, making exposure to extreme weather events less likely. Some Halifax residents emphasized a local resilience stemming from what they considered to be a hardy population that would for the most part have already had impact-ready construction methods and preparations in place, due to the city's coastal location/climate and its experience with storms. This perceived invulnerability by some residents based on geographical location does not correspond with objective measures of physical risk to these areas, as projections include similar risks to residents in both cities from rain events or rising temperatures that may become more frequent with climate change. However, residents' social identities (related to financial means or access to municipal supports to assist in dealing with effects of climate-related hazards, as discussed further below) may contribute in part to residents' degrees of resilience to climate change impacts affecting home sites.

Some residents related the city-scale impacts they had already encountered to experiences within home sites. With more extended periods of summer heat, several residents in both cities mentioned that they now use home air conditioning more frequently: "Last summer was the first time I actually had to buy a window air conditioner. So, it's noticeable..." (OTT-FG9). Some Old Ottawa East and Old Ottawa South residents spoke of

potential flood risks to basements in their neighbourhoods, with one resident recounting two basement flooding events they had experienced in the past several years. One Old Ottawa East resident noted, “I just had my foundation done. And I notice that everybody is doing them all the same, and then I’m like, oh yeah that’s cause we’re constantly getting rained on frozen ground” (OTT-FG11).

Ottawa and Halifax residents noted varied responses (between concern and complacency) to perceived local risks. One Halifax resident described purchasing a home further up the hill in their neighbourhood rather than on a lower cul-de-sac in part to avoid flooding risk from storms. Another resident commented that any future home purchase would also take these concerns into consideration. Among some Halifax residents, the threat of hurricanes had made them more conscious of wind events in general in the city, with one resident researching hurricane-resistant construction methods for a new home they were intending to build. Another resident made structural reinforcements to a downtown condominium unit following an experience with Hurricane Juan (Demont, 2010, October 1). Among the Ottawa study group, one participant described how residents were willing to live in desired central-area neighbourhoods near the Rideau River despite awareness of flood risks, noting “you have a month with a risk of flooding, and you have sump pumps, which wouldn’t work in a power failure, but it’s worth it for the rest of the year. Because you have this wonderful view” (OTT-FG15).

As some study participants described these types of concerns, many other residents stated that climate change had had limited impact on the physical qualities of dwelling sites or no significant effect on daily life within households. One Ottawa resident suggested they don’t anticipate responding within households in substantial ways in the future:

I guess I don't see anything happening so dramatically, and quickly, that it would change my experience in a really tangible way. I think though what we'll see is these small incremental changes that you just sort of adapt to. Because we can, right? Because we can live where we live... and I'll still be able to walk to the grocery store down the street. (OTT-FG18)

In addition to basement flooding and home structural reinforcements, physical impacts recalled by residents included damage or disease affecting trees and other vegetation around home sites (e.g. blight in the garden from too much rain, dry lawns, storm damage to trees). Regarding effects to households, a few Ottawa and Halifax residents noted concerns regarding a potential increase in home energy use to deal with intense periods of hot or cold, and greater effort in plowing after heavy snowfalls. One Halifax resident described increased effort around emergency management within households, commenting, "We are more guarded in our thinking because we don't know when the next major event may hit... we try to maintain an up-to-date emergency readiness kit... and 25 years ago, didn't give it a thought" (HAL-SRV17). Among measures already taken by study participants in both cities to respond to climate change within households, most involved efforts to reduce greenhouse gas emissions (i.e. as relating to the mitigation of further climate change, rather than dealing with existing effects), including home energy efficiency measures, and reduced car use and red meat consumption. Participants in the Halifax climate change town hall described other mitigation actions such as renewable energy use⁴⁷ in homes (Filmore, 2016).

In general, while some residents in both cities acknowledged impacts from climate change within places of residence, many also often situated more significant places of

⁴⁷ As noted in Chapter 1 of this thesis, renewable energy production may sometimes be considered to provide both mitigation and adaptation benefits (regarding adaptation, in preventing home energy outages during power failures from weather events). However, in many cases residential renewable energy systems in cities are connected to the municipal energy grid, which, in the event of a power disruption, would similarly affect home site installations.

climate change vulnerability and risk beyond individual home sites, for example in other neighbourhoods or in other areas of their own neighbourhoods. Several Old Ottawa South and Old Ottawa East residents described greater flood risk for homes in floodplain areas⁴⁸ along the neighbouring Rideau River versus within their own properties further from the river; this perception of greater risk in other areas was echoed by residents in news media, with some also stating that their own, newer homes were more resilient to impacts than existing homes in the same neighbourhood (Rideau River overflowing, 2017, April 7). Other residents stated they were not particularly vulnerable to wind damage due to their central location or the size of their home, with one resident noting, “we’re surrounded by houses that are bigger than us. We’re almost like in a little cocoon... You’re not the one up there catching the wind” (OTT-FG13). Several Halifax residents highlighted a greater vulnerability to flooding for large-scale developments and infrastructure in coastal areas of the city, or for neighbourhoods lower in elevation than their own. Other Ottawa residents linked the resilience of their neighbourhood to a sense of community among neighbours, expressing more pronounced concern about risks to senior or homeless populations in other areas of the city.

Ottawa residents also frequently compared climate change risk in their city to what they perceived as substantially more vulnerable Canadian cities and regions. Residents spoke about challenges for other populations such as exposure in coastal areas to sea level rise and hurricanes (as for example, in Halifax), or disrupted travel and hunting practices among Northern populations due to Arctic melt. Residents in both cities also often directed

⁴⁸ Despite a greater risk of home site flooding due to river overflows for homes situated along river edges than in other areas of residential neighbourhoods, all homes within these neighbourhoods are at risk of exposure to overland flooding or sewer overflows from intense rain events (Feltmate et al., 2017).

impressions of climate change vulnerability even further outward at wider, global scales, referencing regions of the world with exposure to pronounced physical impacts or systemic poverty, social upheaval, inadequate infrastructure or access to resources (e.g. Pacific island nations at risk of catastrophic flooding, exposure of Haitians to repeated hurricane disaster events). Residents expressed deep concern for these populations, but felt limited direct connection to these global-scale vulnerabilities. In comparing their situation to that of other populations, one Ottawa resident commented, “if people don’t have access to food, it can increase social breakdown. So, I think, having a tree fall down on your roof, or your basement flooded, is a pretty small part of the potential picture” (OTT-FG1). Several Halifax study participants and others in the climate change town hall expressed similar perspectives (Filmore, 2016), including challenges in grasping the local implications of what they perceived as wider-scale concerns. One resident noted, “When you read things online, it’s mostly generic, global failure type of stuff” (HAL-FG17), while another suggested that, “the jury may still be out on the local impacts in Nova Scotia” (HAL-SRV15). While residents recognized some local changes in intensity of heat, freezing rain and precipitation in general, they still perceived themselves as fortunate and their own impacts as different than climate-related events (e.g. catastrophic Australian bushfires or New Orleans flooding) occurring in other areas of the world.

In both cities, residents (particularly middle-age and older adult study participants) also frequently spoke of local climate change concerns applying more intensely to future timescales and generations. One Ottawa resident suggested, “a lot of this is predicated on a time span in decades. I’m 66 so I don’t know how many decades I’ve got, but it’s this sort of legacy you’re leaving your children, your children’s children and they’re going to have to

deal with it... Maybe we should be making the children more resilient” (OTT-FG14).

Participants in climate change town halls held in Ottawa commented that they consider climate change to be a long-term issue (McCrimmon, 2016, September 28; Office of Anita Vandenberg, 2016). One Halifax resident summed this perspective up by stating, “I think for me... climate change is slow, it takes a long time, so I don’t think it will change my experience so much, in my home today, you know?... Certainly, where my children decide to live, will affect the decisions they make, I’m sure” (HAL-FG2). Conversely, another Halifax resident noted that they didn’t “have a sense of time around” climate change (HAL-FG7).

3.4 Discussion

This study of place meanings and climate change draws on established conceptualizations of place in the academic literature (Agnew, 1987; Relph, 1976; Tuan, 1977). It considers the subjectivity of experiences that exists within communities in interpreting how the distinct qualities of local and other places are being altered in the context of climate change. These perceived qualities may be linked to physical landscapes, locales or climates (Knez, 2005), to specific practices undertaken within these areas, or involve aesthetic preferences or emotional connections to valued local places. This study also highlights how residents represent and locate places of climate change risk, recognizing that individual understandings of place may evoke multiple meanings within populations that are not always consistent or fixed (Kopsel et al., 2017).

As the perspectives explored in this study demonstrate, the character of urban areas is changing for many residents. Brace and Geoheghan (2010, p. 296) note that, “Climate and its changes might not only be observed in relation to landscape but also felt, sensed, apprehended emotionally, passing noticed and unnoticed as part of the fabric of everyday

life.” In both cities, residents increasingly associate climate change in urban areas with abnormal conditions and events, altering individual perceptions of the familiarity and security of nearby places (through such new experiences as green winter holiday seasons or repeated freeze/thaw events, or extended periods of summer heat or drought). Disrupted links to traditional outdoor activities in Ottawa offer one example of how the identity of the city is being altered for residents, in this case as existing within a region for valued winter recreational activities. Loss of traditional recreational activities were also noted as significant impacts for residents in empirical research on individual experiences of climate change by Cunsolo Willox et al. (2012) and O’Neill and Graham (2016).

These findings reveal some variability between Ottawa and Halifax residents regarding the ways in which city-scale impacts are understood. Many Ottawa residents associate local climate change impacts with modest and gradual change, taking place within a city that they perceive to be somewhat protected by its physical location as compared to other regions (e.g. coastal urban areas). As one resident commented – despite their perception that Ottawa has experienced longer periods of intense summer heat in recent years – that in general since “climate change is a little like the proverbial frog in the pot that is slowly brought to a boil, we tend not to notice the changes” (OTT-SRV2). Halifax study participants often voiced more assertive perceptions of local climate change risk as compared to Ottawa residents, linking local weather changes, extremes and variability more directly to physical risk to the city, due in part to hurricane exposure and the ominous nature of long-term sea level rise. For some Halifax residents, this awareness of increased risk was noted as relatively recent. Residents in both cities referenced established urban identities that could help in dealing with some of these vulnerabilities, involving populations somewhat accustomed to

and able to cope with harsh winter weather and varying seasonal conditions throughout each year.

Differing perceptions of local climate change vulnerability among residents may in part relate to study participants' varied experiences with previous significant weather events. When asked about past experiences, Ottawa residents most often referenced the 1998 ice storm and the widespread, multi-day power outage that followed for some residents. Though the ice storm was generally experienced as a stressful event for residents, many also recounted opportunities during periods of power outage – which were often resolved in inner-urban neighbourhoods much more quickly during the storm than in outer areas of the city – to strengthen community ties by sharing freezer meals with neighbours or to enjoy “quiet time with family” (OTT-SRV10). It might also be assumed that the sense of vulnerability of living in the city during this event, which occurred just over 20 years ago, may have faded to some degree for residents over time.

In contrast, Halifax residents often spoke of what they considered to be quite pronounced and disruptive weather events: (1) the 2003 Hurricane Juan, and the ‘White Juan’ winter snow event that followed in early 2004, and (2) a large snow/ice event during the 2015 winter period. Regarding these events, Halifax residents frequently recalled their sense of direct physical risk and of feeling isolated, without power/heat or access to supplies as the city was effectively “shut down” for several days due to significant snowfall, ice and wind conditions (HAL-SRV1; HAL-SRV15). Residents recounted feeling restricted in movement within the city on snow- or ice-covered roads and in some cases unable to leave their homes.

The study findings also demonstrate that Ottawa and Halifax residents locate sites of significant climate change vulnerability in varied ways in relation to local *home* places. Even

as some locate areas at risk just beyond or to and from the home site (e.g. the recreational area, the commuting space), for many residents the home site itself remains a place of relative security from impacts of climate change (notwithstanding previous comments noted by a few residents regarding a potential for basement flooding or wind damage, and by some Halifax residents regarding feelings of being trapped in their homes during past severe storm events). This finding corresponds with a general survey of Nova Scotia residents conducted several years prior to this study, in which participants note modest experiences of climate change in urban areas but “generally perceive little risk to their own properties” (Corporate Research Associates, 2012, p. 2). Reid and Beilin (2015) also observe that residents’ perceptions of the *home* places being affected by climate change often extend beyond individual properties, for example across neighbourhoods to more distant landscapes surrounding communities.

As noted, residents also often attributed more concern about potential disruption within cities toward other places, such as neighbouring home sites, other neighbourhoods, other regions of the country or far-off international sites. These findings highlight the subjective and variable nature of residents’ impressions of place-based impacts and risk. Scholars have suggested that shifting impressions of local vulnerability to climate change may be influenced by such factors as sociological ambivalence (i.e. involving variable perceptions of risk in response to inconsistent direct and media exposure to climate change impacts) (Carolan, 2010), or by set biases of perceived climate conditions that are determined in part by “environmental values or political and economic agendas” (Etkin & Ho, 2007, p. 623). Baron and Petersen (2015) suggest that protective technologies, such as levees in flood-

prone areas, shield residents from direct engagement with and therefore alter impressions of local impacts.

Within this case study of Ottawa and Halifax residents, study participants are potentially shielded from experiencing a full sense of vulnerability within local neighbourhoods or home sites in several ways. This study focused mainly on the perspectives of individuals living in inner-urban areas of each city, within relative proximity to municipal emergency management infrastructure (e.g. hospitals, fire departments, government offices), and who often spoke of the sense of community connectedness and support they have experienced within neighbourhoods. Several residents also mentioned opportunities they had the financial means to take to avoid unsettled conditions in inner-urban areas (for example, by escaping to the cottage during periods of intense heat), or to – despite some reluctance – employ small-scale technological controls within homes such as air conditioning to reduce discomfort from impacts.

The relative uncertainty surrounding projections of future change in cities may also influence the degree to which residents recognize or respond to local risk. Previous scholarship has demonstrated that individual understandings of vulnerability to climate change may involve doubt or denial that is determined in part by the degree to which individuals accept the legitimacy of expert climate change projections (Connor & Higginbotham, 2013; Howe & Leiserowitz, 2013). This situation is further complicated by challenges in directly attributing specific weather events or conditions to overall climate change trends (Jeffers, 2014). One Halifax resident suggested an unwillingness to incur personal costs to undertake adaptive actions within their home site “until the problem was staring me in the face. If I was to build a house from the beginning or start over again, it may

be something I would consider, but I don't know if I'd spend the money to retrofit for something that I'm not sure actually might happen" (HAL-FG11). Other residents referred to variable and uneven impacts experienced across regions ("Climate change and the Spryfield fire", 2009), with one study participant commenting, "I don't know where it's all going yet" (HAL-FG11). Some residents also expressed challenges in grasping the gradual nature of change in local places. In general, this reluctance among residents to focus on potential local effects as well as more prominent concerns expressed about future impacts corresponds with experiences documented in the psychological distance literature described earlier in this chapter (Jones et al., 2017; Spence et al., 2012; Stoll-Kleeman et al., 2001).

As discussed earlier in this section, some complacency among residents that have not experienced any recent direct encounter with an intense weather event may also influence how they recognize local vulnerabilities. When residents lack strong, lasting memories of previous significant climate-related events, they may hold fluid impressions of place-based risk that fade over time with variable climate conditions within different seasons and years (Goemans & Ballamingie, 2013; O'Brien et al., 2006). As one Ottawa municipal representative also noted regarding recent conditions⁴⁹, "I think there isn't much knowledge base out there yet, because...we haven't had a significant event. We haven't had Toronto or Calgary floods. We haven't had anything that's put the fear of God into [residents] yet" (M. Clarke, personal communication, December 19, 2016). Others may choose to tune out of discussions of risk almost entirely because, as one Halifax resident noted, "it is too discouraging in a 24-hour news cycle" (HAL-SRV12). Conversely, several residents in each city spoke of potential benefits they associate with climate change (e.g. more comfortable

⁴⁹ Data for this study was collected prior to a tornado event that affected the Ottawa area on September 21, 2018.

winters or a longer agricultural growing season), the awareness of which may to a modest degree also lesson individual recognition of local climate change risks. Some residents have also responded to city-scale risks with relative acceptance; in referencing the need to adapt to changes, one Ottawa study participant suggested that residents will have to “be a little bit more flexible in the way we go about our daily lives... We’re going to have to get a lot less cranky” (OTT-FG6).

A resistance to focusing inward on individual vulnerabilities among some residents in the Ottawa study participant group – that are living, as mentioned, within inner-urban and established middle-class communities, within somewhat of a tight social fabric within neighbourhoods – appears linked to emotive responses of guilt associated with social privilege. One Ottawa resident stated,

Usually I don’t think of local, which is probably odd. I think of globally because I think it’s far more frightening. I mean it’s frightening here, but we’re lucky enough to live in a society that’s rich enough maybe to address it. Whereas, there are many more people in other places in the world who are screwed by this far more than we are. Especially given the fact that we’re the ones doing the damage. (OTT-FG13)

Within interview and focus group discussions, Ottawa study participants frequently devalued personal experiences with local climate change impacts, weighing for example the prospect of limited inconveniences (e.g. loss of access to outdoor skating) as compared to complete livelihoods at risk among wider global populations. As one Ottawa resident commented, “In my personal life I see [impacts], but it feels selfish to worry about it in my personal life, you know? Because I’m not really, I’m not being that dramatically impacted by it as someone who can’t eat, or who’s losing their home because it’s sliding into the water” (OTT-FG18). In describing climate change concerns, some residents in both cities also

deferred to what they perceived to be more challenging conditions within other contexts, including threats to local wildlife or vegetation.

In general, concerns about local climate change impacts are often understood by residents in rather expansive and non-specific terms. Residents in both cities expressed frequent unease regarding new and changing climate conditions that were being experienced, however, as one Ottawa resident noted, these types of concerns were typically “bigger than I could articulate at the neighbourhood level” (OTT-FG6). Residents have repeatedly demonstrated that they are well-versed in general discourses of weather ‘extremes’ relating to climate change, gained in part through exposure to media coverage that often projects future instability at regional or global scales (“Climate change and the Spryfield fire”, 2009; Ecology Ottawa, 2015, June 18), but they appear not fully able to relate these risks to more micro-scale places or potential household experiences. One Halifax resident commented, “There’s obviously a lot of research, and there’s been suggestions that, everything from sea level is going to rise, to crops are going to fail, to all sorts of things. I’m not sure how that will affect me, though” (HAL-FG11). Some residents also seem unsure of how to manage local impacts over which they may ultimately have limited control [e.g. seasons shifting and global-scale climate patterns that are “out of whack” (OTT-FG4)]. As one Ottawa resident described in the study survey,

Climate change has affected my experience of living at an emotional level much more than the actual physical changes so far. We have not seen anything yet. I often find myself contemplating the implications for humans and reasons for our apparent lack of connection to what’s happening. It gets philosophical/existential very fast. (OTT-SRV10)

Implications for municipal climate change adaptation policy

The perceptions of Ottawa and Halifax residents that were explored in this study reveal a need for municipal messaging to citizens that effectively links climate change vulnerability to more fine-tuned conceptualizations of local places. This type of messaging would draw attention to the significance of impacts affecting home sites that are likely to increase in intensity over time, potentially helping to spur citizen adaptation action in urban residential neighbourhoods in response to climate change risk.⁵⁰ Scholars have repeatedly demonstrated a greater likelihood of citizens undertaking adaptive action when they situate risk (e.g. flooding potential for dwellings) as immediate and/or have had direct experience with significant climate-related events (Brace & Geoghegan, 2001; Brenkert-Smith et al., 2012; Broomell et al., 2015; Koerth et al., 2013; Lawrence et al., 2014). Ideally, communication strategies would also capture the diversity of understandings of climate change concerns among residents across city and neighbourhood scales, in line with scholars' contention that governments "recognize and support a wider range of locally relevant adaptation strategies" (Brugger & Crimmins, 2013, p. 1838; see also Adger et al., 2005; McEvoy et al., 2013). As the findings of this study suggest, citizens may hold diverse understandings regarding how to 'adapt in place' that vary according to physical location and personal experience.

To stimulate greater attention among citizens around addressing climate change concerns, it is also important that municipalities demonstrate a nuanced understanding of changes to the qualities of local places that are being noticed by residents (Agyeman et al., 2009; Beaulieu et al., 2016; Moser, 2014; Ramm et al., 2017). Scholars caution that attachment to place may not influence adaptation activity among citizens in the absence of

⁵⁰ A brief discussion of adaptation actions undertaken and considered by study participants is provided in Chapter 6.

context-specific and culturally-relevant messaging from public agencies (Groulx et al., 2014; Lyth et al., 2015; Wilson et al., 2014). Wolf et al. (2013, p. 549) suggest that support for adaptation action is “determined in part by what people consider to be worth preserving”, while other scholars have shown that residents may act to protect local environments in ways that maintain recognizable or comforting impressions of *home* (Amundsen, 2015; Osberghaus, 2015; Reid & Beilin, 2015). Within this study, Ottawa and Halifax residents indicated that changes in local climate conditions were disrupting their enjoyment of, sense of safety within, and connectedness to previously familiar urban environments. Municipal climate change communication strategies could tap into these types of concerns by presenting opportunities for residents to enhance individual places of comfort and safety around home sites, through such measures as creating treed spaces near homes for shading or rainwater capture or fostering backyard garden spaces more resilient to drought.

