Disarming the ‘Silent Killer’
Reducing the vulnerability of Toronto’s elderly to extreme heat

Rosalind Pfaff

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LUCSUS
Lund University Centre for Sustainability Studies
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Abstract:

Global climate projections forecast more frequent, intense and longer heat waves in the decades ahead. Heat waves are considered the most dangerous extreme weather event for human health, with impacts most pronounced in cities because of the urban heat island effect. Heat-related mortality rates are highest in certain at-risk populations, like the elderly. Toronto, Canada’s largest city, faces two compounding challenges: an increasing number of heat waves coupled with a rapidly growing senior population.

This paper, using qualitative interviews, document analysis, and some comparable work on other cities, investigates how response measures in Toronto aim to reduce seniors’ vulnerability to increasing heat waves, evaluates their current effectiveness and explores viable future steps for augmenting these strategies. Using Turner et al.’s 2003 integrated framework, vulnerability is conceptualized as a complex product of both the internal factors of exposure, sensitivity and adaptive capacity within Toronto’s coupled human-environmental system and the external factors beyond this system.

Findings highlight how existing city and some volunteer strategies in Toronto work to increase individual and community adaptive capacity, while ongoing city projects aim to reduce exposure levels at a building and municipal level. Failure to reach certain high-risk seniors, the limited success of cooling centres, high temperatures in some aging high-rise apartments and rooming houses, and the city’s over-reliance on air conditioning in light of energy grid instability and municipal environmental objectives are all identified as gaps in current strategies. Promising alternative pathways forward include developing a stronger social infrastructure with more securely funded community networks to support the elderly, better housing through targeted retrofitting of high-risk properties, and transitioning away from air conditioning dependence through more passive cooling design and expansion of the city’s use of deep water cooling. Findings about the Toronto situation also have applicability to other similar Canadian cities in the provinces of Quebec and Ontario, and in the United States.

Key words: heat wave, heat-related mortality, elderly, Toronto, vulnerability, adaptive capacity

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<td>Hi-RIS</td>
<td>High Rise Retrofit Improvement Support Program</td>
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<tr>
<td>HWR</td>
<td>Hot Weather Response Plan</td>
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<tr>
<td>TPH</td>
<td>Toronto Public Health</td>
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<td>UHI</td>
<td>Urban Heat Island</td>
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1 Introduction

According to future global climate projections, regardless of the global emissions pathway, heat waves are expected to occur more often and be both longer and more intense (Perkins, Alexander & Nairn, 2012; IPCC, 2013, p. 956; p.990). Heat waves are considered the most dangerous extreme weather event for human health (Yang et al. 2014) with heat-related mortality highest in urban areas (Kovats and Koppe, 2005). Cities experience greater temperatures versus the surrounding areas due to the urban heat island (UHI) effect, a phenomenon whereby surface modification for infrastructure development, as well as heat from human activity, creates hotter conditions, particularly at night (Laaidi et al., 2012).

Several devastating heat waves have shocked recent memory, most notably the 1995 heat wave in Chicago that killed over 700 (Whitman et al., 1997), the 2003 heat wave in Europe with over 70 000 mortalities (15 000 in France alone) (Lagadec, 2004) and the recent 2015 heat wave in India and Pakistan killing upwards of 3600 (Rafferty, 2016). In the cases of both Chicago and France, deaths rates were highest in the elderly (Vandentorren et al., 2006; Whitman et al., 1997), a population consistently identified as at a greater risk for heat-related mortality (Naughton et al., 2002; Baccini et al., 2006; Son et al., 2012; Sung et al., 2012; Milan and Creutzig, 2015).