Within current municipal policy, varied efforts have been made in Ottawa and Halifax to communicate climate change concerns to residents, though both cities still most often frame challenges and opportunities for action in terms of reducing carbon emissions – in other words, often aiming to help residents further prevent, as opposed to dealing with, impacts. They also often relay climate change impacts in rather broad terms, often at provincial scales and lacking differentiation across individual neighbourhoods (City of Ottawa, 2006, 2018a; HRM, 2014; HRM, 2017, November 24). *Halifax Regional Municipality’s Climate SMART Community Action Guide to Climate Change and Emergency Preparedness* offers some useful information on projected impacts for residents, and references a modest selection of measures to reduce risk around home sites from weather-related events (HRM, 2010). The City of Ottawa, through its *Air Quality and Climate*

Change Management Plan and *Energy and Climate* web page, offers comparatively less information for residents about impacts at dwelling scales (City of Ottawa, 2014a, 2018a). In addition, other City of Ottawa risk reduction or sustainability web pages and programs directed at residents – for example, web pages referencing options for basement flood protection, or its promising *Pinecrest Neighbourhood Rain Project* that works with residents toward increased home site stormwater management – make limited direct links to these actions as proactive responses to (likely increasing) climate change impacts in general (City of Ottawa, 2018d&e)⁵¹. Some other municipal efforts to engage residents have included discussions of projected climate change impacts but focused largely on emergency management planning for the immediate aftermath of intense weather events (City of Ottawa, 2018k; HRM, 2011a). To date, there is no apparent plan for any revised comprehensive climate change-focused adaptation public campaign in Ottawa (D. Chernushenko, personal communication, December 19, 2016).⁵²

Several challenges for municipalities in implementing programs suiting the diverse perspectives and conditions of place-based risk that may exist among urban populations are also acknowledged here. Dealing with the uncertain and variable nature of climate change impacts across neighbourhoods (Susser, 2018) could potentially require, as one Ottawa councillor has noted, “many forms of adaptation at enormous expense” (D. Chernushenko,

⁵¹ A municipal representative indicated that the Pinecrest Neighbourhood Rain Project would have been initiated with or without climate change impacts; the residential neighbourhood within which this initiative is located is vulnerable to flooding in general, as it was constructed prior to current municipal land use standards (D. Conway, personal communication, November 16, 2018).

⁵² As of Fall 2018, Halifax Regional Municipality is initiating an 18-month-long engagement and development process around a new Community Energy & Climate Action Plan (CECAP) initiative. According to HRM, CECAP “provides an inclusive, collaborative opportunity to address community-wide climate change adaptation and mitigation measures in all sectors... This approach will establish short and long-term goals for energy transformation and greenhouse gas reductions for the community looking out to 2050”. HRM *Energy & Environment* staff plan to produce a draft plan by late spring 2019 (Duncan, 2018).

personal communication, December 19, 2016). Substantial resourcing may be required in delivering multiple communication strategies targeting differing physical contexts and priorities among residents, for example in rural versus more central areas of municipalities (J. Robinson, personal communication, March 7, 2017). Municipalities may also encounter resistance among residents to acknowledging that local places are indeed changing (though one Ottawa representative has suggested that focusing on past climate data in communicating with residents may help in effectively illustrating changes over time) (J. Robinson, personal communication, March 7, 2017). Conversely, the potential also exists that an overly assertive approach to communicating risk to local places may fuel greater fear, overwhelm, or ultimately a sense of futility among residents in dealing with climate change concerns (S. Miedema, personal communication, August 20, 2015). As one Ottawa resident has suggested, “It’s not like one answer, it’s not like a simple problem” (OTT-FG10).

3.5 Conclusion

In contrast to climate change mitigation activity involving the collective reduction of carbon emissions, which is commonly structured in global terms, processes of understanding and adapting to climate change impacts are often theorized through more localized frames (Nalau et al, 2015). This chapter has examined how Ottawa and Halifax residents understand climate change to be affecting local places, and where residents place areas of significant climate change vulnerability and risk. The primary focus of this study is on perceptions of change within a specific context, in line with what has been advocated by other scholars (Brugger & Crimmins, 2013; MacGillivray & Franklin, 2015) – in the case of this research, inner-urban neighbourhoods in mid-sized Canadian cities – in efforts to inspire tailored adaptation approaches for urban populations sharing similar opportunities and constraints.

While many Ottawa and Halifax residents in this context construct places of climate change impacts and risk within cities, consistent links to perceptions of vulnerability at the scale of individual home sites among most residents are less apparent. The residents examined in this study were often as likely to locate areas of concern at beyond-local or over future timescales, and when noticed, local changes were sometimes downplayed. For many in the study group, their own home sites appear relatively secure in contrast to other areas considered more at risk – for example, within neighbourhoods/regions in more precarious physical locations or lacking adequate social supports. It is also challenging for some residents to bring large-scale climate change concerns down to the individual dwelling site. One Ottawa resident touched on this general view by stating, “I am in no doubt that the global temperature is increasing. Whether that translates into local remains to be seen” (OTT-FG19).

This study advances scholarly literature in its focus on place meanings among residents in inner-urban and middle-income neighbourhoods, who may experience greater financial stability or comparatively easier physical access to municipal and neighbour supports than the smaller community populations at risk frequently examined in other empirical studies. In this focus, it identifies tendencies among a portion of these residents to resist inward examinations of risk in local places. In presenting a comparative case study of cities contrasted in their proximity to visible elements of physical climate change risk and potential for intense weather events, this study also highlights a similar distancing of place-based risk that exists between residents living in these very different places. Significantly, the qualitative approach to inquiry employed in this study has also allowed for a more in-depth examination of the multifaceted perspectives that individuals may hold regarding local places

impacted by climate change. This research reveals the complicated frames through which citizens locate climate change risk in relation to the personal dwelling space, as both near and away, constraining activities across cities but keeping households largely intact, noticeable within home sites yet also often dismissed.

As policy scholars call on cities to initiate more sophisticated adaptation strategies for residents in urban areas, there is a need for further research regarding how individual citizens process climate change within household contexts and other local places. As Carolan (2010, p. 319) suggests, “Social scientists have only scratched the surface of what it means to understand climate change as a lived experience”. Future research in this area could involve expanding examinations of resident perspectives of place-based impacts across other suburban and rural segments of urban areas, and across a broader demographic of income levels. Additional research could examine the influence of home insurance on resident perspectives of place-based risk. Overall, this type of inquiry could potentially uncover points of connection among residents that could help municipalities in gaining increased attention from citizens and adequately addressing residents’ concerns about valued places at risk. Insights gained may also offer additional alternatives for municipalities to what Adger et al. (2011, p. 2) term “inevitably normative judgments about what is valuable and significant to a society”.

Chapter 4: Is adaptation in our nature? Citizen engagements with urban natures and climate change in Ottawa and Halifax

4.1 Introduction

With impacts of climate change such as increased rainfall and heat events being felt more keenly by residents in urban areas over the last decade, municipalities in Canada have begun to modify local ecologies to help moderate these effects (City of Ottawa, 2017b; City of Vancouver, 2012; HRM, 2014). This practice falls within a general approach of *ecosystem-based adaptation* or enhancement of *green infrastructure* in cities, through varied measures such as planting trees or vegetative groundcovers to assist in neighbourhood cooling or stormwater capture, or maintaining coastal wetlands to reduce flood risk to neighbouring settlements (Arkema, 2013; Berland et al., 2017; Bowler et al., 2010; McPhearson et al., 2015).⁵³ Municipalities increasingly call on citizens to enhance home site ecologies (comprising vegetative elements within the boundaries of individual residential sites, such as trees or grassed yards) to deal with residential-scale impacts of climate change, such as home overheating in summer or basement flood risk from intense rain. Individual citizen actions also contribute to larger-scale ecological measures to foster climate change resilience in cities; for example, trees planted within home sites strengthen the urban forest canopy, extending stormwater capture and moderating urban heat islands across wider urban areas. These types of measures also offer potential co-benefits of enhancing the health of local ecologies as well as fostering connectedness among citizens to non-human urban natures (Gill et al., 2007; Hall et al., 2012; La Point, 2007; Pitman et al., 2015).

⁵³ A more detailed explanation of terminology employed in this study relating to urban natures, ecosystem-based adaptation and green infrastructure, as well as a description of ecosystem-based adaptation methods to address climate change-related impacts and risk, may be found in a subsequent section of this chapter.

A green infrastructure approach to climate change adaptation in cities corresponds in part with social nature scholars' discussions of the *urban ecosystem*, a perspective of the urban environment that recognizes dynamic and mutually assistive relationships between human and non-human natures (Braun, 2005; Heynen et al., 2006; Francis et al., 2012; Meredith, 2005). In general, social nature scholars stress the subjective frames through which non-human natures are represented and understood; they do not deny the material reality of ecologies or of environmental concerns, instead casting doubt on absolute definitions of *what nature is* or how ecological issues should be addressed (Braun, 2002; Castree, 2005; Castree & Braun, 1998; Escobar, 1996; Harvey, 1996). Conceiving of cities as urban ecosystems offers a perspective of these areas as unique, vibrant and relevant ecological spaces, and as contexts for significant environmental action. This conceptualization also involves consideration of how nature is reproduced in cities through human activity, and how built structures may accommodate ecological needs and flows (Braun, 2005; Francis et al., 2012).⁵⁴

The academic literature has emphasized a crucial requirement for community support in implementing ecosystem-based adaptation policy in cities, as well as a need to better understand citizen responses to related suggested practices within the home site space (Derkzen et al., 2017; Zidar et al., 2017). Through their preferred approaches to home site landscaping (e.g. the hardscaped terrace, the backyard forest, the dense turf grass lawn), citizens hold considerable influence over the vibrancy of surrounding urban ecologies and the

⁵⁴ Scholars have offered some critique regarding linkages between the urban ecosystem conceptualization and ecosystem-based climate change adaptation strategies, suggesting that this method of adaptation primarily conforms to an understanding of non-human natures as resource for human benefit (see for example Braun, 2014). While this concern is acknowledged, this study maintains a perspective of ecosystem-based adaptation responses as fostering more cooperative, mutually beneficial engagements with non-human natures that aim to help both human and non-human natures to thrive.

adaptive capacity of local neighbourhoods (Robbins & Birkenholtz, 2003; Sisser et al., 2016; Sun & Hall, 2016). Actions taken to enhance ecologies within individual properties comprise crucial points of connectivity across urban landscapes, assisting in the protection of built structures against changing climate effects while fostering broader ecological health at city scales.

Scholars highlight a continued paucity of literature exploring citizen constructions of nature at the scale of the individual home site (Conway, 2016; Dahmus & Nelson, 2014; Robbins et al., 2001). Existing scholarship on residential-scale nature discourses has frequently focused on conflicting perspectives in maintaining traditional dense turf grass or more contemporary eco-friendly alternatives in the residential yard, as households are swayed alternately by the pull of neighbourhood aesthetic norms, larger yard-care industry marketing schemes and/or societal eco-ethics (Feagan & Ripmeester, 1999; Goddard et al., 2013; Robbins, 2007). The limited body of literature referencing citizen engagements with local natures in relation to climate change and intense weather impacts more often involves resident responses to recommendations to *remove* vegetation, as in the case of wildfire risk at the wildland-urban interface, or to install green infrastructure measures aimed at specific individual conditions (e.g. stormwater management) (Baptiste et al., 2015; Collins, 2005; Nelson et al., 2005). Few of these studies are situated in Canadian urban areas. What is yet to be fully explored in the academic literature is the more extensive range of understandings potentially held by residents in relation to *enhancing* local natures to adapt home sites and wider neighbourhoods to a multiplicity of subtle and profound climate change effects.

In response to this gap, this study extends the academic literature on social constructions of nature within a climate change adaptation context, by exploring how

residents from inner-urban neighbourhoods in Ottawa and Halifax discursively construct local natures in response to recommended ecosystem-based adaptation measures for home sites. This research also considers how residents perceive home site landscaping activities as connected to the vulnerability or resilience of individual places of residence, surrounding neighbourhoods and a wider urban ecosystem in dealing with diverse climate change effects. The study also identifies opportunities for municipalities to more effectively communicate ecosystem-based adaptation policy through a more nuanced understanding of residents' priorities, values and concerns related to home site natures, wider urban ecologies, and climate change impacts and risk.

This research involves a qualitative case study focused on resident perspectives from established, middle-income and inner-urban neighbourhoods in two mid-sized Canadian cities, Ottawa and Halifax.⁵⁵ This study explores first-person accounts from 47 residents (25 Ottawa residents; 22 Halifax residents) regarding individual impressions of local natures and climate change, as well as residents' willingness to implement suggested ecosystem-based adaptation approaches within home sites. Resident perspectives were gleaned from primary data involving resident participation in detailed surveys and semi-structured interviews/focus groups that was collected between 2015-2017. During interview/focus group sessions, residents were encouraged to discuss (and, if they wished, offer challenges to) varied topics related to climate change and local ecologies in each city, including recommended adaptation measures for home sites such as installing rain gardens to manage local stormwater, planting larger-scale vegetation for shading, or trimming trees to reduce storm debris. Secondary data involving resident perspectives was also reviewed, including public consultation documents

⁵⁵ Maps of Ottawa and Halifax study neighbourhoods may be found in Chapter 2.

related to Halifax Regional Municipality's *Urban Forest Master Plan* and the City of Ottawa's *Urban Forest Management Plan*, resident feedback on a residential rain garden/bioswale street stormwater management pilot project also administered by the City of Ottawa, as well as records from federal climate change town halls held in both cities. Though residents touched on a range of residential yard features, including gardens and vegetative groundcovers (e.g. grass, low-growing perennials) in their comments about local natures and climate change, their responses most often referenced home site trees and the wider urban forest. Study findings and analysis also draw from interviews with 12 municipal representatives (six representatives from each city) and three representatives from environmental organizations based in Halifax, who provided additional perspectives on resident engagements with local natures in the context of adapting to climate change, as well as greater insight into municipal-scale activities and challenges related to resident engagement in ecosystem-based adaptation efforts.

This research uncovered several key findings. Within the context of climate change, residents conceptualize surrounding natures through varied frames, including: as agents of adaptation, as vulnerable to impacts, or as sources of additional risk to settlements in extreme climate conditions. Residents' varied responses to ecosystem-based adaptation recommendations within home sites reflect differing ethical perspectives toward local ecologies, adherence to neighbourhood aesthetic norms, and concerns associated with a perceived volatility of larger-scale natures. As a result, municipal programs aimed at enhancing citizen activity around ecosystem-based adaptation will need to expand communication strategies to address multifaceted understandings of local natures and environmental risk that are held by residents.

The next section of this chapter, Section 4.2, provides an explanation of terminology related to local natures, green infrastructure and ecosystem-based adaptation methods, along with a brief discussion of the effectiveness of these strategies in managing home site temperatures and stormwater flows. Section 4.3 explores scholarly framings of citizen engagements with local ecologies within and surrounding home site spaces. Sections 4.4 and 4.5 present study findings and analysis, highlighting varied influences on residents' understandings of and engagements with local natures in response to climate change concerns, and including prescriptive comments for municipalities regarding ecosystem-based adaptation programs for residents. Section 4.6 offers a summary of how scholarship has been advanced through this study, as well as a brief discussion of study limitations and opportunities for future research around the ecosystem-based adaptation theme.

4.2 A typology and examination of ecosystem-based climate change adaptation strategies in Ottawa and Halifax

This study examines how Ottawa and Halifax residents understand urban natures in relation to changing climate conditions and the potential of local ecologies to assist in climate change adaptation in urban areas. In this chapter, the term *local natures* refers to the vegetative (i.e. non-human/non-animal) elements that grow in urban areas, for example trees, vegetable or perennial gardens, groundcovers such as grass, or green infrastructure technologies such as green roofs, bio-swailes or rain gardens⁵⁶. Individual *natures* or local *ecologies* combine with settlements to form larger *urban ecosystems*.

⁵⁶ Green roofs incorporate soil and vegetation on roof surfaces (Lawlor et al., 2006). Rain gardens are landscaped areas within residential-scale sites that are deeply dug out, filled with gravel and topped with vegetation. Rain gardens are designed for permeability, and usually located at the lowest elevation point within properties so that on-site stormwater is directed to flow into them (CMHC, 2011). Bioswales are also vegetated but are often employed for drainage at larger scales, and are described as “stormwater runoff

This chapter refers to local natures in this capacity as part of an *ecosystem-based adaptation* strategy or as a *green infrastructure* approach to maintaining urban ecologies (Brink et al., 2016; Geneletti & Zardo, 2016). Ecosystem-based adaptation is described as “the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change” (Geneletti & Zardo, 2016, p. 38), while green infrastructure is defined as “the natural vegetation and vegetative technologies that collectively provide society with a broad array of products and services for healthy living” (Green Infrastructure Coalition Ontario, 2016). Ecosystem-based/green infrastructure measures are assumed within the context of this study to foster ecological sustainability and climate change adaptation co-benefits under ideal conditions. Green infrastructure technologies relating specifically to lot-level stormwater management are also referred to as part of a strategy of *low impact development*.⁵⁷

The effectiveness of ecosystem-based strategies in moderating intense weather and climate change impacts is well-documented. Planting trees, shrubs or vegetative groundcovers helps to reduce home cooling energy and improves resident comfort during warm weather months – through shading or other ambient air-cooling properties such as evapotranspiration – while larger-scale vegetation may also reduce home heating needs by shielding building structures from cold weather winds (Bowler et al., 2010; Thom, 2016). One Canadian study demonstrated that planting 30% more vegetative cover within residential sites contributes to significant reductions in home heating and cooling energy use (10% and

conveyance systems that provide an alternative to storm sewers [which can] absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters” (NRCS, 2005, p. 1).

⁵⁷ The City of Ottawa’s *Infrastructure Master Plan* states that low-impact development (LID) measures “include ‘lot-level controls’ in the form of green roofs, rain gardens, and pervious pavers on individual properties, as well as bioretention facilities within right-of-way boulevards. LID approaches can complement or reduce (but may not eliminate) the need for ‘end-of-pipe’ solutions” (City of Ottawa, 2013, p. 117).

40% reductions respectively) (Akbari & Taha, 1992). Studies in other locations have produced similar findings (Akbari et al., 1997; Akbari et al., 2001).

Enhancing vegetation within properties by planting trees, increasing permeable groundcovers or installing rain gardens also improves lot-level stormwater retention by up to 40% of an average rainfall event, reducing flood risk to nearby structures (HRM, 2006a; Xiao & McPherson, 2011). Trees play a significant role in this process, by capturing rainwater within leaves, needles and roots and by loosening soils for greater permeability, intercepting for example about 25% of a 25 mm rainfall (City of Ottawa, 2017b; Mahendrappa, 1982)

Increased plantings also offer cumulative cooling and stormwater management benefits across wider scales. Studies have demonstrated that enhanced tree-planting can lower air temperatures across neighbourhoods, such as within parks where forested areas have been shown to lower temperatures by up to 7°C in relation to surrounding hardscaped areas (City of Ottawa, 2017b; Coutts & Harris, 2012; Georgi & Zafiriadis, 2006; Slater, 2010). Urban forest enhancement cools ambient air temperatures even when trees are not directly shading buildings (Bowler et al., 2010; Graham et al., 2016). Regarding cumulative stormwater management benefits, Halifax Regional Municipality's *Urban Forest Master Plan* cites Coder (1996) in stating that “for every 5% increase in overall canopy cover, total city run-off is reduced by 2%” (HRM, 2013, p. 4). Another study examining the effectiveness of expanding vegetative groundcover within the space of a New York City residential block found that “increases in annual precipitation projected from climate change could be fully mitigated by reducing impervious surface cover by 25%” (Mason & Montalto, 2015).

Despite a significant stormwater absorption potential available through green infrastructure strategies such as rain garden installations or tree planting, the effectiveness of these measures may be somewhat variable depending on soil types, size of trees and weather conditions (for example, ecosystem-based adaptation methods will often reduce, but not eliminate, stormwater runoff during prolonged intense rainfall events). For this reason, practitioners often recommend that ecosystem-based adaptation approaches be coupled with other grey infrastructure approaches for stormwater management such as stormwater storage tanks (Berland et al., 2017; CMHC, 2011; Kuehler et al., 2017; US Environmental Protection Agency, 2014).

The addition of larger-scale trees or other vegetation close to homes also carries some potential risks to nearby homes during: (1) strong storm wind events from flying branches or other vegetative debris; and, (2) wildfire events near residential developments at the wildland-urban interface. Appropriate species selection and trimming or thinning vegetation near structures, and/or planting vegetation farther away from structures, are recommended to reduce these risks (Purcell, 2013; Whiting & O'Meara, 2014).

The City of Ottawa and Halifax Regional Municipality have employed various ecosystem-based strategies for adapting to climate change impacts involving excess heat and increased rainfall in urban areas.⁵⁸ HRM planning policy includes measures to retain riparian buffers along waterways with the purpose of mitigating flood risk to nearby settlements (HRM, 2014), while an urban forest canopy cover analysis currently being undertaken by the City of Ottawa aims to link prioritization of new tree planting sites with a heat island vulnerable populations tool (M. Copestake, personal communication, April 26, 2017). Both

⁵⁸ Additional residential site-scale strategies by municipalities are described later in this chapter.

municipalities are considering additional future ecological sustainability measures to respond to a changing climate, such as adapting species selection in urban forestry programs to deal with altered growing conditions over time (J. Simmons, personal communication, March 3, 2017; M. Copestake, personal communication, April 26, 2017). Both cities also increasingly locate ecological sustainability measures within residential neighbourhoods, for example through a targeted street tree planting program in Halifax, as well as through several stormwater management pilot programs in Ottawa incorporating trees/bushes, rain gardens or bioswales along residential streets and front yard rights-of-way (City of Ottawa, 2016a; HRM, 2013b). These latter measures reflect a trend in cities for implementing green infrastructure strategies within municipally-controlled spaces abutting residential properties (Stovin et al., 2008).