1.1 Research Problem

Heat waves in cities are a complex phenomenon driven by global greenhouse gas emissions, yet exacerbated by regional factors such as air pollution and the UHI effect. Developing successful strategies presents key challenges, especially when considering elderly individuals. Heat waves have been described as “silent killers” (Luber and McGeehin, 2008, p. 429), invisible during the event and fading from memory soon after the temperature drops (Klinenberg, 2002). Furthermore, vulnerability to heat-related mortality results from many interacting variables across different scales converging at the individual level. Some variables are rooted in structural challenges well beyond the heat wave’s time frame, such as issues of poverty, access to adequate housing and profound social isolation. In North America, a high reliance on air conditioning, essentially a maladaptation to heat, frequently complicates the issue. Not only do air conditioners emit excess heat that can increase temperatures during heat waves (Rizwan, Dennis & Chunho, 2007), but when high rates of usage strain the electrical grid, neighbourhood or city-wide outages further increase vulnerability (Queensland University of Technology, 2010).
Toronto, Ontario is the largest city in Canada with a population of 2.8 million (City of Toronto, 2016a). It consistently experiences high summer temperatures, accompanied by humid conditions (ICLEI, 2015). In the past, heat waves (in Toronto, defined as temperatures above 32°C for over three days or longer) have been relatively common; according to the Toronto Environment Office (2012), between 1971-2000, the city experienced an average of 0.57 heat waves annually, but the regional climate projections predict significant increases in that number. At the same time, Toronto’s population is aging; in the next fifteen years, the total number of seniors in the city is expected to grow by one-third (City of Toronto, 2012b). These two trends, taken together, create a situation that poses considerable future challenges for the city.

Since 1999, many sectors in Toronto have completed heat-health research. This has led to, among other activities, the development of an extensive heat-health warning system, heat vulnerability assessment projects (including vulnerability mapping of the general population and seniors), a community heat registry and research on mitigating extreme temperatures in multi-residential apartment buildings (Toronto Public Health, 2011; City of Toronto, 2012a; ICLEI, 2015).

1.2 Research Gap, Project Aims, Research Questions

Experts agree that the health impacts of climate change will be most significant in certain vulnerable regions of the globe and within vulnerable sub-populations (Ebi, 2009). Yet, which subpopulations, and how they will be affected has only just begun to be explored. As a 2011 report prepared for Toronto Public Health by the Clean Air Partnership, notes, “few studies in Canada go beyond a general discussion of climate change vulnerability to really delve into the health equity implications” (Pinto, 2012, p. 11). This thesis, by focusing on how the city is, will be, and should be, responding to changing demographics and rising numbers of heat waves is, in part, an outcome of this identified research gap.

This thesis aims to investigate critically how response measures in Toronto are working to reduce seniors’ vulnerability to heat waves and to explore viable alternative future pathways.

The following research questions guide this study:

1. How are current strategies in Toronto reducing the vulnerability of seniors to heat waves?

2. Using Turner et al.’s integrative vulnerability framework (2003) and perspectives of city and community stakeholders, what gaps and implementation challenges exist in Toronto’s current strategies for protecting seniors from heat waves?
3. What alternative pathways would be valuable for Toronto to address these gaps and reduce the vulnerability of seniors to heat waves in the future?

1.3 Value-Added of a Sustainability Science Approach

This project is informed by the principles of sustainability science. Sustainability science is an emerging academic field that aims to capture the “dynamic interactions between nature and society” (Kates et al., 2001, p.642). Research is problem-driven and pragmatic (Miller et al., 2014) with the aim of producing “usable, place-based knowledge” (Clark and Dickson, 2003, p.8059). Importantly, sustainability science is characterized “by the problems it addresses rather than the disciplines it employs” (Clark, 2007, p.1783).

Employing such an approach, this thesis brings together voices from diverse sectors of society: individuals in public health, urban planning, the environmental sector, the private sector, NGOs and civil society. In this way, it strives to understand the “breadth and depth of interconnections” across policy realms (Swart et al., 2004, p.139) and also relies on “non-conventional forms of knowledge,” (Polk, 2014, p.440), two important markers of sustainability science research. What emerges is a holistic perspective of the circumstances unique to Toronto. The problem of mitigating the vulnerability of seniors to heat demands a solution that extends far beyond the boundaries of public health interventions, and needs to consider issues of energy stability, infrastructure design and elder care. Crucially, it needs to address deeper societal questions about who we include and exclude in our society and why.