4.3 Citizen engagements with local natures in the scholarly literature

Scholarly examinations of citizen engagements with urban natures have been situated at varied scales. Burgess et al. (1988) for example demonstrate how individuals value public greenspaces as places for socialization or recreation, or for experiencing a perceived more *natural* aesthetic. This latter observation links to scholarship that explores how individuals express preferences for specific representations of urban natures that favour the preservation of pristine over managed vegetative landscapes, in line with traditional cultural narratives or romantic ideals (Maines & Bridger, 1992; Buell, 1995; Cronon, 1996; Kirkpatrick et al., 2013). Other scholars suggest that urban ecologies are accorded spiritual meaning or more intrinsic values by citizens; within this conceptualization local natures (e.g. urban forests) are understood as deserving preservation for their own sake, or as crucial in sustaining other non-human species (birds or other wildlife) within densely developed urban environments

(Camacho-Cervantes et al., 2014; Davenport & Anderson, 2005; Goemans & Ballamingie, 2013).

Other literature has also offered more fine-tuned examinations of these types of engagements at the scale of the home site, where residents arrange yard greenspace to encompass varied opportunities for relaxation, recreation, and local access to the outdoors, or to promote social interaction or exclusion (Levine Coley et al., 1997; Blaine et al., 2012; Lebowitz & Trudeau, 2017). Regarding residents' specific engagements with trees, the literature offers several examples in which individuals manage home site treed spaces to maintain preferred visual attributes or to enhance personal comfort (e.g. for shade); this literature also considers how individuals may seek to preserve trees within home site spaces to maintain personal connections they hold with local forests (Avolio et al., 2014; Conway, 2016; Pearce et al., 2015).

As earlier noted, a prominent strand of the literature examining individual connections to home site natures has explored more specific ties held by households to the mainstream turf grass yard, suggesting how yard upkeep is frequently influenced by individual aesthetic preferences relating to a preferred neighbourhood status or residential property values (Feagan & Ripmeester, 1999; Fraser et al., 2013; Robbins, 2007). As Robbins observes, resulting lawn maintenance actions may be contradictory; residents may engage in behaviours – for example, through maintenance of water- and chemical-dependent lawns – that contravene personal environmental values, bowing instead to “the contextual pressures of real estate, community, and municipality” (Robbins, 2007, p. 7; see also Mechenich & Shaw, 1994; Robbins et al., 2001). Interestingly, more recent studies have demonstrated how contemporary ‘eco-friendly’ neighbourhood norms are instead influencing

action to manage home site ecologies at the expense of grassed yards, through such activities as encouraging perennial or food gardens along front yard streetscapes, or through wildlife-friendly gardening practices (Goddard et al., 2013; Hunter & Brown, 2012). These observations suggest a multiplicity of potential discourses among residents about stylistically preferred, ecologically healthy or morally appropriate approaches to managing local natures. They also reveal diverse assumptions among citizens regarding suitable frames through which to manage the urban yard to align with perceived traditional or *natural* qualities of neighbourhood natures (Dahmus & Nelson, 2014; Feagan & Ripmeester, 2001).

In recent years, scholars have begun to examine how individuals understand local natures as elements of *green infrastructure* within and around properties to deal with climate change impacts and other intense weather conditions in residential neighbourhoods (Baptiste, 2014; Brugger & Crimmins, 2013; Derkzen et al., 2017; Lo et al., 2017). This modest body of scholarship has largely focused on residents' general receptiveness to recommended ecosystem-based adaptation strategies, as influenced by residents' experience with previous intense weather conditions, their perceptions of the visual qualities of proposed measures, or more pragmatic factors such as cost or ease of implementation (Baptiste, 2014; Baptiste et al., 2015; Church, 2015; Everett et al., 2018). Scholars have shown how these influences often persist, even where residents' preferred landscaping activities negatively affect the sustainability and adaptive capacity of home sites – for example, in cases where residents resist visually unappealing low-water landscaping measures that would have assisted households in dealing with drought (Chui, 2014; Conway, 2016; Hayden et al., 2015). In general, this literature does not offer any deeper reflection on how local natures are perceived

by residents in their consideration of these measures, or explore other influences on their willingness to participate in ecosystem-based adaptation efforts across neighbourhoods.

A related body of scholarship examines how residents regard and engage with home site natures in relation to local environmental risk. This includes literature examining how residents willingly increase individual exposure to risk when settling in areas prone to significant natural hazard – for example, in densely forested areas at risk of wildfire – with the intention of gaining more intimate access to preferred ecological landscapes (Daniel et al., 2003). Within this context, residents may resist modifying local ecologies – for example by not removing vegetation around homes in areas prone to wildfire – instead placing higher value on preserving perceived aesthetic or intrinsic attributes of local natures (Collins, 2005; Goemans & Ballamingie, 2013; Nelson et al., 2005).

This current study explores several themes from existing literature, including individual understandings of local natures at home site scales, citizen responses to recommended green infrastructure strategies, and individual engagements with urban ecologies within local risk (i.e. climate-related hazard) environments. This study extends these themes through in-depth examination of resident perspectives of home site natures in the context of enhancing local ecologies to adapt to multiple and advancing climate change impacts and risks. Section 4.4 describes study findings, revealing how Ottawa and Halifax residents employ diverse conceptualizations of local natures in inner-urban, densified environments, as well as how they alternately consider and disregard links between home site ecologies and wider ecosystems within urban adaptation efforts.

4.4 Citizen perspectives in Ottawa and Halifax: Discursive constructions of and engagements with urban natures in the context of climate change

In examining residents' perceptions of local natures in the context of dealing with climate change impacts, this study reveals that Ottawa and Halifax residents generally hold partial understandings of urban ecologies as fostering greater neighbourhood adaptative capacity. While some study participants noted they held limited or no awareness of adaptation benefits associated with enhancing local ecologies, others indicated they had had some knowledge of these links prior to interview/focus group sessions. These residents spoke of potential measures to deal with climate change effects such as planting trees to help shade/cool homes and neighbourhoods during periods of intense heat, or adding vegetation to help capture rainwater and reduce flood risk to homes. Comments from public consultations for the City of Ottawa's *Urban Forest Management Plan* and HRM's *Urban Forest Master Plan* also reveal some understanding among residents of a critical role for trees in improving neighbourhood stormwater management and reducing heat island effects in densely developed urban areas (City of Ottawa, 2015c, 2017a; HRM, 2013). Many study participants noted that during warmer weather periods they often took notice of cooler, more comfortable conditions in proximity to parks and other public green spaces, and that they often unconsciously gravitated towards shaded treed areas during pedestrian travel around the city. Regarding home site spaces, one Ottawa resident commented that during warmer periods "we're very grateful for our shady backyard" (OTT-SRV13), while another Ottawa resident noted, "I've always been very grateful that we've got all these mature trees in the neighbourhood, and that in the summer I hardly ever use our air conditioner. We have one but I hardly ever use it because we have a canopy in the front" (OTT-FG18). Interestingly, many residents also frequently commented on the value of urban ecologies in helping to

mitigate further climate change – through carbon sequestration effects – with some residents offering more pronounced comments in this respect as compared to an understanding of local natures as helping cities adapt to already occurring climate change impacts.

While comments among study participants were somewhat mixed, many Ottawa and Halifax residents indicated that they would consider enhancing home site ecologies to deal with local climate change heat or stormwater effects, for example, by replacing hard surfaces with more permeable planted ground covers, adding trees or shrubs, or installing rain gardens. Some residents spoke of having already taken some of these types of actions, with one Halifax resident noting they had already been considering replacing their driveway with vegetation to improve stormwater retention on their property, despite a possibility that this might negatively affect their property value.

Many study participants and other residents – including participants in public consultations and town halls related to urban forest management and climate change action respectively in Ottawa and Halifax -- also highlighted an important role for enhancing natures within private lands in strengthening overall adaptive capacity and ecosystem health across broader cities (City of Ottawa, 2015c; City of Ottawa, 2017a; Filmore, 2016; HRM, 2013). As one Ottawa resident remarked, “if all the neighbourhoods do something, especially along the river where you’re thinking of something like flooding, it does change the picture for the city at large” (OTT-FG15). Several residents expressed support for planting trees in contributing to a more robust urban tree canopy that could extend adaptation benefits across urban areas. In this regard, one Halifax resident stated, “Resilience to climate change is to foster an urban forest” (HAL-SRV6).

Several study participants suggested that effective ecosystem-based adaptation strategies would require cumulative and integrated efforts to enhance ecologies across multiple residential sites. Residents described how their home sites had benefitted (e.g. through cooling or rainfall absorbing effects) from trees and green spaces located within nearby residential properties, parks or other public green spaces. Others noted concerns about the removal of vegetation on neighbouring properties from intensive redevelopment, and associated reductions in neighbourhood-wide adaptive potential.⁵⁹ Some residents also referenced previous experiences of participating in larger collaborative activities to enhance ecologies at neighbourhood scales, such as through citizen stewardship projects to maintain public greenspaces, or with neighbours to plant trees or remove invasive species along nearby river ecosystems.

In many cases, suggested ecosystem-based adaptation actions aligned with residents' other values and preferences in their engagements with local natures. Residents frequently described improved aesthetic or other sensory qualities associated with enhancing local ecologies, suggesting for example that adding gardens or treed areas contributed to the beauty and comfort of outdoor home spaces and a pleasant neighbourhood ambience. As one Halifax resident articulated,

it just seems like there are so many multiple benefits...things tend to be more walkable, and it's nice to be out in your neighbourhood when there's tree cover and shade...and so it seems like a positive feedback thing, when you're doing some of these things that can accommodate climate adaptation, it actually probably makes it a nicer place to live, in general. (HAL-FG2)

An Ottawa resident commented, "I like having trees in the neighbourhood, because then it looks like a major neighbourhood, not a new neighbourhood, with a bunch of little seedlings"

⁵⁹ A more extensive discussion regarding this concern is provided in the Chapter 5.

(OTT-FG4). For some residents, a move away from hardscaping or dense grass to more porous and larger-scale planting arrangements in yards was in keeping with evolving neighbourhood social norms toward a more environmental ethic in general; as one Ottawa resident described, “It’s much more interesting to have all these wild things... I look around at the yards of so many neighbourhoods. So many are no longer grass, they’re other things, wild things and so on...a lot more other natural things rather than manicured grass lawns” (OTT-FG3).

Conversely, other residents expressed doubt about the effectiveness of ecosystem-based approaches in strengthening neighbourhood resilience to climate change impacts, or suggested that even if effective, applying ecosystem-based adaptation strategies would likely not be a top priority for most residents. Several residents suggested that the small scale of individual inner-urban home sites was insufficient to support more extensive planted groundcovers or larger-scale vegetation such as trees. As one Ottawa resident suggested, “anything we do on a very local basis is going to have a very modest and localized effect” (OTT-FG19). Some residents noted a related uncertainty regarding the effects of municipal greening efforts such as street rain garden projects or tree planting within residential rights-of-way on neighbourhood adaptive capacity, with one Halifax resident stating, “[the trees are] so far away from the houses, they’re right next to the street. So, I don’t know if they’re really going to make much difference” (HAL-FG17).

Other residents expressed some hesitancy to add green space within properties as this would conflict with other priorities. Some residents commented that the addition of shade trees might disrupt views across home properties, darken house interiors or shade vegetable gardens. Regarding heavily treed areas on neighbouring properties, one Ottawa resident

remarked, “I haven't got a tree on my front lawn... But looking just to my left, it is so dark. Those houses aren't getting any sunlight in the mornings. And that's okay in the summer and spring and fall. But I like seeing the river when the leaves come off the trees” (OTT-FG15). Study participants also described situations in which neighbours or they themselves had reduced green space within home sites in implementing home extensions or larger rebuilds.⁶⁰ Residents also referenced other potential inconveniences associated with adding trees or other large-scale vegetation around home sites, such as leaves clogging eavestroughs or becoming too cumbersome to rake. One Halifax resident described how others in their neighbourhood were resistant to municipal tree planting efforts in residential neighbourhoods, noting, “Some of my neighbours were saying, ‘we don’t want trees...leaves on the street, leaves will go on my property, I don’t want them’... So I might be able to get them on my property, but maybe not on somebody else’s” (HAL-FG14).

Significantly, residents in both cities also frequently expressed pronounced concerns that local natures could pose increased risk to home sites during climate change-related severe weather events. This apprehension was directed most often at trees, including those located within home sites, on neighbouring properties and within front yard municipal rights-of-way (i.e. street trees). Residents often spoke of the potential for trees falling or hazard branches flying towards homes or nearby vehicles during strong wind events or winter storms. As one Halifax resident commented in the study survey, “Severe weather in the form of intense thunderstorm (though rare) or an approaching tropical storm or hurricane do give me anxious moments when I wonder if the large tree at the back might fall” (HAL- SRV15). One Ottawa resident recounted,

⁶⁰ A more detailed discussion of infill development and permeable green space in residential yards may be found in Chapter 5.

This year when we had that one weird storm that blew in really fast it did a lot of damage. One of my neighbour's trees, they have at least a 50-foot or 60-foot high maple tree... It's massive. And one of its big branches blew off. And if I hadn't had my big trees in my backyard which stopped it...that would have hit my house. (OTT-FG13)

Residents also spoke about the potential for larger trees toppling over hydro wires and causing power outages during wind or ice storms, or expressed concerns about increased risk of damage to homes from wildfire due to the proximity of densely forested areas in some Halifax neighbourhoods. Resident concerns about trees on municipal rights-of-way conflicting with power lines were also noted by one representative involved with HRM's *Urban Forest Master Plan* (P. Duinker, personal communication, August 8, 2016).

Some residents suggested that planting additional trees or other large-scale vegetation within close range of properties within tight neighbourhood spaces could increase risk not only to their own home sites but also to that of their neighbours during strong storms. One Ottawa resident stated, "You put a tree anywhere in my yard and it could fall on my house. And mine's a big lot for this area" (OTT-FG14), while a Halifax resident suggested, "when you think about it, if you think there's going to be more storms, you're going to be more concerned about trees on yours and neighbours' properties. That they may be able to reach your house if something was to happen to them" (HAL-FG11). In response to a recommendation that trees and other larger-scale vegetation be regularly pruned to reduce risks of flying debris during storms⁶¹, another study participant commented that, "even a tree that is sound and well-trimmed can be torn up in a really bad storm" (OTT-FG19).

Comments provided by one Ottawa councillor summarize these types of concerns, in stating

⁶¹ For a list of home site measures for climate change adaptation that were recommended to resident study participants, please refer to study survey questions listed in Appendix 1.

challenges during major street rehabilitation projects in inner-urban neighbourhoods in his ward,

[...] to get property owners to willingly not just replant a tree that might have been there, but to actually accept another one... There are a whole list of reasons why people often don't want a tree. And even if they do accept one, they don't want it to be big. The roots might cause damage, limbs might fall on someone or my car, don't want my house to be too shaded, etc. So, the take-up, yeah, you would have thought everyone would say, yes, I would love a great towering oak a hundred years from now on my property, but a lot of people don't. Give me a little ornamental thing, so I've got a tree, but it isn't actually doing a whole lot. (D. Chernushenko, personal communication, December 19, 2016)

4.5 Discussion

This study explores diverse frames through which residents discursively construct and engage with local natures in relation to climate change concerns. It draws on social nature literature in adopting a wider ecosystem view encompassing both human and non-human natures, and in recognizing constructions of nature as inspired by varied influences including individual values, responses to neighbourhood norms, and perceptions of risk associated with climate change (Braun, 2002; Castree, 2001; Castree, 2005; Castree & Braun, 1998; Demeritt, 2002). This analysis is situated more generally in an urban context, within which the integration of human and non-human natures is often assumed to be most visible through the social processes underpinning urbanization (Cronon, 1996; Harvey, 1996), but also focuses more specifically on perceptions of local natures existing within the individual residential yard in densified inner-urban environments. Regarding the ways in which these understandings influence citizen engagements with home site ecologies and affect wider urban ecosystems, Robbins et al. (2001, p. 370) suggest that, “the very ordinariness of these daily decisions makes them easy to overlook, even as they combine to create large effects” (see also Feagan & Ripmeester, 2001).

Overall, the findings of this study reveal that Ottawa and Halifax residents – within a main context of residents that are informed about and engaged in community/municipal issues, and largely living within middle-income, inner-urban neighbourhoods – display similar ranges of understanding regarding urban natures in relation to climate change. Many residents hold a comparable sense of the importance of maintaining urban forests and of not “paving over ecosystems” (OTT-SRV14) as measures of sustainable urban development in general (though their own activities in managing home site ecologies may often conflict with this ideal). Beyond the perspectives presented in the previous section, some residents also possess more advanced awareness of possibilities for ecosystem-based adaptation approaches, demonstrating for example a greater familiarity with green infrastructure terminology (e.g. bioswales, low-impact development) and advocating for more species diversity and older-growth vegetation in enhancing adaptive effects. In addition, a few residents, despite their support for these types of adaptation measures in general, also offered legitimate critiques regarding the effectiveness of ecosystem-based approaches to adequately protect neighbourhoods during extreme conditions – for example, in sufficiently redirecting stormwater and preventing flooding to properties during severe or prolonged rainfall events.⁶²

The perspectives of Ottawa and Halifax residents examined within this study reveal multiple conceptualizations of local natures held by residents. For residents, local natures are often understood as *offering protection* for home sites from climate change impacts such as excess heat and flooding risk, and for some residents, more prominently in mitigating further

⁶² Concerns among some residents about the limits of ecosystem-based measures in dealing with extreme weather conditions are not unfounded; a similar discussion of the limits to effectiveness of these measures may be found in Section 4.2.

climate change rather than in adapting to impacts. This latter understanding is most likely due to the influence of municipal sustainability discourses over the last few decades in North American cities, where urban ecologies are often valued for their carbon sequestration benefits (Ravin & Hibbard, 2007; Roy et al., 2012). Residents correspondingly express some willingness to consider enhancing home site ecologies to increase local adaptive capacity, but often where these measures align with personal landscaping tastes and neighbourhood aesthetic norms. In many cases however, the presence of larger-scale natures (most notably, trees) within residential sites are also understood by residents as conflicting with other priorities in home site maintenance, or more significantly as *potentially intensifying risk* to personal property and safety during climate-change related intense weather events. A main concern expressed among residents in this respect is the potential for treefalls affecting homes during storm events.

In recognizing urban ecologies as assisting home sites in adapting to intense weather impacts, Ottawa and Halifax residents display perspectives like those found within a modest body of existing empirical study where residents also prioritize home site landscaping with attention to “local climatic and environment factors” (Avolio et al., 2014, p. 73; Baptiste, 2014; Lo et al., 2017), over other influences frequently cited by scholars. Other literature has demonstrated how individuals manage home site landscaping according to values associated with “individual place-making” (Pearce et al., 2015, p. 6) or middle-class neighbourhood norms (Lebowitz & Trudeau, 2017). Responses by some of the Ottawa and Halifax residents profiled in this study appear also linked in part to these additional influences; for some residents, ecosystem-based adaptation measures are accepted as they align with residents’ existing gardening activities and a preferred more informal, less managed and ‘wild’

landscaping aesthetic. As one Ottawa resident also suggested, “I think a lot of people probably think it might be nice to have a tree on the front lawn. They’re not maybe thinking of it in terms of climate change” (OTT-FG15).

Support by some residents for planting trees or other larger-scale vegetation within home sites corresponds more widely with enhancing the visual character of established inner-urban neighbourhoods, or is aimed at extending familiar perceptions of each city as a beautiful and “green city”, or as a “city of trees” (OTT-FG5; OTT-FG13; HAL-FG16). As one Ottawa resident commented, “As someone who is letting both rear and front yards go back to the forest, I’m a big fan of planting trees wherever possible. This is the best climate change approach because people won’t recognize it as such. It’s got just as much to do with making the city a pleasant place to be” (OTT-FG8). Conversely, resistance among some residents to enhancing home site vegetation appears linked in part to keeping up with other neighbourhood trends in expanding building footprints or hard landscaping, as also noted in other studies (Stovin et al., 2008; Sun & Hall, 2016). Additionally, residents’ impressions that enhancements of ecologies within inner-urban home site spaces would be too modest to meaningfully support increased resilience at wider neighbourhood or city scales corresponds with similar observations by Conway (2016).

Among other residents, a willingness to undertake ecosystem-based adaptation measures aligns with a broader cultural eco-ethic and with residents’ personal identities as ecologically-minded citizens. Enhancing local natures within home site landscaping offers opportunities for residents to put forth, as one Ottawa resident noted, “a personal statement that this is something that you care about” (OTT-FG15). These actions follow a growing trend in middle-class neighbourhoods, where residents – which Lebowitz and Trudeau (2017,

p. 706) term “lawn dissidents” – move away from the typical (chemically-injected and non-porous) turf grass yard toward landscaping more in keeping with personal environmental interests (for example, through more bee-friendly gardening practices). Though some motivations in this respect may coincide with what Lebowitz and Trudeau suggest are “frames that treat [land] as a commodity and as a signifier of cultural distinction, particularly within an elite cosmopolitan subcategory of whiteness” (Lebowitz & Trudeau, 2017, p. 706), this does not appear to be the predominant influence on study participants’ eco-friendly gardening practices. In the current research context, residents’ perspectives appear to correspond with other studies that have demonstrated how residents act to preserve or enhance home site landscapes to support perceived intrinsic values of local natures, and for a main purpose of helping urban ecologies to thrive (Goemans & Ballamingie, 2013; Harris et al., 2013; Nelson et al., 2005).

As evidence of this claim, study findings include concerns voiced by several residents about potential detrimental effects to established neighbourhood ecologies that might result from implementing suggested ecosystem-based adaptation measures, including damage to trees from trimming programs, or reductions in species diversity from landscapes overmanaged in prioritizing protection to settlements. These concerns are also evident in feedback comments provided by residents (regarding potential impacts to existing trees) in relation to a residential street green infrastructure pilot project in one Ottawa neighbourhood (City of Ottawa, 2017c). Other residents expressed substantial concern about the vulnerability of local ecologies to already-occurring climate change impacts; residents commented that they were noticing a “change in the vegetation that’s in our neighbourhood”,

“lots of dead looking trees”⁶³ (OTT-FG12; HAL-SRV16), or other changes such as plants wilting during periods of extended drought or mildew in gardens from excess rain or humidity. Study participants also frequently spoke of their concerns about the susceptibility of trees and other vegetation to damage from future climate change-related intense weather events involving strong winds, significant snowfall or wildfire.⁶⁴

Lastly, study findings reveal an important additional factor in residents’ willingness to implement ecosystem-based adaptation measures, involving pronounced concerns among residents regarding larger-scale natures as potentially increasing risk to nearby homes and personal safety during extreme weather events. Due to this concern, some study participants displayed conflicted relationships with home site natures. Residents expressed an alternating willingness or reluctance to undertake ecosystem-based adaptation activities involving trees; measures to enhance resilience to climate change within home sites in these cases then required that “trade-offs” (HAL-FG14) be considered by residents, for example between enhancing lot-level stormwater management capacity or cooling through tree planting versus increasing the potential for damage to home and property from hazard branches or treefalls during intense weather events.

Previous examinations of citizen perceptions of local natures and risk in the scholarly literature have often focused on contexts in which individuals willingly locate home sites in

⁶³ During these discussions, residents sometimes referenced upsetting memories of wide-scale tree losses from the 1998 ice storm in Ottawa, and from past events in Halifax including Hurricane Juan in 2003, the 2009 Spryfield wildfire, and a major winter snow/ice event in 2015. For several Ottawa residents, concerns about trees at risk also stem in part from having witnessed the removal of a significant proportion of the city’s ash trees due to an Emerald Ash Borer infestation affecting the area in recent years. Though most residents did not directly link this situation to climate change, some noted that they had become more attuned to how jarring these types of losses could be to local neighbourhood landscapes.

⁶⁴ Residents’ concerns in this respect align in part with documented observations of damage to urban ecologies from intense weather conditions related to climate change, for example through detrimental heat and drought effects to urban trees as noted by Ordóñez Barona and Duinker (2015).

areas exposed to natural hazard (e.g. by inhabiting densely wooded areas at risk of wildfire), or defy suggested measures to remove vegetation to reduce risk (e.g. thinning trees around home sites), in order to maintain more intense engagements with valued local ecologies (Collins, 2005; Daniel et al., 2003; Goemans & Ballamingie, 2012; Nelson et al., 2005). This current study offers a more nuanced exploration of the complexity of understandings of local natures and hazard held by residents, where measures to enhance larger-scale vegetation offer perceived options to alternatively mitigate or potentially increase weather-related risk to inner-urban settlements. This research highlights a significant challenge in engaging residents in inner-urban neighbourhoods in participating in ecosystem-based adaptation initiatives, as residents balance desires to align home sites with municipal ecological sustainability/climate change adaptation programs with concerns around the constraints of enhancing vegetation within densely-developed urban areas.

Implications for municipal climate change adaptation policy

Inevitably, municipal policy measures to spur increased citizen adaptation activity will need to address residents' varied understandings of local natures and individual motivations for considering ecosystem-based adaptation action. The citizen perspectives examined in this study (as captured within primary data from many residents that are members of neighbourhood organizations, and within secondary data from municipal/climate change public consultations) relate to a demographic of residents that is often active in responding to community and sustainability issues and offers critical perspectives on municipal affairs. Within the context of largely middle-class, inner-urban study neighbourhoods that were the focus of this study, many resident study participants were receptive to enhancing home site ecologies and expressed interest in learning more about ecosystem-based adaptation

methods. Residents also often understood the beneficial effects of enhancing local natures as cumulative in contributing to wider resilience, ecosystem health and livability across neighbourhoods; as one Ottawa study participant stated when asked if fostering wider adaptive capacity would be a motivator in implementing individual measures, “yes, definitely, that would matter to me, because I’m part of this community, part of this city, and everything counts” (OTT-FG20). Concurrently, residents also expressed some uncertainty and intimidation regarding how to adequately implement ecosystem-based adaptation measures in ways that would avoid incurring additional risk to properties from larger-scale vegetation hazards during storm events. Other residents stated more frankly that though they recognized a potential for strengthening neighbourhood resilience through enhancement of home site ecologies, as one Halifax resident noted, they “wouldn’t be doing it for that purpose” (HAL-FG8). These residents commented that they would be more likely to consider implications for their own households of these measures such as effects on property values, or that they would likely require municipal incentives (e.g. free trees) to help with these efforts.⁶⁵

Prescriptive comments to guide municipalities toward more effectively motivating action among residents are offered with an acknowledgement of ongoing challenges for cities in engaging private landowners – even among citizens with demonstrated environmental mindsets – as active participants in municipal green infrastructure enhancement efforts (Bissonnette et al., 2018; Sun & Hall, 2016). At a basic level, implementing cohesive city-

⁶⁵ Some of these study findings (e.g. the expressed interest among some residents in incentives and guidance to implement their own ecosystem-based adaptation measures within home sites) may not apply to research contexts involving other socio-economic profiles, where residents may not have the financial means or decision-making control to implement desired measures. This situation would suggest a greater requirement for public investment in residential ecosystem-based adaptation strategies in these areas.

wide green infrastructure programs involves managing multiple objectives across often siloed agencies, which deal with a variety of issues such as land-use planning, urban forestry, and water quality among others (Chaffin et al., 2016; Fitzgerald & Laufer, 2017; Wright, 2011). This situation frequently leads to some ambiguity among planners regarding how best to implement green infrastructure approaches (Wright, 2011), as well as resource constraints and a lack of political will in prioritizing ecological sustainability programs in general; as one municipal representative in Ottawa has noted regarding urban forestry concerns, “we still have a ways to go, in terms of convincing everybody that matters, that there’s value to these [ecological] assets” (M. Copestake, personal communication, April 26, 2017).

Regarding physical challenges, Halifax Regional Municipality and the City of Ottawa also currently deal with continued tree losses on private property, and new plantings encounter challenging growing conditions within increasingly densified inner-urban areas (City of Ottawa, 2017b; HRM, 2013; M. Copestake, personal communication, April 26, 2017). In addition, the long-term viability of vegetation planted within residential sites is somewhat uncertain, as green space is sacrificed to other homeowner preferences or influences over time (City of Ottawa, 2013, 2017b). More broadly, there exist other uncertainties around exactly how urban ecologies will react to climate change over coming decades, as well as how municipalities might appropriately respond to this situation (for example, through assisted species migration as one option) (HRM, 2013; J. Pollard, personal communication, February 14, 2017; J. Simmons, personal communication, March 3, 2017; Matthews et al., 2015).

To date, efforts by the City of Ottawa and Halifax Regional Municipality to influence citizen-led ecosystem-based adaptation action through regulatory or incentive measures

(though not branded as part of a comprehensive climate change adaptation approach) have been aimed at strengthening the urban forest canopy in residential neighbourhoods or encouraging more permeable vegetative groundcover within home sites. Within Halifax Regional Municipality, a *Site Related Flow Charge* for residents sets stormwater rates according to the proportion of permeable surface area on residential properties (Halifax Water, 2017, November 22; Halifax Water, 2018, February 28a). Examples from the City of Ottawa include its *Trees in Trust* program, which offers free street trees to residents for planting in front yards along municipal rights-of-way, and its *Urban Tree Conservation By-law*, which requires permits for removal of trees larger than 50 centimetres in diameter (though as the City acknowledges, “about 90% of ‘distinctive tree’ permits requested are issued”) (City of Ottawa, 2017b, p. 84; City of Ottawa, 2018c). Minimum requirements for yard setbacks within the City of Ottawa’s *Infill By-laws* are also aimed in part at encouraging the implementation of increased ‘soft’ landscaping and larger-scale vegetation within residential properties (City of Ottawa, 2018h).

Existing municipal efforts to communicate ecosystem-based recommendations to residents vary between the two cities. While Halifax Regional Municipality currently has no active outreach initiatives with residents underway, its *Climate SMART Community Action Guide to Climate Change and Emergency Preparedness* offers general statements for residents to add trees or to “recognize the value of water catchment areas, such as swales, wetlands, streams and ponds” on properties to manage stormwater flows (HRM, 2010, p. 26). The city’s primary method of involvement has been to express support for adaptation-related initiatives among local community-based organizations, including efforts by *Clean Nova Scotia* and *Halifax Diverse* to communicate ecosystem-based stormwater management

measures (Clean Nova Scotia, 2016; Halifax Diverse, 2016), as well as a *Living Shorelines* program administered by the *Ecology Action Centre* that employs vegetative methods to moderate erosion along coastal residential properties (Ecology Action Centre, 2017). A large focus of municipal engagement efforts with residents by the City of Ottawa involves a newly implemented pilot program known as the *Pinecrest Neighbourhood Rain Project*, which is aimed at stimulating greater citizen engagement in ecosystem-based stormwater management in one Ottawa neighbourhood through such measures as an online quiz and questionnaire, workshops and “rainscaping demonstration projects”. While the project emphasizes a main goal of improving water quality by reducing runoff from residential properties to surrounding waterways in the area, the program also promotes recommended activities as helping to reduce flood risk to residences in the neighbourhood (City of Ottawa, 2018e).

Despite these notable efforts, encouraging further citizen activity requires, as a first step, that both cities provide more nuanced information about ecosystem-based adaptation methods that draw more extensively from residents’ varied perceptions of local natures. This type of approach would ideally motivate action by building on residents’ awareness of already-occurring negative impacts to local ecologies from climate change such as those noted by many study participants (e.g. vegetation suffering during drought), and link to residents’ previous lived experience with climate change-related intense weather conditions, as has been suggested by other scholars (Baptiste, 2014; Lo et al., 2017). More generally, it would also bring greater awareness to the broader implications of individual resident actions such as paving over yards not only on local ecological sustainability, but also on the management of neighbourhood stormwater volumes and cooling.

Municipal ecosystem-based adaptation programs could be additionally enhanced by fostering more explicit connections for residents between the management of smaller-scale home site natures and cumulative benefits to wider urban ecosystems. Scholars advocate for measures to enhance local ecologies on private lands in inner-urban areas as part of an overall strategy of ecological connectivity across urban areas, however in practice, these types of strategies are not often undertaken to any great effect (Ahern, 2013; Geneletti & Zardo, 2016; Jim, 2013; Rudd et al., 2002). Regarding urban trees, municipal policy discourses in Ottawa and Halifax offer modest attempts to forge these connections for residents; for example, Halifax Regional Municipality refers to its urban forest as a “comprehensive resource that includes trees on public and private property” requiring management programs that involve “the active participation of citizens” (HRM, 2013, p. 14), while the City of Ottawa notes that management of the urban forest canopy is a “shared responsibility” (City of Ottawa, 2017b, p. 56). Both cities also advocate for greater citizen stewardship of municipal street trees abutting home sites (City of Ottawa, 2017b; HRM, 2013). However, both cities also recognize a requirement for more robust urban forest stewardship programs to forge these connections, and in the case of Ottawa look to examples such as the City of Toronto’s *Neighbourwoods* program with its philosophy that “the neighbourhood is a logical ‘management unit’ and that the private and public trees in the neighbourhood should be managed as a functioning ecosystem” (City of Ottawa, 2017b, p. 124). These types of communication strategies could be further extended by referencing a wider range of contexts for citizen involvement in strengthening neighbourhood-scale greening and adaptability, for example through enhancement of permeable vegetation and/or rain garden technologies within residential sites.

Bolstering strategies to encourage ecosystem-based adaptation action among citizens will also require that municipal agencies appeal to other frames through which residents understand and engage with local natures, beyond provision of technical information on green infrastructure methods or focusing on the “ecosystem services” that urban ecologies provide (Conway, 2016; Wild et al., 2017). Existing policy discourses relating to ecological sustainability and climate change adaptation in Ottawa and Halifax, to a degree, portray local natures through varied frames. Beyond referencing local natures as valued green infrastructure in helping cities adapt to climate change and in contributing to municipal carbon reduction efforts, policy discourses also frame local ecologies as vulnerable to varied climate change-related effects (City of Ottawa, 2006, 2017b; HRM, 2013, 2014); alongside these framings, both cities also present enhancement of the urban forest in particular as a low cost, renewable economic investment that may “realize significant financial returns” in addressing climate change and other urban sustainability concerns (City of Ottawa, 2017b, p. 56; see also HRM, 2013).

A more nuanced approach to engagement with residents would include other values-based adaptation strategies emphasized by scholars, which highlight the complementarity of ecosystem-based adaptation measures with activities that address residents’ stylistic preferences in yards or emotional connections to nearby landscapes (Blaine et al., 2012; Jones & Somper, 2014; Kirkpatrick et al., 2013; Matthews et al., 2015; Ordonez Barona, 2015). An augmented strategy of engagement with residents would also recognize the influence of neighbourhood aesthetic norms on individual action, employ efforts to shift these norms, and encourage “neighbourhood mimicry” towards home site arrangements incorporating more permeable landscaping practices and cooling vegetative effects (for

example, encouraging trends among neighbours for front yard rain gardens) (Goddard et al., 2013, p. 258; Blaine et al., 2012; Chaffin et al., 2016; Derkzen et al., 2015; Iverson Nassauer et al., 2009). The need to employ additional frames through which to motivate citizen action has already been acknowledged by one of the coordinators of the City of Ottawa's *Pinecrest Neighbourhood Rain Project*, who contends that "those of us that are driven by environmental agendas have to get over ourselves and realize that...sometimes the full-on environmental messaging, it can't be the only messaging" (Julia Robinson, personal communication, March 7, 2017). As part of this effort, the *Pinecrest Neighbourhood* program's website communicates ecosystem-based stormwater management opportunities for residents that will "add beauty and value to your property with low maintenance landscaping" (City of Ottawa, 2018f). This diversity of framings has not been as extensively employed within HRM policy and program discourses directed at residents.

Significantly, within these efforts municipalities will also need to respond to residents' anxieties, as well as address potential misconceptions, regarding risk aspects associated with implementing larger-scale vegetation on properties. This may involve offering ecosystem-based adaptation workshops that allow opportunities for residents to ask questions associated with these concerns. These venues would also ideally include education programs for residents related to proactive sizing and spacing strategies for planting that would be tailored to neighbourhood spatial constraints, suitable local species types for planting within constrained areas, and measures for dealing with the realities of regional physical conditions and projected climate change impacts. Pruning education programs for residents could further reduce potential risk to properties from enhancing larger-scale vegetation within home sites.

4.6 Conclusion

This study extends academic literature on social constructions of home site natures in revealing the complex and conflicted perspectives of local ecologies that exist among residents in dealing with a diverse set of existing and potential climate-related hazards, and in highlighting residents' concerns regarding possible risks associated with implementation of some ecosystem-based adaptation measures within dense inner-urban environments. Future research could explore how residents' perceptions of local natures within adaptation contexts may be altered in the event of subsequent intense weather events or gradually intensifying climate conditions (e.g. lengthening summer heat waves) in inner-urban areas. This research theme could also be continued by examining how residents' views regarding the adaptation-potential of home site ecologies may be influenced with the advancement of municipal sustainability/climate change planning and initiatives over time in both cities (for example, with implementation of objectives within the City of Ottawa's *Urban Forest Management Plan* and HRM's *Urban Forest Master Plan*) (City of Ottawa, 2017b; HRM, 2013).

Across the extensive distribution of residential landscapes that comprise urban areas, the frames through which households understand and arrange home site natures has substantial influence on climate change vulnerability and resilience within neighbourhoods and urban ecosystems. A large portion of promising sites for adding (shading or stormwater capturing) trees to the urban forest canopy may be located within private lands in cities, while the dense (and low permeability) turf grass lawn continues to be a prominent feature of many residential lots (M. Copestake, personal communication, April 26, 2017; Robbins & Birkenholtz, 2003). As empirical study in other contexts has demonstrated only modest improvements in neighbourhood stormwater absorptive capacity with current levels of uptake

of ecosystem-based adaptation measures by residents – even among residents that have been informed about stormwater capture benefits (Sun & Hall, 2016) – it is imperative that municipalities consider other motivators for citizen action.

5.1 Introduction

Rainfall and flood events have become more frequent in Canadian cities with the advancement of climate change, with associated costs for municipalities, as well as stress and disruption for residents as basements are deluged or neighbourhoods experience widespread flood damage (Kovacs et al., 2014; Amec Foster Wheeler and Credit Valley Conservation, 2017; Thistlethwaite et al., 2017). Existing urban infrastructure to manage stormwater – the precipitation that falls to the ground and is carried away to local waterways, infiltrates into soil, or accumulates on hard surfaces – is increasingly inadequate in addressing flood risks for municipalities. As the federal and provincial governments in Canada look to set in place “a policy shift [for flood management] that will place more responsibility on homeowners” (Thistlethwaite et al., 2017, p. 1), there exist varied perspectives among residents in Canadian cities regarding the role of citizens in managing stormwater within home sites and residential neighbourhoods (Kovacs et al., 2014; Amec Foster Wheeler and Credit Valley Conservation, 2017). Within the current context of limited government intervention on private lands, citizens hold considerable influence over the flood resilience of homes and residential neighbourhoods through their willingness to implement (or not) recommended home-based stormwater management measures. This situation warrants a more in-depth examination of citizen understandings of their own and others’ responsibilities in managing stormwater and flood risk across residential sites.

There exists a growing climate change scholarship in support of active citizen involvement in programs to deal with climate change impacts in residential neighbourhoods (Stoll-Kleeman et al., 2001; Whitmarsh, 2009; Bichard & Kazmierczak, 2012; Porter et al.,

2014). Regarding specific stormwater management efforts, scholars contend that citizen activity such as adding vegetation or removing hardscaping within residential properties offers both private and public benefits (e.g. individual basement flood protection or strengthened neighbourhood-scale stormwater absorptive capacity), and that individual actions are often substantially more effective in moderating local flood risks when part of a larger combined effort among neighbours (Tompkins & Eakin, 2012; Wamsler & Brink, 2014). These realizations exist alongside a modest body of research that reveals situations of low uptake of stormwater management and other adaptation recommendations among homeowners, in some cases even where there is substantial financial capacity and awareness of intense weather risks (Thistlethwaite et al., 2017; Whitmarsh, 2009). Regarding this concern, scholars advocate for more extensive empirical research to better understand citizen motivations for undertaking or resisting household-scale adaptation activities within diverse contexts (Porter et al., 2014; Wamsler & Brink, 2014).

As municipalities consider the substantial proportion of residential property and other private lands that comprise urban areas, some have moved towards greater co-governance of stormwater management efforts with citizens (Mees et al., 2012; Mees, 2017; Mees et al., 2017; Zidar et al., 2017). Within contemporary neoliberal paradigms, scholars have examined how governments increasingly call on the *self-governing citizen* to undertake action at the scale of the individual home site in response to climate change and other environmental concerns (Brand, 2007; Jeffers, 2014). The academic scholarship exploring citizen responses to this call have examined varied influences among residents in undertaking sustainability or risk mitigation action within home sites, including individual aesthetic or environmental values, neighbourhood norms, or personal experience with intense weather

events (Baptiste et al., 2015; Lim, 2018; Porter et al., 2014; Vaisanen et al., 2016). There has been limited examination to date regarding how residents conceptualize the residential property as a space of individual and collective responsibility for citizen action in relation to environmental impacts and risk across neighbourhoods. Blomley and other scholars have considered how notions of property autonomy and boundaries may be disrupted through the actions of citizens or within dynamic ecological landscapes (Blomley, 2005b, 2008; Guercio, 2013; Milman & Warner, 2016). Discussions within this branch of academic literature gain relevance in the context of evolving physical effects of climate change in cities, where climate change impacts and adaptation activities within individual sites may not always be bounded within property lines across dense urban settlements.

This study extends scholarly discussions of the contested nature of property by examining how the residential site is understood by citizens in adapting to impacts of climate change – specifically, stormwater flows from intense rain – in urban areas. Given that municipal governments increasingly promote self-governing measures by residents in response to environmental issues and risk, this research explores how residents situate responsibility for managing stormwater and reducing flood risk to home sites and surrounding neighbourhoods, as well as how these impressions reflect underlying understandings among residents of property boundaries, autonomy and connectedness. This study focuses on the management of permeable land across inner-urban neighbourhood spaces.

This research draws from a comparative case study of resident perspectives in Ottawa and Halifax, and employs qualitative methods of discourse analysis to assess residents' views. Gathering of primary data was focused on the perspectives of residents living within

central neighbourhoods in each city, to assess how residents from densely-developed inner-urban areas view flood risk and opportunities for home-based stormwater management in relation to their own and neighbouring (and frequently quite proximal) residential sites. Halifax study neighbourhoods include North End, South End, Bedford, Fairview-Clayton Park and Spryfield. Ottawa study neighbourhoods include Old Ottawa East, Old Ottawa South, Riverside South, Centretown and Alta Vista. Maps of the study neighbourhoods may be found in Chapter 2. Primary data was gathered from 47 residents (22 Halifax residents; 25 Ottawa residents), through their completion of an initial survey and/or participation in semi-structured interview/focus group sessions held between 2015-2017. The survey was designed to assess residents' general awareness around issues such as climate change impacts and risk in each city, and included questions regarding how participants accord responsibility among residents and municipal government for adapting residential properties to these effects. Interview/focus group sessions allowed residents to expand on survey responses, and provided additional information for residents and opportunities for discussion about suggested home-based adaptation measures, municipal adaptation/environmental initiatives and neighbourhood-scale climate change impacts. Specific concerns related to neighbourhood stormwater management were repeatedly mentioned by residents within surveys and during interview/focus group sessions.

To broaden the scope of resident perspectives analysed in each city, resident comments in secondary data – including municipal public consultations and committee meetings, media accounts, and records from federal climate change town halls held in Ottawa and Halifax – were also reviewed. This data offered extended insights regarding residents' concerns about flood risk within a climate change context, and included residents' responses

to specific municipal stormwater management initiatives in areas outside of the study neighbourhoods (e.g. the City of Ottawa's *Stewart Street Greening Project* involving rain garden installations along residential streets). In addition, municipal policy documents related to climate change and stormwater management were reviewed, and 12 municipal officials (six representatives from each city) were interviewed, to better situate resident perspectives on flood risk management within the context of municipal climate change/stormwater management policy.

This research revealed several key findings. In keeping with other scholarly examinations of property as unsettled or fluid, discourses of responsibility for stormwater management reveal multiple understandings of residential sites among residents in Ottawa and Halifax, as alternately autonomous and linked to flood vulnerability and resilience across neighbouring home sites and abutting municipal lands. While study participants were often willing to take on a role of *self-governing citizen* to help manage neighbourhood stormwater within individual home sites, they also ascribed responsibility to activities among existing neighbours and larger municipal efforts. In addition, some residents expressed frustration about the actions of urban private development interests, perceived as *free-riders* that consume disproportionate amounts of permeable land and negatively impact flood resilience across neighbourhoods (and correspondingly reducing motivation among some residents to take action on their own properties). In general, efforts to encourage greater stormwater management activity among residents in increasingly densified inner-urban areas will require that municipalities better acknowledge citizen understandings of linked flood vulnerability and resilience within neighbourhoods, account for inconsistencies between lot-level

stormwater management and intensive development policy objectives, and apply greater controls on developer proposals for large-footprint infill projects in these areas.

The following section of this chapter, Section 5.2, contains a survey of the academic literature relating to varied frames through which individuals attribute and contextualize responsibility for action toward climate change and other environmental risk for home sites. Section 5.3 provides detail on stormwater management policy in Ottawa and Halifax, focusing on initiatives directed at lot-level flood mitigation activity by citizens in residential neighbourhoods. Sections 5.4 and 5.5 lay out detailed study findings and analysis, revealing diverse reasoning among residents regarding perceived individual, municipal and neighbour obligations for adapting home sites to increasing rainfall within a larger context of urban residential development. Section 5.6 offers concluding comments and suggestions for further research.

5.2 Home sites, climate change, and responses to environmental risk

The disaster, environmental and climate change literatures reveal a diversity of perspectives among citizens regarding responsibility for managing environmental sustainability and hazards in residential neighbourhoods. Scholars have examined situations in which residents actively take responsibility in mitigating risk to home sites and personal property in intense climate conditions, through measures such as thinning vegetation around home structures in drought- and wildfire-prone areas, implementing green infrastructure measures (e.g. planting trees, installing rain gardens) for improved lot-level stormwater management, or purchasing home disaster (e.g. flood) insurance (Baptiste et al., 2015; Goemans & Ballamingie, 2013; Lo, 2013; Ryan, 2010). Within the context of homes situated at the wildland-urban interface, McCaffrey et al. (2011, p. 485) reveal how residents perceive mitigation of local fire risk to

be “an internal household matter”. The empirical literature suggests that the degree to which residents are motivated to undertake individual risk-mitigation activities within home sites may be influenced by a variety of factors (beyond the resources to act, or home ownership/decision-making control), including household experience with extreme weather and sense of risk to personal safety or property (e.g. in situations of intense rain causing local flooding, or neighbourhood proximity to previous wildfire events) (Baptiste et al., 2015; Porter et al., 2014; Vaisanen et al., 2016). Other scholars note that residents are more likely to implement actions to adapt to climate change effects when these align with personal aesthetic preferences, or when nearby neighbours have applied similar measures (e.g. installing rain barrels or rain gardens to deal with intense precipitation events) (Baptiste et al., 2015; Lim, 2018).

Scholars have also demonstrated how citizen activities to adapt to climate change impacts may take the form of “reactive coping responses”, or involve lower cost, small-scale and easily implemented measures (e.g. opening windows to deal with intense heat, ensuring stormwater drains remain free of debris during intense rainfall events) (Porter et al., 2014, p. 373; Milman & Warner, 2016). This inclination to apply less onerous or costly measures has also been observed in relation to suggested home-based climate change mitigation (i.e. carbon reduction) measures (Whitmarsh, 2009); in addition, individuals may be more likely to undertake mitigation actions when they perceive that they or their loved ones could be directly affected by climate change, when actions align with personal environmental values, or when they believe individual actions would effectively contribute to wider-scale carbon reduction measures (Brody et al., 2012). In a similar vein, scholarship related to home site adaptation action has demonstrated how citizens understand individual measures to reduce

environmental hazard as part of a larger communal approach across communities, and participate when they believe their actions will produce substantive results or involve limited risk or costs (Mees et al., 2017; Tompkins & Eakin, 2012).

Scholars have also considered how residents are motivated to implement lot-level risk mitigation measures when supports in the form of public education or incentive programs are made available by local governments (Lim, 2018; Zidar et al., 2017), though Head (2010, p. 237) also cautions that in this context, “it is necessary to forestall framings that envisage too straightforward a link between public education and behavioural change”. This arrangement corresponds with neoliberal forms of governance that aim to engage with the *self-governing citizen* in addressing environmental concerns (Rutland & Aylett, 2008). Brand (2007, p. 626) associates this concept with “the idea of the citizen as an agent enmeshed into the processes of social change” under which “all citizens acquire a certain autonomy and with it, responsibility”. This situation also reflects a wider ‘governmentality’, as originally conceptualized by Foucault (1991), through which institutions discipline society and manage knowledge (Hajer & Versteeg, 2005; Oels, 2013). Rutland and Aylett (2008, p. 630) describe Foucault’s concept as a form of “self-policing” that is “put in place by creating a congruence between the interests of the state and the interests of the family, group, or individual”. Foucault notes that governmentality often operates through subtle and/or diffuse exercises of power, incorporating other forms of intervention beyond regulation such as capital market arrangements and incentives. This strategy may be applied within diverse environments. For example, within a climate change mitigation (i.e. emissions reduction) context, Braun (2014) suggests how the actions of citizens are subtly managed by a car’s fuel consumption meter, in manipulating immediate environments in ways that suggest particular moral guidelines;

management occurs in the form of continuous ‘feedback’ that influences a series of voluntary actions on the part of the individual within a setting where “nobody is watching” (Braun, 2014, p. 54).

Within climate change contexts, governments may allocate responsibility to citizens for reducing individual carbon footprints by offering community-scale guidance and resources, for example neatly managing the ‘carbon-relevant citizen’ (Rice, 2010, p. 930) by suggesting specific technological solutions (such as home energy efficiency measures) while neglecting other options (reducing house sizes or participating in the sharing economy) that conflict with the contemporary growth paradigm in cities (Rutland & Aylett, 2008; Rice, 2010). Prescribed actions by public agencies may not align with citizens’ preferred activities, particularly if they involve financial sacrifice (e.g. purchasing fuel-efficient cars or furnaces to reduce household greenhouse gas emissions). Or residents may be expected to act even as they lack the knowledge or financial capacity to implement recommended measures (e.g. implementing rain gardens within home landscaping) (Nalau et al., 2015; Wamsler & Brink, 2014; Whitmarsh, 2009).

Related literature has examined how citizens may instead expect that governments play a predominant role in managing environmental issues in residential neighbourhoods. For example, empirical study has demonstrated how residents ascribe direct responsibility to governments to fund and maintain wider-scale infrastructure supports as a “public good” in adjusting to climate change impacts or dealing with other environmental concerns (Derkzen et al., 2017, p. 115), or resist incurring personal costs to manage seemingly random risks and impacts occurring over broad urban scales (Winter & Fried, 2000; Bichard & Kazmierczak, 2012). Scholars have also shown how residents recognize personal responsibility for

reducing risk within home sites as participants within a larger social contract, wherein governments provide more general protective measures in the form of municipal hazard mitigation infrastructure, planning controls (e.g. restricted floodplain development), and emergency management, while residents choose from suggested home-based resilience measures such as installing protective technologies or purchasing flood insurance or (Adger et al., 2013, 2016; McCaffrey et al., 2011; Winter & Fried, 2000).

Examinations of citizen perceptions of responsibility for managing home site climate-related risk links to more general scholarly explorations of how the residential property space is understood. Within several studies of citizen activities in residential neighbourhoods, Blomley (2005b; 2005c) explores the concept of *property* as a social construct, subject to diverse representations by individuals and governments. In reference to typical perceptions within contemporary society of private lands as enclosed, autonomous and “produc[ing] a highly individuated self, anxious of others” (Blomley, 2005a, p. 293), Blomley advocates for a deeper critical reflection on the “varied and inventive ways in which property actually gets put to work in the world” (Blomley, 2005b, p. 127), including ways in which individuals enact property beyond home site boundaries. By showcasing modest activities by citizens such as extending the home site front garden onto the public boulevard, Blomley offers contexts in which “the meaning and location of property’s spatial divisions can be open to conversation, ambiguity and nuance” (Blomley, 2005a, p. 282; 2005c). He also suggests these types of activities blur boundaries between private and shared space, eliciting complex responses of support or resistance among other residents that reflect differing perspectives regarding communal access to neighbourhood amenities, community aesthetic/social norms and responsibilities to neighbours, and respect for individual expression (Blomley, 2005a;

2005c). Significantly (as relates to this current study), Blomley also applies this conceptualization of “fluid” property spaces in challenging imposed boundaries on elements of the ecological landscape (e.g. rivers), where physical elements continually shift, transform, and incorporate essentially indistinct edges (Blomley, 2008; see also Scott, 1998; Steinberg, 1995).

Regarding understandings of property within the context of broad-scale environmental conservation initiatives, other scholars have demonstrated how efforts that require the involvement of citizens across residential sites face resistance stemming from entrenched notions of individual property rights, at times devolving into conflicts between species/habitat preservation and development freedoms (Feldman & Jonas, 2000; Pincetl, 2006). Within other environmental initiatives (e.g. efforts toward stricter lawn pesticide legislation), where individual autonomy is usurped in favour of a perceived greater public good (healthier lawn ecologies and cleaner water supply), Sandberg and Foster (2005, p. 483) suggest that those opposed to these measures make their case by citing “the sovereignty of homeowners with property rights as the ultimate decision makers”. Overall, these conflicts reflect multiple perspectives among citizens and governments regarding how understandings of the residential property should be enacted, drawing from differing environmental, aesthetic and livelihood values.

In recent years, scholars have contemplated how climate change complicates traditional notions of bounded and autonomous property. Within this focus, scholars have considered the far-reaching consequences on other vulnerable populations of individual choices made within home sites to implement or resist carbon footprint reduction measures within a global carbon emissions context (Adler, 2009; Babie, 2010). They have also

explored how property boundaries may be obscured by impacts of climate change (e.g. among homes along coastlines eroding from sea level rise) (Guercio, 2013), and how individual property rights intersect with adaptation efforts across connected residential sites – for example, in the case of sea level rise, regarding the environmental/security implications of diverse applications of vegetative⁶⁶ versus structural methods of coastline erosion control across properties; or within ethical considerations regarding the forced relocation of entire settlements (Lo, 2014; Titus, 1998). Other scholars have explored how boundaries may be blurred between private adaptation activities and public benefits, as for example where residents are called upon to act within home site spaces (e.g. permit flooding or alter the flow of rivers near individual residences) to protect other properties downstream (Milman & Warner, 2016; Tompkins & Eakin, 2012). Individuals may take on significant risk and costs in implementing adaptation strategies that rely on concerted action across home sites to be fully effective, where beneficial impacts within the originating home site are not guaranteed, and within a climate of uncertainty regarding the degree to which projected hazards to residents will fully materialize. Within this context, residents may take on increased risk as long as others are also doing so, or resist, citing private property rights (Milman & Warner, 2016).

Building on several aspects highlighted within the literature presented in this section, this current study explores influences on citizen motivations for home-based action in dealing with climate-related risks, beyond themes related to individual values, experience with hazard, or receptivity to neighbourhood norms that have commonly been explored within

⁶⁶ One example of vegetative methods of coastal erosion control is found within the *Living Shorelines* initiative organized by the Halifax-based organization *Ecology Action Centre*, where plant cover, biomass and reduced slope grades have been applied to help stabilize various coastal sites around Nova Scotia (Ecology Action Centre, 2017). Information about this initiative may be found at <https://ecologyaction.ca/livingshorelines>.

previous scholarship. This study presents a novel frame of analysis regarding how urban residents situate their own and others' responsibilities in adapting home sites to changing climate conditions, through a deeper examination of ways in which residents envisage residential property and boundaries within the context of home site flood resilience and the management of neighbourhood stormwater flows. The focus of this study on resident perspectives from inner-urban areas sheds additional light on how residents attribute risk and responsibility within densified urban environments.

5.3 Stormwater management policy in Ottawa and Halifax

Municipal policy discourses from the City of Ottawa and Halifax Regional Municipality (HRM) refer to the management of stormwater from increased rainfall events as an increasing priority in dealing with anticipated climate change impacts (City of Ottawa, 2006; 2013b; HRM, 2014; 2017). Though the two cities experience some substantially differing physical conditions in relation to climate change – for example, the exposure of Halifax to sea level rise, hurricanes and storm surges due to its coastal location, versus Ottawa's comparatively drier inland climate – they both face a projected greater incidence of intense precipitation events over the coming decades (Province of Nova Scotia, 2017; Province of Ontario, 2015).⁶⁷ Both cities position municipal-scale stormwater drainage systems (e.g. main sewer lines, overland flow routes) as significant lines of defence in reducing flood risk to residential neighbourhoods from intense rain (Kovacs et al., 2014; HRM, 2017). The City of Ottawa has been more active in maintenance of stormwater infrastructure than HRM; while the City of Ottawa's *Infrastructure Master Plan* lists several recent retrofits that have

⁶⁷ A discussion of current and projected climate change impacts in Ottawa and Halifax may be found in Chapter 1.

been undertaken to storage tanks in existing residential neighbourhoods, as well as several stormwater management retrofit master plans underway across the city, HRM acknowledges that the municipality will undertake these types of activities in designated priority areas only when funds allow (City of Ottawa, 2013; HRM, 2017).

In recent years, both cities have placed greater emphasis on the potential for lot-level *low impact development* (LID) measures⁶⁸ (e.g. planting trees or installing rain gardens to absorb stormwater where it falls) to reduce strain on traditional municipal-scale stormwater drainage technologies (City of Ottawa, 2013; HRM, 2017). In addition, municipal stormwater management activity is also increasingly focused on neighbourhood-scale measures that are situated at the edges of residential properties. For example, the City of Ottawa has recently undertaken a series of ‘green street’ pilot projects toward this effort, incorporating varied LID measures including tree plantings and permeable rain garden installations to capture rainwater along municipal rights-of-way and residential street medians (City of Ottawa, 2016a). HRM is implementing a targeted tree planting program along residential streets in several priority inner-urban neighbourhoods, with a goal in part of strengthening vegetative stormwater absorptive capacity in these areas (HRM, 2013).

Alongside the promotion of municipal stormwater management measures, the City of Ottawa and HRM increasingly exert a role for citizen activity within home sites in strengthening individual and collective flood mitigation and stormwater absorptive capacity in residential neighbourhoods. Both cities apply some limited regulatory controls, and engage residents through modest public education and incentive programs, with the intention

⁶⁸ The City of Ottawa describes low-impact development (LID) measures as including “‘lot-level [stormwater] controls’ in the form of green roofs, rain gardens, and pervious pavers on individual properties, as well as bioretention facilities within right-of-way boulevards” (City of Ottawa, 2013, p. 117).

of expanding citizen stormwater management activity. Regarding regulatory measures for residents, the City of Ottawa requires that backflow valves be installed in the construction of new dwellings to reduce basement flood risk during intense rainfall events (City of Ottawa, 2018i; Kovacs et al., 2014). HRM's *Inflow and Infiltration Reduction* (formerly *Stormwater Inflow Reduction*) Program is aimed at reducing stormwater discharge from residential properties into the municipal wastewater system; residents are required to fix leakages in or disconnect home downspouts from wastewater piping with a threat of "suspension of service and/or other penalties" for property owners that do not take action (Halifax Water, 2017, July 18).

Efforts to educate residents about opportunities for managing stormwater within home sites are communicated in part through a series of stormwater management pages directed at residents on municipal websites in both cities (City of Ottawa, 2018d&e; Halifax Water, 2017, November 22; Halifax Water, 2018, February 28b). Suggested measures include the application of basement flood protection technologies (e.g. backwater valves), enhancement of home site vegetation and reduction of hardscaping, as well as other measures of stormwater capture such as rain barrels or green roofs. The City of Ottawa is also currently testing a neighbourhood-scale outreach approach to engaging residents in lot-level stormwater management activities. Its *Pinecrest Neighbourhood Rain Project* pilot encourages resident participation through various approaches including workshops, demonstration projects and a questionnaire, to instruct residents on such topics as rain garden installation and proper downspout placement. The project's website highlights the cumulative effects of individual action for residents, suggesting that "we all play a part in reducing the harmful effects of stormwater", and that "simple actions...can make a real

difference, especially when many people do them” (City of Ottawa, 2018e). Interestingly, education programs in both cities reference the protection of water quality in local waterways as a main rationale for encouraging home site stormwater management measures, often prior to mention of reducing flood risk to homes (City of Ottawa, 2013; Halifax Water, 2017, November 22). Halifax Regional Municipality does not currently employ any program of direct engagement with residents, however, the municipality has expressed support for a range of efforts by local organizations such as *Clean Nova Scotia*, *Halifax Diverse*, and the *Ecology Action Centre*, which have effectively offered stormwater management guidance for residents at the individual lot level (Clean Nova Scotia, 2016; Ecology Action Centre, 2014; Halifax Diverse, 2016).

Both cities also employ financial incentives to stimulate residential stormwater management action. The City of Ottawa’s *Residential Protective Plumbing Program* offers full subsidies for actions such as backwater valve or sump pump installations in homes that have experienced previous rain-related flooding events, and 50% subsidies for homes deemed “high risk areas” for future flooding (City of Ottawa, 2018d; Kovacs et al., 2014). Halifax Water (the agency responsible for water distribution in HRM) applies financial incentives for increased permeability within home sites through opportunities for reduced stormwater fees for residents; its *Site Related Flow Charge* applied to water billing for residents is calculated proportional to the impervious area within residential properties within a set of five tiered rate levels, from no fee for properties with under 50 square metres of impervious area to a maximum of 81 dollars for properties with 810 square metres of impervious area or above (Halifax Water, 2017, November 22; Halifax Water, 2018, February 28a). This fee system is promoted by Halifax Water as an effort that is “leading the

industry in standards with respect to methods to provide precision in terms of measurement of impervious area in relation to billing” (Halifax Water, 2017, November 22).

5.4 Citizen perspectives: Situating responsibility for managing stormwater in residential neighbourhoods

The citizen perspectives examined within this study reveal a diverse situating of responsibility among residents for managing local stormwater and flood risk within and beyond the home site. Regarding climate change adaptation action in general, residents in both cities frequently acknowledged some share in responsibility for mitigating risk to home sites and residential neighbourhoods from climate change effects such as intense rain, with one Halifax resident noting in this respect that “we have all cooperated in getting ourselves to this point” (HAL-SRV15). Several residents commented that they viewed adaptation action as an integral part of responsible homeownership and as helping to preserve a valuable home asset, though as one Ottawa resident suggested, actions taken should not need to “extend beyond the personal finances or interests of the resident” (OTT-SRV1). In general, residents were often willing to take on stormwater management measures that were not overly onerous or cost-prohibitive, and prioritized intended actions according to their effectiveness in reducing flood risk to properties (for example, often supporting installation of backwater valves as a relatively cost-efficient and effective measure in reducing basement flood risk). Conversely, other residents stated they held no or very limited responsibility in undertaking adaptation activities to protect home sites; interestingly, one Halifax resident stated that measures should only be undertaken “insofar as lack of action will adversely affect surrounding properties”, and additionally suggested that, “regarding damage to their own properties, that is up to [residents] to deal with as they see fit” (HAL-SRV9). Despite their

own hesitancy to implement protective measures, one Ottawa resident additionally contended that “homeowners shouldn't receive compensation or insurance if they did not implement changes that would have increased their resilience” (OTT-SRV16).

Among residents that asserted some personal responsibility in strengthening resilience to climate change within home sites, many noted that significant adaptation action (including stormwater management action) would require better municipal supports, including more substantive public education or incentive programs. While several residents suggested that adaptation education and assistance from government had been insufficient to date, some also referenced the effectiveness of other environmental incentive measures such as energy efficiency rebates and plastic bag discount programs as models by which municipalities could encourage environmental (in this case, adaptation) action among residents. Several residents suggested that municipalities provide more meaningful guidance in dealing with climate change impacts by demonstrating adaptation efforts within their own organizational activities – for example, by installing green roofs or rain barrels at municipal buildings. Regarding a perceived lack of easy access to municipal information on potential adaptation measures for residents, one Ottawa resident commented:

I think of myself as a fairly well-informed person, but I don't know about [adaptation information for residents from municipal sources]. So, what's the problem there? It's very passive, like I think we wait for people to go get [information], so I don't know how to address that... It's a lot of onus on individuals, property owners, and they're not hiding the information, but you have to go get it. (OTT-FG9)

Regarding financial incentives to assist in reducing home site flood risk, many residents provided suggestions or indicated some interest regarding subsidies for household-scale stormwater management technologies (e.g. basement backwater valves or sump pumps) or tree planting, or for property tax credits proportional to residential permeable surface area.

Some study participants noted that they didn't anticipate that others would be interested in undertaking stormwater management activities such as enhancing home site vegetation without some form of financial incentive:

I would think, I myself would be willing to modify my yard....But mostly around my neighbourhood, those people would be in a minority who would be willing to change...putting in trees and things like that. There would have to be something in it for them, to get them to move in that direction. (HAL-FG11)

I think the only way they can get people on board is basically to have your insurance be dependent on it. Because everybody wants to say, 'yeah, yeah, I'm all for it', and this and that, and then they turn around and go off in their car, and totally have forgotten about it.... So, I think I mean it's a wonderful idea...that they're coming up with ways to do it, but they're not making people do it. (HAL-FG16)

Many residents indicated that individual responsibility for stormwater management also applied to the activities of neighbours, as part of collective efforts residents perceived as necessary to ensure flood resilience across neighbourhoods. Several residents spoke about previous occurrences of pooling water around their own home sites that they assumed to have resulted from activities on neighbouring properties, for example from neighbours increasing yard hardscaping or through inappropriate grading. As one resident commented about a perceived lack of awareness among neighbours regarding detrimental impacts of impermeable landscaping on neighbourhood flood resilience, "[It] drives me crazy... people don't think about it. I bet if you asked someone, they would tell you you should pave your house because you want to direct the water away" (OTT-FG10). Some residents expressed an associated desire for greater municipal controls on resident activities (e.g. extensive home renovations) that reduced collective neighbourhood stormwater absorptive capacity.

In addition to their support for individual action within home sites, several residents expressed interest in participating in collaborative adaptation efforts among neighbours to further bolster neighbourhood flood resilience. For one Halifax resident, this interest came out of a sense of “obligation to think about the small actions we take and the impact it has on our community” (HAL-FG2). Others referenced previous positive experiences of neighbours rallying together in support of other community initiatives, or an interest in stimulating positive peer pressure among neighbours. As one Halifax resident noted,

You hope that if enough people would make some changes, it would make a big enough change to make a difference, right? And maybe there’s a campaign where it says ‘hey, I just did this’ on Facebook or something, ‘you should do it too’... I’d definitely be willing to, you know, participate in something like that. (HAL-FG11)

As many residents acknowledged some required involvement in undertaking individual stormwater management measures, they also frequently situated responsibility for reducing neighbourhood flood risk within larger-scale municipal stormwater management strategies. Several study participants spoke of a need for better maintenance of city-wide drainage infrastructure or for improving stormwater absorptive capacity on public lands surrounding residential neighbourhoods, through such measures as drainage piping upgrades, enhanced flood protection along local waterways or increased planting within neighbouring greenspaces or forests. Some of these residents also commented that individual flood mitigation efforts would be ineffective in the absence of wider government intervention. Alongside these concerns, Ottawa and Halifax residents have often responded positively to initiatives that encourage residents to help maintain vegetation enhancement initiatives aimed in part at increasing permeability and managing stormwater on municipal lands abutting

home sites, including tree planting programs within front yard rights-of-way, and rain garden projects along residential streets⁶⁹ (City of Ottawa, 2017a&b; HRM, 2013).

Significantly, residents often shifted sites of responsibility for dealing with stormwater and flood risk to development projects taking place in each city. Residents frequently commented that they associated urban development projects with substantial increases in hard surfacing and building footprints within neighbourhoods, that combined with tree losses were perceived to significantly reduce neighbourhood permeability and associated stormwater absorptive capacity. Residents voiced a corresponding anxiety regarding the effects of urban development on the adaptive capacity of cities in general, including concerns about the negative effects of clearcutting for new development noted by residents in both cities, and by Halifax residents about exposure of continued shoreline development to sea level rise. One Halifax resident also expressed concern about impacts of development on the resilience of the urban forest, stating, “I have been discouraged to see some developers going in and bulldozing everything down, and start with a blank slate. And then they have got homes, and then 40 years later they’ve got a value tree” (HAL-FG14). In general, study participants expressed recurring concern about excessive profit-making among private development interests that residents perceived to be taking place at the expense of neighbourhood adaptive capacity, as well as about an assumed complacency on the part of municipal planning agencies regarding potential detrimental impacts of private development in preference to generating municipal tax revenue. As one Ottawa resident suggested in summing up this concern, “developers rule this city, not the people” (OTT-SRV4).

⁶⁹ One municipal representative in Ottawa commented that some residents have been resistant to street rain garden projects due to concerns about reduced street parking (D. Conway, personal communication, January 12, 2017).

Among Ottawa study participants, these types of concerns were often linked more directly by residents to infill residential development taking place within their own immediate neighbourhood areas. As one Ottawa resident expressed, “It kills me every time somebody buys a house our size, they rip it down, they put in a giant house and they take every inch of space, and all the trees go down” (OTT-FG13). Ottawa residents repeatedly voiced frustration in attributing the proliferation of larger-footprint infill development within local neighbourhoods to a lax municipal planning approvals process. Some residents also expressed specific concern about recent by-law approval in Ottawa for the construction of coach houses within established residential neighbourhoods, noting anxieties about potential associated stresses on existing stormwater infrastructure and expanding proportions of building footprints/hard surfaces within lots.

In both cities, residents also described what they considered to be limited municipal controls on larger development projects in general, and asserted a requirement for municipalities to exert more stringent control over development through strengthened and pro-active design criteria and planning reviews. One Halifax resident expressed cynicism about current planning restrictions by suggesting that overall, “If it’s economical to get this money from the developers, then [the City will] do it, find a loophole, or find a way around it” (HAL-FG2). Regarding limits to urban forest protection within City of Ottawa legislation (and concerns about associated effects on neighbourhood stormwater adaptive capacity), one Ottawa resident commented,

There's supposed to be a rule about not tearing down a mature tree. But apparently that goes right out the window, if you're building a bigger house where another house was. Because that happens. If you live in this neighborhood you see it everywhere. So how come that tree is sacred unless a builder is coming in and building a gigantic house? That took all your permeable land away and killed your trees...I think the city is just a little bit

more crazed about building bigger places and putting more houses in and not thinking about, well don't do that. (OTT-FG13)

Relating to these concerns about neighbouring development activities, some residents commented on a perceived futility of individual stormwater management action, as they witnessed what they considered to be short-sighted measures on the part of planning agencies or neighbours that contravened recommended stormwater management practice. As one Halifax resident suggested,

I'm not sure how much our city planners take into account any kind of climate change. I know that the urban foresters are maybe moving forward in that direction, but some of the other things... [within new development] the water just runs off because it's all asphalt, for miles and miles on end. So, I don't know how much that I as a resident can do to think about the future when my city planners, or our city planners, are not really working on that. (HAL-FG2)

5.5 Discussion

Self-governing strategies for residents in managing urban concerns have elicited notes of caution from various scholars – referencing, among other things, the limited resources and capacity of residents to participate in these types of efforts, potential negative impacts on neighbourhood resilience from reduced municipal service/infrastructure provision, or ethical questions surrounding excessive municipal downloading to citizens in managing public concerns without adequate consideration of other systemic issues (Brand, 2007; Edwards & Bulkeley, 2017; Rutland & Aylett, 2008). This discussion has taken place while other scholars have recognized a potential in building on increasing citizen awareness of and interest in contributing to local environmental issues within the vast proportion of private lands existing within cities (Whitmarsh, 2009; Bichard & Kazmierczak, 2012; Porter et al., 2014).

The resident perspectives explored within this research largely reflect the views of individuals living in the inner-urban Ottawa and Halifax neighbourhoods where primary data was gathered for this study. Many of these residents have witnessed significant growth and change from urban intensification that has taken place in both cities over the last several decades, and their comments – particularly among Ottawa residents – often reflected concerns held about impacts of these changes on local stormwater management. Responses from these residents, in addition to insights drawn from secondary data (which comprises comments from residents with an assumed interest in local environmental initiatives and issues, as demonstrated in their participation in public consultations relating to urban forestry plans, municipal green infrastructure projects and climate change), reveal that many residents are increasingly cognizant of intense rain events in each city⁷⁰, are considering the causes of local flooding (mostly minor events occurring to date) around home sites, and are interested in learning more about suggested practices for stormwater management. Overall, residents display multi-faceted understandings regarding individual and wider-scale flood resilience and responsibilities for stormwater management action.

In their willingness to consider investing in lot-level stormwater management actions such as planting trees, reducing hard surfaces or installing backwater valves to strengthen flood resilience within their own home sites, many of these residents embrace – within limits – the role of self-governing citizen within a neoliberal model of climate change governance, if financial incentives and guidance are made available by governments. This result corresponds with findings from other empirical research on resident responses to suggested home site stormwater and flood management practices (Lim, 2018; Thistlethwaite et al.,

⁷⁰ A detailed discussion of Ottawa and Halifax residents' awareness of local climate change impacts such as intense rain may be found in Chapter 3.

2017; Zidar et al., 2017), and reflects the influence of continuing trends among North American municipalities over the last several decades toward allocating greater shares of responsibility to individual citizens in dealing with common environmental issues and risk. Several study participants also commented that individual stormwater management action should be reinforced by wider municipal stormwater management infrastructure and activity beyond the edges of properties (e.g. boulevard tree planting or rain gardens) or at wider scales; this corresponds with studies from other contexts where perceived social contracts between residents and government serve as incentives for individual action to mitigate property-level climate-related hazards (e.g. wildfire) (Moritz & Stephens, 2008), or where individuals display reduced motivation to undertake adaptation activities when associated government involvement in adaptation measures is perceived as insufficient (Bichard & Kazmierczak, 2012).

Even as residents assert some responsibility in taking individual action to mitigate flood risk within home sites, these study findings reveal that residents simultaneously shift sites of responsibility for neighbourhood stormwater management to the actions of other homeowners on neighbouring properties, and significantly, express pronounced concern about the influence of new development projects taking place in each city on urban stormwater management efforts in general. More specifically, Ottawa residents hold considerable anxiety regarding the impacts of more immediate residential infill development projects on collective stormwater absorptive capacity within their own neighbourhoods. Within this context, residents indicate perceptions of development interests as *free-riders* that benefit from residents' actions (e.g. suitable grading around/between homes and maintenance of permeable landscaping measures), while placing neighbourhood stormwater management

and flood mitigation potential at risk through inappropriate and over-scaled development activities.

Climate change scholarship has typically examined how free-riders are perceived at broader scales within carbon emissions reduction efforts, in the form of states within a global ‘commons’⁷¹ of carbon emitters that opt out of emissions reductions agreements while benefitting from the actions of other states to reduce their carbon footprints (Althor et al., 2016; Bodnar & Salathe, 2012; Raihani & Aitken, 2011). Within this context, scholars suggest various measures to deal with the free-rider challenge, including sanctions on large emitters or the advancement of co-operative transnational carbon footprint reduction regimes (Stewart et al., 2013; Vasconcelos et al., 2013; Wang & Chen, 2013). The limited scholarship referencing free-rider concerns at the scale of the home site in the climate change literature addresses such issues as resistance among residents to undertaking individual home-scale carbon footprint reduction activities in light of others’ perceived inaction (Lorenzoni et al., 2007; Ockwell et al., 2009), or rural land-use policy concerns (with no focus on citizen perspectives) relating to alternating risks and benefits for coastal farm property owners from participation/non-participation in controlled flooding projects along nearby waterways (Agthe et al., 2000). This current study advances scholarship in highlighting citizen free-rider concerns, specifically within inner-urban and increasingly densified residential neighbourhoods, that are directed at redevelopment interests within the context of climate change adaptation, collective stormwater management and the distribution of existing neighbourhood-scale permeable space.

⁷¹ Tompkins and Eakin (2012, p. 4) distinguish shared climate change adaptation (in this case, flood mitigation) efforts from common property contexts in stating that, “unlike common property resources, the benefits gained from private action are non-rival. Second the benefits are non-excludable – they accrue to anyone living in or near the area where adaptation outcomes are realized.”

Several study participants indicated that they attributed the spread of inappropriate development to municipal planning practices that continually accommodate significant building footprints, extensive hard surfacing and tree removal within development approvals for modest-sized residential lots. This response reflects a wider cynicism among residents regarding private development influence on municipal governments in the context of ‘compact city’ and other related sustainability policy involving densification in many cities, where “in practice the purported sustainable aspects of intensification are often difficult to discern, while the dominant pattern of growth characteristic of a market economy remains undisrupted” (Leffers & Ballamingie, 2013, p. 134; see also Ruming, 2014). The focus of this current study on perceived impacts of development on neighbourhood stormwater management potential extends the scholarly literature relating to resident concerns about development, where other academic literature has typically noted opposition stemming from such concerns as perceived threats to the familiar character of nearby places, local business and community liveability (Curic & Bunting, 2006; Farris, 2001; Leffers & Ballamingie, 2013); concerns about potential negative effects on property values for existing residents (though opposition may also be present in cases of property value increase); anxiety surrounding the social impacts of gentrification relating to population diversity, equity and displacement (Dale & Newman, 2009); resistance to the removal of valued trees or greenspace (with concerns not relating to stormwater management); and other environmental concerns about development related to altered local species diversity or ecosystem services (e.g. air and water quality) (Dale & Sparkes, 2008; Hamilton & Curran, 2013).

Overall, this study reveals complex frames through which residents conceptualize the residential property, through the diverse rationales they employ to situate responsibility for

stormwater management action in residential neighbourhoods. Within this study context, residents frequently perceive the home site as an autonomous space within which – as self-governing citizens – they may choose to implement (or not) varied adaptation options according to personal priorities set around cost, convenience, responsible home ownership or maintenance of property values. At the same time, residents also often understand individual stormwater management activity within home sites as somewhat accountable to larger combined efforts among neighbours (in combination with wider-scale municipal efforts/infrastructure) to reduce flood risk across neighbourhoods. In some cases, residents are additionally willing to take part in maintaining municipal stormwater management measures across home site boundaries (for example, by caring for trees on front yard boulevards or rain gardens along nearby streets). Conversely, intensive new private development free-rider activity that significantly reduces permeability within neighbouring properties, along with other hardscaping actions by existing neighbours, are perceived as disrupting stormwater management and climate change adaptation potential more broadly across connected home site spaces.

These findings correspond with scholarly assertions that concepts of property and property boundaries may be fluid and unfixed. As he demonstrates how the act of domestic gardening extends home boundaries into other (in this case, public) spaces (Blomley, 2005a; 2005c), Blomley's notion of "boundary crossing" is enacted where Ottawa and Halifax residents place responsibility for managing local stormwater and protecting home sites alternately *within* and *beyond* residential properties. This study also extends considerations of blurred boundaries of risk and benefit across properties in the context of climate change that have been highlighted by other scholars (Milman & Warner, 2016; Tompkins & Eakin,

2012). In addition, these findings also correspond with examinations of intersections between individual autonomy within properties and larger environmental or risk reduction efforts, and the collective (and often disproportionate) impacts on others of distinct activities within the home site space (Feldman & Jonas, 2000; Pincetl, 2006; Sandberg & Foster, 2005).

Associated scholarly conceptualizations of natural/physical elements of the landscape as also unbounded and unfixed – for example, with challenges to legally-imposed bounds on river edges (Blomley, 2008), or within observations of changing coastal property lines from sea level rise (Guercio, 2013) – additionally relate to this research; within the current study context, increasing rain events from climate change and hardscaping from development hold significant potential to alter the volume and direction of stormwater flows across neighbourhoods and in disregard of property boundaries.

In connecting the adaptation potential of their own properties to that of their neighbours – as well as to other stormwater management activity undertaken by municipalities on surrounding public lands – residents recognize somewhat conflicting and porous property boundaries in the context of neighbourhood stormwater management. Home sites are perceived alternately as separate entities within which residents hold control over individual flood resilience potential, and as linked and inevitably affecting each other. In some cases, when they perceive excessive impacts from new development on surrounding stormwater management potential, residents may also see limits to private property rights, inviting more stringent municipal controls on private development within their own neighbourhoods and across wider urban areas.

Implications for municipal stormwater management policy

There exists growing recognition among municipalities of the need for greater incorporation of climate change adaptation measures within existing planning policy, with stormwater concerns front-and-centre in many Canadian cities (Amec Foster Wheeler and Credit Valley Conservation, 2017). In practice, municipal stormwater management agencies are constrained in implementing flood mitigation strategies within residential neighbourhoods, as they hold limited control over citizen activity within residential properties and other private lands (Kovacs et al., 2014). In Ottawa and Halifax, municipal stormwater management agencies have demonstrated varied commitments to fostering flood resilience in existing neighbourhoods, through maintenance of broader municipal stormwater infrastructure as well as more targeted measures at the edges of home sites (e.g. through tree planting and rain garden projects on residential streets and front yard rights-of-way), though both cities admit there exists significant room for improvement. Both Halifax Regional Municipality and the City of Ottawa have indicated that these broader strategies are intended to be supplemented by home-based measures among residents (City of Ottawa, 2012b; 2016c; 2018d; 2018e; HRM, 2011b; 2014; 2017; Halifax Water, 2017, November 22).

Climate change scholars commonly support the encouragement of citizen activity by governments through varied applications of regulatory methods, incentives, and removal of barriers to implementation (e.g. providing financial rewards, cost subsidies, or more accessible education/guidance to residents) (Whitmarsh, 2009; Bichard & Kazmierczak, 2012; Porter et al., 2014). Stormwater management activities that combine measures within public property with incentives and regulation targeting private lands have been demonstrated to significantly reduce flood risk in urban areas (Clean Air Partnership, 2012). Scholars also advocate for targeted public education programs to challenge misconceptions

about climate change adaptation measures, foster environmental citizenship among residents, and tap into existing social networks to stimulate increased neighbourhood adaptation action (Stoll-Kleemann et al., 2001; Lorenzoni et al., 2007; Whitmarsh, 2009; Conway, 2016; Derkzen et al., 2017). These assertions are often couched within a proposed model of “distributed and participatory governance” involving avenues for meaningful public input into adaptation strategies for residential neighbourhoods (Dhakal & Chevalier, 2016, p. 1112). Successful public education projects for climate change adaptation in other North American cities have also incorporated ongoing exchange of information about adaptation options among residents that makes space for experimentation (e.g. by testing out measures that also address aesthetic or other values among residents) and builds on residents’ lived experience with intense weather events (Clean Air Partnership, 2012; Derkzen et al., 2017; Hopkins et al., 2018).

While large-scale downloading of responsibility to citizens for maintaining flood resilience in residential neighbourhoods would be neither feasible nor appropriate, the findings of this study suggest that the City of Ottawa and Halifax Regional Municipalities have opportunities to leverage the receptiveness displayed by some residents in this study to home-based stormwater management measures – and to additional municipal supports in this effort – by making available more extensive education and incentive programs for residents. Both cities could build on stormwater management initiatives already in place, including HRM’s *Site Related Flow Charge* and the City of Ottawa’s *Residential Protective Plumbing Program* and *Pinecrest Neighbourhood Rain Project* (described in Section 5.3), by looking to promising flood mitigation programs implemented in other municipalities such as the *RiverSmart Homes* program in Washington, D.C., which provides an expansive range of

subsidies to residents for such measures as tree planting and rain garden or permeable pavement installations within home sites (City of Ottawa, 2018e; 2018f; Halifax Water, 2017, November 22; Lim, 2018). Engagement initiatives with residents could be further enhanced with a more explicit framing of individual actions within home sites as fitting within broader neighbourhood stormwater management efforts. This type of strategy would also highlight the potentially negative impacts of practices within individual home sites - such as expanding home footprints, applying inappropriate grading or installing extensive hardscaping - on nearby properties and collective neighbourhood flood resilience. Community-based social marketing strategies⁷² for residents may assist in reinforcing these shared impacts and opportunities to reduce flood risk among neighbours (McKenzie-Mohr & Smith, 1999).

Clearly, as municipalities employ strategies to engage citizens in increased lot-level adaptation activity, they will also be required to address residents' concerns about the effects of new/infill development on the stormwater management capacity of existing neighbourhoods. Many of the residents participating in this study recognized substantial contradictions between municipal efforts to encourage uptake of stormwater management measures among residents in established neighbourhoods, versus persistent planning approvals granted for intensive redevelopment by influential development interests in these areas. Across central areas of Ottawa in particular, the City's infill approval practices have also generated substantial concern among many residents over the last several years in

⁷² Community-based social marketing “draws from the idea that sustainable behavior change is most effective when it involves direct contact with people and is carried out at the community level” (University of Pennsylvania, 2018, p. 1; see also McKenzie-Mohr & Smith, 1999)

relation to continuing losses of mature trees and green space in established neighbourhoods (Leffers & Ballamingie, 2013; “Our Trees”, 2015).

Practices of densification in many cities reveal moments in which environmental policymaking is susceptible to neoliberal agendas that place continued growth above other sustainability concerns (Mansfield, 2009; Mitcham, 1995; Redclift, 2005). Within ‘compact city’ policy discourses, where the sustainable city is rationalized primarily through the preservation of outer-urban natures, strategies of containment and intensification to counter the negative effects of urban sprawl often place the viability of inner-urban greenspace – and associated stormwater absorptive potential – at risk (Dieleman & Wegener, 2004; Millward, 2006; Neuman, 2005). These strategies of intensification invariably involve a considerable volume of planning approvals for hyper-densified private development projects, within a municipal context of developer and pro-growth lobby funding, power and influence (where municipalities depend on property taxes from private development for significant fiscal support and municipal councillors rely on developers for election expenses) (Berman, 2016, December 16; Chianello, 2018, September 21; Tindal & Tindal, 2004).

Though there exists some opportunity for effective integration of densification with other sustainability objectives within municipal planning (for example, by encouraging or mandating permeable green roof technologies on new building structures)⁷³, the potential for these measures may be reduced with resistance among private developers, or a lack of “municipal leadership and commitment” toward promoting these strategies or toward environmental monitoring of new projects in general (McWilliam et al., 2014, p. 48; Girling,

⁷³ One municipal representative who was interviewed noted that a private developer is currently working with the City of Ottawa to implement LID demonstration projects within a major residential redevelopment project underway in the city’s east end (D. Conway, personal communication, January 17, 2017).

2010; Hansen et al., IN PRESS). Overall, despite modest shifts towards environmental sustainability among private development interests, property rights and individual profit-making too frequently remain prioritized in approvals for urban development (Keil & Graham, 1998), and even in cases where needs associated with adaptation to climate change are considered (e.g. through measures to preserve public infrastructure from climate-related hazards), urban redevelopment may largely “continue ‘business as usual’ albeit with greater attention to localised physical risk” (Taylor et al., 2014b, p. 17).

In Ottawa and Halifax, as in many cities across Canada, there exists a substantive growth paradigm bolstered by various financial incentives directed toward new urban development, with a significant portion of new development focused on inner-urban areas (Bunce, 2009; Grant & Gregory, 2016; Krawchenko & Stoney, 2011; Leffers & Ballamingie, 2013). The City of Ottawa and Halifax Regional Municipality acknowledge conflicts between development and stormwater management objectives – including stresses on existing sewer systems, constrained growing space and compacted soils, and reduced permeability from expanded hardscaping and removal of vegetation in these areas – with negative effects potentially compounded by uncertain future stormwater volumes from climate change (City of Ottawa, 2013, 2017a; HRM, 2014, 2017; Halifax Water, 2017, November 22; D. Conway, personal communication, January 12, 2017). Both cities have applied some general controls on new development, including restricting development in floodplains and within riparian buffers along local waterways (City of Ottawa, 2006; HRM, 2014, 2017). At the site plan level, they have also set requirements for lot grading, storm drainage and erosion control (City of Ottawa, 2018j; HRM, 2016, 2017). In recent years, specific action has also been taken within City of Ottawa planning policy with amended infill

zoning by-laws aimed at preserving rear and side yard residential setbacks in the city's core, in part to preserve existing/promote expanded permeable landscaping (City of Ottawa, 2011a, 2012a, 2015b, 2018m; City of Ottawa, 2015, January 30). The City's *Urban Tree Conservation By-law* also requires permits for removal of trees over 50 centimetres in diameter (a considerable size) on individual residential properties, though as the City has also noted, "about 90% of 'distinctive tree' permits requested are issued" (City of Ottawa, 2017b, p. 84; City of Ottawa, 2014b, 2016b). In Halifax, municipal agencies have developed several educational materials to encourage developers to implement stormwater management methods and other measures of mitigating climate-related hazards on development properties, though these measures constitute guidance – not regulatory – initiatives (HRM, 2006a&b, 2007).

Despite these efforts, continuing municipal approval for new development projects and admittedly weak controls on infill development offset efforts to maintain permeable land area in both cities. In the current context, new development not fully corresponding with municipal stormwater management regulations may still be allowed to proceed with financial compensation from developers (often toward stormwater management measures in other areas). In addition, regarding infill on smaller-scale lots, HRM acknowledges that larger building footprints offer "limited opportunity to introduce [stormwater best management practices]" (HRM, 2006a), while the City of Ottawa admits that, "building permit review [for infill] does not look at...anything related to trees" (City of Ottawa, 2015a). Within Ottawa, the municipality also faces pressures from existing residents wishing to remove permeable area within home sites (e.g. within front yard spaces for additional parking), and despite municipal controls in place, as one councillor has noted, "in almost all cases people manage

to get away with going ahead with doing what they wanted to do anyway” (D. Chernushenko, personal communication, December 19, 2016).

Moving forward, municipalities are advised to strengthen the permitting process for inner-urban redevelopment and infill projects – as well as for major building renovations on existing lots – for more substantive sanctioning of development ‘free-riders’ within neighbourhood stormwater management; in this respect, Keeley (2011) offers one policy option of setting a required minimum ratio for permeable land area within development projects, though she acknowledges that adequate monitoring and enforcement of this type of measure presents a significant challenge for municipalities.

5.6 Conclusion

Citizen activity within home sites may significantly influence how climate change impacts, including those associated with increased rainfall, are managed in urban areas. With precipitation events intensifying in many Canadian municipalities, many residents remain unaware of local flood risk; as one national survey of Canadian residents recently discovered, “seventy-four percent [of residents did] not think they [were] vulnerable to flooding, despite living in areas designated as high-risk by the federal government” (Thistlethwaite et al., 2017, p. 1). In addition, there continue to exist low levels of implementation of home-based stormwater management measures, despite a common perception among citizens that households are at least partially responsible for reducing flood risk to home sites (Thistlethwaite et al., 2017).

This study extends academic literature in several theme areas by revealing how residents both align with municipal *self-governing* strategies for citizens and direct *free rider*

concerns at neighbouring development in considering responsibility for management of climate change adaptation concerns. Significantly, within a contemporary context where municipalities maintain individual private property rights while increasingly encouraging adaptation activity among citizens, this study also illuminates complex *spatial (property) frames* through which residents contemplate not only their own responsibilities for action, but also those of governments, neighbours, and larger development interests across residential neighbourhoods. In dealing with unpredictable flood risks and stormwater flows, residents demonstrate perceptions of residential property within the collective neighbourhood space as dynamic and interdependent. Future research could shed further light on resident responses within other climate change adaptation contexts and physical locations, such as within coastal neighbourhoods collectively managing sea level rise or hardscaped inner-urban communities dealing with extreme heat. Subsequent study could also investigate the potential for engagement strategies such as community-based social marketing to spur integrated citizen stormwater management efforts across neighbourhoods that better recognize individual influences on combined flood risk (McKenzie-Mohr & Smith, 1999). Another suggested stream for future research could examine how provincial or federal initiatives or constraints influence distributions of responsibility to residential sites and within neighbourhoods within municipal stormwater management policy.

Overall, an accessible and comprehensive approach to engaging residents in Canadian cities would offer information about recommended stormwater management measures for home sites, guidance regarding municipal incentive programs and regulations for residential property owners, updates on flood risk mapping in urban areas, access to municipal stormwater management LID demonstration projects (e.g. street bioswale projects) in and

around residential neighbourhoods, as well as information about private flood insurance options (an emerging opportunity in Canada) for homeowners (Church, 2015; Thistlethwaite et al., 2017; Tompkins & Eakin, 2012). It would also communicate information and invite discussion around municipal policy tools to acknowledge citizen concerns and property rights, ongoing development pressures, the preservation of permeable land, and ongoing efforts to foster increased flood resilience as cities deal with climate change.

As municipalities move forward with stormwater management initiatives in residential neighbourhoods, they will need to balance efforts to engage effectively with citizens with more enlightened strategies to manage growth in cities. This will require that cities demonstrate climate change leadership and forge greater trust with residents through municipalities' own adaptation activities, thereby potentially increasing citizen motivation to undertake recommended adaptation measures; it will also require that municipalities resist excessive developer influence and associated efforts to push through oversized infill projects that negatively impact stormwater management in inner-urban areas.

Chapter 6: Synthesis and Conclusions

6.1 Moving forward in Ottawa and Halifax within the current climate change context

In the absence of meaningful global greenhouse gas (GHG) emissions reductions, impacts of climate change in urban areas are projected to significantly intensify over coming decades – an urgent message reinforced in a recent report from the Intergovernmental Panel on Climate Change (IPCC, 2018). As Ottawa and Halifax residents adjust to evolving climate change impacts, they join citizens in other urban areas across Canada in considering their own roles and capacities, as well as those of local governments, in both mitigating and managing these effects. National surveys in recent years have revealed that although many Canadians remain worried about climate change, they continue to prioritize other household issues (e.g. healthcare, employment), with some disregarding climate change as a local or immediate concern. Regarding household carbon footprints, many Canadians are also challenged in linking individual home-based actions to significant mitigation of future climate change. Interestingly, none of these surveys offer insights about how Canadians understand their own potential – or that of local governments – to adapt to already-occurring impacts of climate change (a gap in understanding that is partially filled through this thesis research) (Borick et al., 2011; Environics Research Group, 2015; Ipsos, 2018; Lachapelle et al., 2014; Mildenerberger et al., 2016; The Environics Institute, 2014).

As municipal agencies in Ottawa and Halifax move forward in engaging residents in home-scale adaptation activities, there exist opportunities to draw on promising regulatory regimes, incentive programs, and public education practices from other Canadian cities. These include initiatives in Toronto – considered a leading city regarding climate change action – such as an online portal for residents that provides guidance about adapting

residential sites to a range of intense weather conditions, or its unique *Eco-Roof Incentive Program* that offers residents financial support to install green or cool roofs on homes⁷⁴ (City of Toronto, 2018; Gordon, 2016; Guilbault et al., 2016). Promising adaptation-related policy measures in other Canadian cities include:

- repeated direct mailout efforts in Quebec City to encourage stormwater management (downspout disconnection) practices around select home sites that garnered an eventual 100 per cent success rate (Kovacs et al., 2014);
- the establishment of a *Tree Watering Alert* system in Kingston to engage residents in helping to water local trees during periods of intense heat and drought (Guilbault, 2016);
- measures to encourage tree planting and preservation in Surrey in residential yards and along residential streets, including a tree by-law requiring any trees over 30 cm trunk diameter that are removed be relocated or replaced, and a tree voucher program that provides subsidies for tree purchases as well as guidance on tree species selections and planting locations (Guilbault, 2016); and
- stormwater fee credits in Waterloo for residents when home-based stormwater management measures such as rain barrels or rain gardens are implemented within home sites (Henstra & Thistlethwaite, 2017).

⁷⁴ Green roofs incorporate soil and vegetation on roof surfaces; cool roofs incorporate highly reflective roofing materials on buildings. Both roof types help to mitigate urban heat island effects in densely developed areas, while green roofs also help to absorb stormwater. Toronto's *Eco-Roof Incentive Program* offers a financial incentive of \$75 per square metre of green/cool roof installed, up to a maximum of \$100,000 (City of Toronto, 2018; Guilbault, 2016).

These types of initiatives offer a substantial range of supports to facilitate implementation of adaptation measures by residents. However, these initiatives do not address potential influences on home-based adaptation activities that were revealed in this study – including diverse perceptions of local climate change risks or responsibility for adaptation action that may be held by these residents – nor are most of these initiatives packaged within any comprehensive or readily accessible home-based adaptation program.

Moving forward, there exist ongoing challenges for Canadian cities that may hamper effective implementation of adaptation programs. These challenges include inadequate resources or capacity to undertake climate change initiatives, provincial restraints over municipal authority or limited funding support from other levels of government⁷⁵, a lack of political will within municipal agencies, or a general disconnect between climate change policy timeframes and municipal electoral cycles (Bulkeley & Betsill, 2005; Corfee-Morlot et al., 2011; Gordon, 2013; Gore, 2010). These constraints exist alongside frequent resistance to home-based measures among residents (as often evidenced in relation to other home-based emissions reduction programs) and “limits to the power of municipal officials to compel action on private property” (Kovacs et al., 2014, p. 15; Guilbault et al., 2016).

Responses to the initial survey distributed as part of this thesis research provide some initial indications of a potential for enhancing adaptation practices among the Ottawa and Halifax study groups. Within surveys, many residents noted that they have already implemented some recommended adaptation measures, are willing to consider others, and have an interest in learning more about suggested practices of which they were previously

⁷⁵ The influence of provincial restraints and limited upper-level funding support on effective delivery of municipal adaptation programs for residents could be examined within future research in this home-based adaptation theme area.

unaware. Adaptation actions already undertaken by study participants have often involved relatively modest efforts (e.g. trimming vegetation, installing downspout extensions), with stated constraints on further action including the perceived expense, effort, or physical disruption associated with implementing other measures. Common findings across the three sub-themes of this thesis, which are presented in Section 6.2, offer additional insights regarding influences on home-based adaptation activity among Ottawa and Halifax residents.

6.2 A review of key insights and contributions to scholarship

Key findings within each of the three research sub-themes of this thesis, which are presented in Chapters 3, 4, and 5, provide varied insights regarding home-based perspectives of climate change among residents living in middle-income, inner-urban neighbourhoods in Ottawa and Halifax. These varied insights include: (1) how Ottawa and Halifax residents frequently construct and situate places of meaningful climate change impacts and risk *beyond* home sites and often *beyond* city scales; (2) how residents perceive local natures (within the context of ecosystem-based adaptation measures) as both contributing to and potentially limiting climate change resilience within home sites; and, (3) how residents discursively both maintain and blur residential property boundaries, as they alternately support self-governing practices and accord responsibility to neighbouring development free-riders to manage stormwater flows within and beyond home sites across residential neighbourhoods. Within thesis sub-themes, this research refined understandings of such spatial framings as *home site ecologies* – as individual (and linked) residential sites of significant ecological sustainability/adaptation potential that are embedded in larger urban ecosystems – and the *middle spaces of shared climate change vulnerability and adaptation potential* that exist along blurred boundaries between home sites and adjacent residential and public property

spaces. Several common themes that emerged across these sub-themes offer additional insights regarding perspectives of climate change based at home site scales.

A first common theme highlights scalar influences on residents' perceptions of climate change impacts, risk, and opportunities for adaptation action. The focus of this thesis on perspectives based at the scale of individual dwellings offers nuanced insights regarding the context-specificity of understandings of and responses to climate change that is often evident across scales. For example, this study reveals differing understandings of risk within varied scales at which Ottawa and Halifax residents perceive *local/home places* to be disrupted by climate change, including the home site, neighbourhood and surrounding urban areas. Scalar tensions are evident where Ottawa and Halifax residents attributed urgency regarding climate change risks increasingly outward beyond the home site to broader regional or global contexts, and where residents downplayed local impacts; these perceptions contrast with common discourses among climate change adaptation practitioners and scholars that locate adaptation concerns and opportunities for action within more local spheres (in contrast to mitigation discourses that are framed at global scales) (Funfgeld, 2015; Krellenberg et al., 2014; Nalau et al., 2015; Wilbanks & Kates, 1999).

This thesis also reveals diverse understandings among Ottawa and Halifax residents regarding scales of influence of home-based adaptation activities; for example, impacts of individual actions (e.g. modifying home site natures, removing hardscaping) were perceived by residents as largely contained within home sites, as improving conditions for or extending risk (in the case of planting large trees) to neighbours, and/or as affecting vulnerability or resilience to climate change across wider cities or urban ecosystems. Responsibility for adaptation action was also understood by residents in different ways across varied scales: as

limited to strengthening personal resilience (e.g. preventing basement flooding within individual properties) or, across broader areas, as required to contribute to permeability/flood resilience across combined neighbourhood spaces.

Beyond framings of residents' concerns across physical spaces, this research demonstrates how Ottawa and Halifax residents understand climate change impacts and respond to climate-related risks with varied degrees of urgency across different timescales. Many residents situated significant climate change concerns toward future decades and generations. They also placed diverse priorities around home-based interventions to deal with climate-related hazards along a continuum of options over time that included: (1) immediate, pro-active actions taken *in advance of* potential impacts (e.g. strengthening home structures, enhancing home site permeability in preparation for future hazards); (2) emergency management measures employed *during* an event; or, (3) reconstruction efforts *following* significant disruptions (though this latter option was not frequently mentioned by residents). In general, residents also frequently displayed a preference for focusing on requirements for home-based mitigation (emissions reduction) actions that should be taken *prior to* (i.e. to prevent) further climate change impacts, with less emphasis often placed on measures to adapt home sites to effects *resulting from* climate change. This research on home-based perspectives lies at the cusp of the shift from climate change mitigation to adaptation that is currently taking shape in contemporary society, though clearly one shouldn't preclude the other.

Many of these findings correspond with scholarly literature that employs various scalar frames to enhance understanding of environmental issues. This literature includes demonstration by Mincey et al. (2013) of how broadening scales through which urban

ecologies are examined provides more nuanced understandings of how local natures are distributed across residential sites. On a related theme, Iverson Nassauer (2011) reveals how individual management of home site natures may spread through social norms across larger neighbourhood scales. Adger et al. (2005) consider how varied interests among actors within multi-level governance of adaptation initiatives – for example, in the context of local water supply management, differing cost-efficiency or sustainability interests – may manifest across scales of the household, commercial utility or national government, while Shaw et al. (2018) demonstrate how citizen involvement in environmental efforts offers varied challenges at household, community organization or municipal levels. As has occurred within this current thesis research, scholarly examinations through scalar frames frequently uncover a diversity of experiences and perspectives existing across scales, and recognize scalar framings as neither “fixed” nor “pre-given” (Shaw et al., 2018, p. 276; Tsing, 2012).

A second common theme involves the multi-faceted and conflicting perspectives of climate change that were observed across the study group and within views among individual residents. These complex perspectives included diverse frames of denial, complacency or concern held by residents relating to local climate change impacts and risks. Climate change effects were perceived by residents as both near and far, and responsibilities for adaptation action as alternately disconnected from and linked to wider urban areas/ecosystems. Residents saw potential in effectively managing home site impacts, felt overwhelmed in considering how to deal with uncertain and uncontrollable changes, or noted a futility in individual activities given a perceived inaction by others. Adaptation actions undertaken or considered by residents were influenced by varied factors such as personal aesthetic preferences, individual ecological goals, or neighbourhood social norms. Residents also

balanced individual property rights, a sense of obligation to neighbours, and desires for greater municipal support in considering home-based adaptation actions.

Scholars increasingly recognize a plurality of perspectives within societies regarding climate change experiences and opportunities for action (Bluhdorn & Welsh, 2007; Nyamwanza & Bhatasara, 2014; Redclift, 2005). This recognition includes efforts by scholars to explore a range of perceptions of climate change that are generated within varied social and cultural realms; scholars also suggest that processes of developing viable strategies to address climate change issues ought to incorporate a wider breadth of knowledges, concerns and needs (Castree et al., 2014; Hulme, 2009; Mebratu, 1998; Shaharir, 2012). Ideally, this would also involve nuanced examination of varied ways in which communities and environments are valued by societies and individuals within diverse contexts of changing local climates (Warren, 2007; Wolf et al., 2013).

I suggest that the complex and often conflicting perspectives observed among residents within this thesis research result in part from the location of this case study within cities where residents have thus far experienced some notable disruptions but no devastating consequences (through significant loss of life or property) from climate-related hazards. These diverse perspectives of risk and opportunities for adaptation action displayed by residents may also be due to the location of this study predominantly within middle-income neighbourhoods, where many residents might presumably more effectively recover from potential impacts (for example, by financing their own rebuilds or relying on insurance). In addition, most study participant home sites are in areas near but not directly adjacent to visible climate change impacts and risk (for example, not on the eroding ocean coast or river's edge at risk of flooding, but in sight of the ocean coast/river's edge). Within these

contexts, residents appeared not always fully cognizant of ways in which their own home sites are exposed to subtly increasing climate change impacts (e.g. rising temperatures) or to random climate-related hazards that could strike any location in each city (e.g. intense rainstorms causing sewer backups and basement flooding). Lastly, climate change may spur multiple and concurrent impacts to home sites that vary substantially or intensify over time; this situation may influence feelings of being confused and overwhelmed that were sometimes observed among residents, and may complicate current and future efforts among residents to consider reasonable (e.g. cost-effective) measures in responding to climate change concerns.

A third common theme involves influences on resident perspectives related to the location of study neighbourhoods within established and densifying inner-urban areas. Within climate change contexts, scholars commonly consider how densification may aid cities in facilitating low carbon transitions, while often paying limited attention to how municipal adaptive capacities may be affected (for example, within management of urban heat islands or individual and collective permeable space) (Hoymann & Goetzke, 2016; Ottelin et al., 2015; Paterson & Mueller, 2018). This thesis has explored how settlement densities and a comparative ease of access to physical infrastructure and social supports affects how residents direct urgency toward home-based and other local vulnerabilities to climate change, how they consider managing home site natures to reduce risks to their own properties or extend benefits to neighbours (e.g. regarding urban heat island effects or stormwater pooling), and how they accord responsibility to others (particularly nearby development interests) in maintaining resilience to climate-related hazards across linked neighbourhood spaces.

Overall, this comparative case study of understandings of climate change in two mid-sized Canadian cities has revealed several similarities in perspective among Ottawa and Halifax residents, including comparable views regarding home sites natures and responsibility for stormwater management action in a climate change adaptation context, and a similar devaluing among many residents of personal climate change risk (and corresponding outward focus of concern on perceived vulnerabilities among other populations and regions). These common observations highlight opportunities to apply study findings and related implications for municipal climate change policy within similar contexts in other Canadian cities. However, the parallel views displayed by residents within these two contexts exist alongside other important distinctions between the two study groups, including differences within understandings of local impacts (for example, common perceptions of steady and subtle climate change impacts noted among Ottawa residents, versus perceptions of a potential for more abrupt climate-related disruptions among Halifax residents), and more pronounced concerns about development impacts on neighbourhood adaptation (stormwater management) potential that were voiced by Ottawa residents.

6.3 Opportunities to advance municipal climate change adaptation policy in Ottawa and Halifax

As previously noted in other chapters of this thesis, the City of Ottawa and Halifax Regional Municipality (HRM) apply varied measures to engage residents in climate change adaptation-related activities. These initiatives have been developed in addition to existing municipal climate change mitigation efforts aimed at residents in both cities, including HRM's *Solar City* program which offers financing to residents for installation of solar photovoltaic, hot air, or hot water systems on homes (HRM, 2018). Chapters 3, 4, and 5

present additional suggested measures for these cities to enhance adaptation-related engagement programs with residents, including by:

- assisting residents in recognizing specific climate change impacts and risk at localized scales, including within home sites and surrounding neighbourhoods;
- communicating recommended ecosystem-based adaptation measures in ways that incorporate diverse values among residents regarding home site natures, reduce potential risks from planting larger-scale vegetation around homes, and foster awareness of links between healthy home site ecologies and climate change resilience across broader urban ecosystems; and,
- leveraging resident interest in home-based adaptation incentives and guidance, and addressing concerns among residents (and calling out developers) regarding the effects of local construction and retrofit activities that diminish permeable land area and linked stormwater management potential across neighbourhoods.

Reflection on common insights across the thesis sub-themes inspires additional prescriptive policy recommendations for agencies addressing home-based climate change issues in Ottawa and Halifax. At a basic level, the two municipalities are advised to enhance measures to advance residents' awareness of options for home-based adaptation action within climate change communications, beyond the typical municipal focus on emissions reductions efforts⁷⁶. This may be most effectively achieved through a comprehensive home-based

⁷⁶ As of Fall 2018, Halifax Regional Municipality is initiating an 18-month-long engagement and development process around a new Community Energy & Climate Action Plan (CECAP) initiative. According to HRM, CECAP "provides an inclusive, collaborative opportunity to address community-wide climate change adaptation and mitigation measures in all sectors... This approach will establish short and long-term goals for energy

adaptation communication strategy that helps residents understand the broad range of impacts and risks to which they are exposed, some of which may be concurrent and intensify over time.

Additionally, it is recommended that these cities assist residents in conceptualizing climate change risks and opportunities for adaptation across urban scales that are based at the individual home site, and in better understanding linked and bi-directional vulnerability and resilience to climate change across these scales. This would include emphasizing risks to individual home sites during wider-scale intense weather events, and highlighting potential cumulative impacts of home-scale adaptation activities across cities and urban ecosystems (for example, the potential for improved flood resilience and reduced urban heat islands across neighbourhoods, and for a more resilient urban-scale forest canopy, resulting from tree planting within individual home sites). This approach would form one way in which municipalities could overwrite common understandings of private residential property spaces among residents (as spaces of individual freedom to undertake/not undertake adaptation actions within home sites) within the coordination of broader municipal environmental policies to address shared vulnerabilities to climate change across urban scales. Ideally this strategy would also include more direct support for community-based adaptation social marketing programs, inspired by existing neighbourhood-scale strategies such as the *Brantwood Park 610 Action Plan* flood risk communication initiative in Old Ottawa East, stormwater management engagement efforts by the *Ecology Action Centre* in Halifax, and

transformation and greenhouse gas reductions for the community looking out to 2050". HRM *Energy & Environment* staff plan to produce a draft plan by late spring 2019 (Duncan, 2018).

initiatives in other cities such as the *Sustainable Neighbourhood Action Plan* that has been implemented across various locations in the Greater Toronto Area⁷⁷.

A final recommendation is that these cities better recognize and respond to the plural perspectives of climate change that exist among residents. Within this study, while residents considered such factors as costs and disruption involved with suggested adaptation measures, their comments also reflected differing perceptions of urgency in responding to local risks, varied values directed toward modifying home site natures, and diverse understandings of responsibility in managing home site/neighbourhood resilience. Scholars increasingly promote a more democratic policy-making context that supports multiple framings of climate change concerns, and includes participants from government, business, scientific communities and civil society, in the development of environmental programs (Hulme, 2009; Corfee-Morlot et al., 2011). This goal is articulated among scholars despite acknowledgement of corresponding challenges that may include a lack of resources to enhance more inclusive policy-making contexts, or vulnerability to influence from local lobby groups or economic interests (Douglas, 2014; Pahl-Wostl, 2009; Pitt, 2010). Leck and Simon (2013, p. 1222) also note that this type of effort requires “genuine collaboration and co-operation (as opposed to mere interaction)” among participants.

⁷⁷ The Toronto and Region Conservation Authority describes the *Sustainable Neighbourhood Action Plan* (SNAP) as helping municipalities to “draw strong local community support and build trust for long-term engagement as they implement a broad range of climate change-related urban renewal initiatives in the public and private realms”. Examples of SNAP projects include a Green Home Makeover demonstration project and Residential Eco-Landscaping program (Toronto and Region Conservation Authority, 2018).

6.4 Future research directions

Section 2.5 of this thesis provides an extended discussion of methodological limitations within this thesis and potential measures to overcome these constraints within future home site-scale climate change research. Analysis of research sub-themes presented in Chapters 3, 4, and 5 revealed several issues that may also be further explored in future research, including: the role of municipal leadership (e.g. within public adaptation projects) and provision of incentives for residents in stimulating home-based adaptation action; the challenges of free-riders in furthering combined adaptation efforts across residential neighbourhoods; and the influence of ecosystem-based adaptation aesthetics (for example, within measures that contrast visually with the typical manicured lawn) on the curb appeal/resale value of residential properties.

Further reflection on the parameters of this research – as framed within a specific period that precluded examination of the influence of subsequent intense weather events on resident perspectives, and focused on perspectives within middle-income, inner-urban neighbourhoods – has inspired several other general suggestions to enhance future research on home-based perspectives of climate change. For example, an exploration of these thesis sub-themes within more rural portions of urban areas may offer additional insights about how resident perspectives are influenced by differing physical or social vulnerabilities, access to supports, or urban central/rural institutional relations that may exist within these areas. Regarding this latter consideration, Shaw et al. (2014) note that differing experiences and relations of power between central and rural institutions may influence diverse priorities regarding climate change concerns. These themes could also be more extensively explored within inner-urban areas across a wider range of home types (e.g. apartment units) or among

lower-income or socially marginalized populations (as has been noted in Section 2.5), with recognition that levels of home-based adaptation activity that residents within this demographic could undertake may be limited. Implications for municipalities coming out of this research could link to existing literature that has considered how marginalized groups are affected by or ignored within municipal climate strategies, and that has examined promising practices of more *just* frames through which climate change policies may be implemented in cities (McKendry, 2016; Pearsall & Pierce, 2010; Wilson et al., 2014).

Where feasible, it may be effective to examine thesis sub-themes over extended timeframes, as residents deal with subsequent weather events or intensifying impacts over longer periods of time; these variable climate conditions may offer a deeper understanding of a range of responses among residents – including residents’ willingness to implement measures, responses to risk, or sense of complacency – which may ebb and flow with changing climate effects. In the context of Ottawa resident perspectives of climate change, a longer timeframe of study would have offered opportunities to capture reactions from residents following recent flood and tornado events affecting parts of that urban area. As a large proportion of analysis within this study focused on resident views regarding the individual/combined management of stormwater flows in residential neighbourhoods, future research could also focus on other perspectives that may be revealed within the context of increasing (and often shared) urban heat effects in these areas. These research themes could also be extended by considering the influence of availability of home insurance on resident perceptions of climate change risk and responsibility/opportunities for action, which has been demonstrated to both stimulate and reduce motivation for household adaptation action within other contexts (Etkin & Stefanovic, 2005; Hanger et al., 2018; Hudson et al., 2016). An

examination of the influence of home insurance on resident perceptions of climate change risk and motivations for adaptation action would include resident involvement with other private actors, beyond resident engagements with municipal policy and programs that were the focus of this study.

Lastly, as this study has highlighted both points of connection and divergence in resident perspectives between the two study cities, an additional promising course of future research would be to explore the potential for facilitating communication among residents from a wider swath of urban areas across Canada within a climate change-themed social learning model. Exploration of the potential for this type of network could increase awareness of how residents may learn from each other – through their differing exposures to physical and other climate-related risks, experiences with diverse climate change impacts and intense weather events, or experimentation with varied home-based measures – in adapting to climate change impacts at home scales. As this thesis research has revealed, examination of the plural home-based perspectives and experiences of climate change that exist among residents in Canadian cities offers numerous opportunities to enrich municipal adaptation policy and strengthen home site resilience moving forward.

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Appendix 1:
Sample questions: Survey for Ottawa and Halifax residents

1. What are the age and gender of the person who is completing this survey?
2. Are there other persons living in your home? What are the ages of each of these persons?
3. How much control do you have over decision-making in relation to modifying your home and property?
4. How long have you lived in this home? This neighbourhood? This city? This country?
5. What do you like best about your home/property? Your neighbourhood? Your city? For these questions, please consider aspects such as local character, aesthetic qualities, community/social atmosphere, local environments and ecologies, local amenities, local climate, or some other aspect of your choosing.
6. Is there anything you don't like about your home/property? Your neighbourhood? Your city?
7. Can you describe any ways in which Ottawa/Halifax may be vulnerable to climate change?
8. Can you describe any ways in which Ottawa/Halifax may benefit from climate change?
9. How would you describe adaptation to climate change, and resilience to climate change, within the context of this city? If you wish, you may indicate that you do not understand these terms.
10. Have you experienced a severe weather event in this city (e.g. winter storm, heat wave, drought)? If so, please briefly describe your experience.
11. Do you have any comments about how climate change (from small changes in your environment to severe weather events) is affecting daily life in your household (desired and/or undesired effects)?
12. Do you have any comments about how climate change (from small changes in your environment to severe weather events) is affecting the physical qualities of your home and property/landscaping? Your neighbourhood? (desired and/or undesired effects)
13. Has climate change (from small changes to severe weather events) changed your experience of living in your home, neighbourhood, and/or city? If so, how (you may include personal emotional reactions here as well if you wish)?

14. Are you aware of any initiatives administered by the municipal government or other organizations to help residents adapt their homes and properties/landscaping to changing climate conditions and potential severe weather events? If so, can you briefly name and/or describe these initiatives, as well as how you heard about them?
15. What is your impression of any initiatives you mentioned in Question 14? Is there any way that you think these programs could be improved?
16. Please take a moment to review some potential actions below that may help residential properties in your city adapt to climate change effects, and indicate whether or not you would be willing to consider implementing these actions:

	Willing to consider?	Already implemented?
Strengthen roof, walls and/or doors (to protect against high winds, water damage, ice dams from winter/summer storms)		
Install/maintain backwater valve at foundation drain, install downspout extensions (to reduce flooding risk from intense rainfall)		
Modify lot grading (to reduce flooding risk from intense rainfall)		
Trim branches and shrubs, remove dead or rotted vegetation, remove selected plants/trees (to reduce damage from flying debris during storms; to reduce forest fire risk)		
Plant trees or other vegetation (to reduce flooding during intense rainfall/storm surge; increase cooling effects during periods of intense heat)		
Remove hard surfaces (e.g. asphalt) and increase permeable surfaces (e.g. gravel, gardens) (to reduce flooding during intense rainfall; increase cooling effects during periods of intense heat)		
Install green roof – use plantings as roof materials (to reduce flooding during intense rainfall; increase cooling effects during periods of intense heat)		
Practice xeriscaping – planting drought-tolerant plants (to conserve water during drought, or at any time)		

(continued on following page)

17. Please indicate how the following factors might increase/decrease your likelihood of implementing adaptation actions (such as those described in Question 16) on your property:

Action helps your home/property to adapt to climate change impacts/severe weather events	
Action helps your wider neighbourhood and/or city to adapt to climate change impacts/severe weather events	
Action helps to preserve/enhance local ecologies (e.g. planting trees)	
Action will remove portion of local ecologies (e.g. removing trees/vegetation to reduce forest fire risk)	
Action increases property value	
Action increases personal comfort (e.g. provides cooling effects during periods of intense heat)	
Action increases 'curb appeal'/aesthetic value of your home/property	
Action has high financial cost	
Action has low financial cost	
Action generates cost savings a few years after initial investment	
Action requires high degree of time and effort	
Action requires low degree of time and effort	
Action is also being undertaken by others in your neighbourhood	
Action is relatively new or untested, or you are not familiar with the suggested action	

18. Are there any other factors (not mentioned in Question 17) that may influence your willingness to implement climate change adaptation actions (like those mentioned in Question 16) on your property? If so, could you please describe these factors and how they would influence your willingness?
19. Do you think your municipal government has a responsibility to adapt residential properties to climate change? If so, how (you may choose to refer to items in Question 16 and/or other items of your choosing)?
20. Do you think that residents have a responsibility to adapt residential properties to climate change? If so, how (you may choose to refer to items in Question 9 and/or other items of your choosing)?
21. Do you have any other general comments you'd like to share about climate change adaptation programs in Ottawa, or about anything else related to climate change in this city?

Appendix 2:
Sample focus group/interview slides for Ottawa and Halifax residents
(sample from North End Focus Group)

North End focus group:

CLIMATE CHANGE ADAPTATION STUDY

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August 2016

INTRODUCTION:

- **Interview structure:** four themes – can take breaks when required
- Large amount of information – links to info sources will be provided
- Information within a particular scope of cc impacts and adaptation options
- Information about climate change impacts & adaptation not always fully certain – you are encouraged to ask questions, challenge ideas
- If you become uncomfortable at any point during the discussion, you are welcome to cease participation in the interview at any time

INTRODUCTORY QUESTIONS:

What does climate change mean to you?

Do you have other comments to add about climate change if we frame the discussion within the context of your home, neighbourhood and city?

THEME A: Projected impacts of climate change:

- **Temperature:** projected to rise
- **Precipitation:** projected to rise (more days with rain, fewer days with snow) – more pronounced seasonal and yearly variations
- **Sea level rise:** projected to rise by 0.73 m over the next century
- **Intense rainfall events, and associated flood risk:** projected to become more frequent (while precipitation in general may become less frequent)
- **Hurricanes, storm surges, and associated flood risk:** may become more frequent over the next century (some uncertainty)
- **Intense snowfall and ice storms:** may become more frequent
- **Heat waves and drought:** may last longer, and become more frequent
- **Wildfire risk:** projected to decrease over the long term, and increase over the short term

THEME A: Projected impacts of climate change

What do you think about this information?
Is there anything you disagree with, or don't understand?

THEME A: Projected impacts of climate change

Were you aware of some or all of these projected climate change impacts, before I presented them to you today?

THEME A: Projected impacts of climate change

Do you think predicted future impacts of climate change might influence your experience of living in your place of residence/neighbourhood at some point in the future?

If so, how?

If so, how do you feel about this?

THEME A: Projected impacts of climate change

In general, do you feel that your place of residence, neighbourhood and/or city are at risk from climate change impacts?

If so, how and to what degree?

THEME B: Adaptation recommendations:

- **Managing stormwater:** modify slopes; direct water to rain gardens; plant trees; collect downspout water in rain barrel
- **Reducing basement flooding:** disconnect downspouts from sanitary sewers; install a backwater valve; install weeping tile/foundation drain, window wells and/or sump pump
- **Reducing damage from snow and ice:** strengthen roof structure or increase roof slope; install electric heating cables; seal air leakage from attic penetrations
- **Reducing damage from severe wind:** choose high wind-rated reroofing materials; install braces at roof sheathing; select pressure- and impact-rated doors; trim trees and remove rotted vegetation
- **Reducing risk from wildfire:** modify vegetation around the home; install fire-resistant roofing materials; install fire-resistant exterior wall finishes

THEME B: Adaptation Recommendations

What do you think about these recommendations?

Is there anything you disagree with, or don't understand?

THEME B: Adaptation Recommendations

Do you think this information adequately addresses potential climate change impacts in your neighbourhood?

Why or why not?

THEME B: Adaptation Recommendations

Is there anything you'd like to share today about why you would or wouldn't implement these recommendations?

THEME C: Initiatives/info from municipal govt:

HRM Energy & Environment Climate SMART Community Action Guide to Climate Change and Emergency Preparedness:

- Plant trees
- Water catchment areas for stormwater flows

THEME C: Initiatives/info from municipal govt:

Halifax Water Stormwater Management:

- Link to 'From Pipes to Parks' video
- Stormwater Inflow Reduction Program

THEME C: Initiatives/info from municipal govt:

Urban Forest Master Plan:

- promotes urban forest benefits that include stormwater retention, cooling

THEME C: Initiatives/info from environmental orgs:

The screenshot shows the homepage of the Clean Water Project website. The header includes the logo, navigation links, and social media icons. The main content area is titled "Manage stormwater on your property" and includes a sub-header "When it rains, it pours...but you'll be ready". The text explains that when it rains, water can't soak into surfaces like driveways and roads, instead running off into streets and storm sewers, carrying pollutants. It suggests that minor landscaping changes can help manage stormwater and that harvesting rainwater can reduce runoff. Below the text is an infographic showing various stormwater management techniques. At the bottom, there is a legend for the infographic and a button to "View the Legend".

THEME C: Initiatives/info from environmental orgs:

THEME C: Initiatives/info from environmental orgs:

Halifax Diverse:

THEME C: Initiatives/info from govt and orgs:

Were you aware of this information/these initiatives,
before I presented them today?

THEME C: Initiatives/info from govt and orgs:

How do you respond to this information/these initiatives?
Is there anything you disagree with, or don't understand?

THEME C: Initiatives/info from govt and orgs:

Do you think this information/these initiatives address(es) potential climate change impacts within your place of residence, your neighbourhood, and/or your city?

To what degree? Why or why not?

North End – Factors influencing cc adaptation:

North End – Factors influencing cc adaptation:

Paved/hard surfaces:

- Extensive paving and other hard surfaces around commercial and institutional properties – reduces capacity for stormwater retention, contributes to urban heat island effect

North End – Factors influencing cc adaptation:

Tree canopy:

- Trees help to retain stormwater and offset the urban heat island effect
- Trimming tree branches, planting trees away from house reduces debris during storms
- UFMP neighbourhoods: large proportion of older trees, not enough younger trees to replace; low proportion of native species; low species diversity

Source: HRM, 2013)	% canopy cover (actual)	% canopy cover (target)
North End	27	≥70
Harbour/Windsor (also part of South End)	4	≥20
Source: HRM, 2013)	% of res prop - one value tree (actual)	% of res prop - one value tree (target)
North End	67	100
Harbour/Windsor (also part of South End)	43	100

THEME D:

What do you think about this information? Is there anything you disagree with, or don't understand?

Have you thought about your neighbourhood in this way before?

THEME D:

Do you think that modifying local ecologies could be effective in reducing potential climate change impacts?

Would you be willing to modify local ecologies around your place of residence?

Would it matter to you if modifying local ecologies also helped to increase the adaptive capacity of your neighbourhood or wider city?

CONCLUSION:

Would you like to provide any other comments today?

Is there anything we haven't discussed today that you feel is important to this topic?

Appendix 3:
Sample questions:
Interviews with Municipal Government Representatives

1.
 - a. What position do you hold within this department?
 - b. How long have you held this position?
2.
 - a. How would you describe how [Ottawa/Halifax] may be vulnerable to climate change?
 - b. How would you describe adaptation to climate change, and resilience to climate change, within the context of this city?
3.
 - a. Are you aware of any residents voicing concerns to municipal government about how climate change/severe weather events are affecting their homes and properties/landscaping? their neighbourhoods? the wider city?
 - b. Can you briefly describe these concerns?
4. In general, how would you describe the degree of awareness that [Ottawa/Halifax] residents hold about options to adapt their homes and properties/landscaping to changing climate conditions and potential severe weather events?
5.
 - a. Can you briefly describe any policies/programs initiated within your department that are aimed at improving the ability of [Ottawa/Halifax] to respond to changing climate conditions and potential severe weather events? What are the main goals of these policies/programs, and who/what are they intended to benefit?
 - b. Can you describe any policies/programs that are geared specifically to helping residents adapt their homes and properties/landscaping to changing climate conditions and potential severe weather events? What are the main goals of these policies/programs, and who/what are they intended to benefit? Are there specific socio-economic groups that are being targeted?
6.
 - a. Can you describe how these climate change adaptation initiatives (*addressed in question 5*) have been developed?
 - b. Have these initiatives changed over time, and if so, how and why?
 - c. Are there plans within your department to introduce other climate change adaptation initiatives in the future?
 - d. Is there any way that you think these initiatives could be modified/improved?
7.
 - a. How are initiatives geared to adapting [Ottawa/Halifax] to changing climate conditions promoted/communicated to residents?
 - b. Has your office received any feedback from [Ottawa/Halifax] residents regarding these initiatives? If so, can you provide any details about these comments?
8. Do you have any other general comments you'd like to share with me today about municipal climate change adaptation policy and programs in [Ottawa/Halifax], about residents' responses to these initiatives, or about anything else related to climate change in this city?

Appendix 4:
Sample questions:
Interviews with Environmental Organization Representatives

1.
 - a. What position do you hold within this organization?
 - b. How long have you held this position?
2.
 - a. How would you describe how Halifax may be vulnerable to climate change?
 - b. How would you describe adaptation to climate change, and resilience to climate change, within the context of this city?
3. Can you describe any concerns you've heard from residents about how climate change/severe weather events are affecting their homes and properties/landscaping? their neighbourhoods? the wider city?
4. In general, how would you describe the degree of awareness that Halifax residents hold about options to adapt their homes, properties and landscaping to changing climate conditions and potential severe weather events?
5. Can you describe any programs administered by your organization that are geared specifically to helping municipal residents adapt their homes and properties/landscaping to changing climate conditions and potential severe weather events?
6.
 - a. Can you describe how these climate change adaptation programs (*addressed in question 5*) have been developed?
 - b. Do you work with municipal or other governments to administer these programs? If so, do you have any comments about how these programs are administered?
 - c. Have these programs changed over time, and if so, how and why?
 - d. Are there plans within your organization to introduce other new climate change adaptation initiatives in the future?
 - e. Is there any way that you think these programs could be modified/improved?
7.
 - a. How are these programs promoted/communicated to residents?
 - b. Has your office received any feedback from Halifax residents about these programs? If so, can you provide any details about these comments? Have you noticed any differences in resident responses in regard to initiatives geared to protecting individual residential properties versus wider urban areas?
8.
 - a. Have any pilot projects that are geared to adapting homes and properties/landscaping to changing climate conditions in Halifax neighbourhoods been initiated through your organization? If so, can you briefly describe the scope and methods associated with these projects?
 - b. Have any Halifax residents contacted your office to voice their support or concern for these projects? Can you or anyone in your office provide any information on these comments?

9. Do you have any other general comments you'd like to share with me today about climate change adaptation programs in Halifax, about residents' responses to these initiatives, or about anything else related to climate change in this city?