1.4 Research Scope

While the research is confined to the current boundaries of the ‘City of Toronto’, a result of significant urban amalgamations of 1998, the city is actually part of a much larger metropolis, the Greater Toronto Area (GTA with a population ~6 million). In this study, a senior is considered an individual sixty-five or older. The study’s timeframe is from 1999, when heat mitigation activity in Toronto began, to 2040, a future date for which both regional climate and demographic projections are available.
2 Context of Toronto’s Changing Situation

2.1 Toronto’s Changing Climate: Rising Temperatures and Increasing Heat Waves

Toronto experiences a continental climate of cold winters, hot summers and high humidity levels (ICLEI, 2015). Although temperatures are somewhat moderated by the Great Lakes, the city still faces heat waves in summer months (SENES Consultants Ltd., 2011). The city has begun to see the effects of global climate change on local climate in the form of heavier precipitation and more frequent flooding, rising rates of vector-borne diseases and more extreme heat (Toronto Environment Office, 2008).

In 2011, motivated by the inability of global and regional climate models to account for Toronto’s unique topography (the Great Lakes, the Oak Ridges Moraine, the Niagara Escarpment), the City of Toronto commissioned a study by SENES Consultants Ltd. to project what global climate change would mean for the city’s local climate. This study relies on the IPCC’s A1B emissions scenario.¹ Findings modelled for 2040-2049 reveal an average temperature increase of 4.4°C, temperatures exceeding 30°C on average 66 days per year (versus the average of 20 days per year between 2000 and 2009) and heat waves (or three day or longer periods of +32°C) to be roughly five times more likely annually in the city (Toronto Environment Office, 2012; SENES Consultants Ltd., 2011). The maximum daily temperature is projected to increase from 33°C (2000-2009) to 44°C (2040-2049) while this projected daily maximum rises to a sweltering 57°C (from 48°C) when the humidity index (humidex)² is considered (SENES Consultants Ltd., 2011). Approximately 130 died annually from extreme heat in the city from 1954 to 2000 but, with rising temperatures, by the 2080s, this figure is projected to increase two or three fold depending on population acclimatization rates (Toronto Public Health, 2005).

2.2 Toronto’s Shifting Demographics

As Toronto’s temperatures rise, the city will also experience dramatic demographic shifts. The most recent 2011 census from the City of Toronto (2012b) reports that individuals over sixty-five currently represent 14.4 percent of the Toronto population. In the next fifteen years, according to Toronto’s Flashforward research study (2006), this number of seniors (+65) is expected to grow by one-third reaching almost 500,000 in 2031 (City of Toronto, 2006, p.5). According to another more recent

¹ The A1 emissions scenarios are based on “a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies” The A1B emissions scenario, in particular, is

² The humidex, or the perceived heat for an average individual, is a product of both temperature and level of humidity. Since humidity increases with temperature and Toronto already experiences high levels of humidity, this measure is particularly relevant (Phillips, 2009).
study, conducted by Hemson Consulting Ltd. (2012), 1.2 million people will be older than 55 and 800,000 over 65 by the year 2041 out of a total projected population of 3.4 million (p.71). In addition, it is estimated that approximately 20 percent of Toronto’s current homeless are over the age of 50, many well on their way to being seniors (SSHA, 2009). Clearly, Toronto will need to expand its services for seniors significantly.

2.3 Toronto’s Urban Fabric

Toronto has a dense financial centre of high-rise buildings (often exceeding 100m) with infrastructure height giving way to mid-rise and residential homes beyond the core (Figure 1) (Wang et al., 2015a, p. 138). There are currently more than 2000 properties in Toronto above 12 storeys (ICLEI, 2015) and the city is undergoing intense densification, especially at major intersections. The city is situated on Lake Ontario, one of the five Great Lakes, and has several major expressways cutting through the city, including a multi-lane major highway across the top half. While city parks make up 12.7% of Toronto (Parks, Forestry and Recreation, 2013), parks are concentrated “along the waterfront and ravine valleys” versus the densely populated city core (De Sousa, 2003, p. 184).

![Figure 1. Land-Use Map, City of Toronto (Source) (Source: DMTI CanMap Route Logistics, 2002)](source.png)
2.4 Toronto’s Environmental Mandate

The city is aware that responding to rising temperatures with increased use of conventional air conditioning is an unacceptable path. It would dangerously enlarge the load on the electricity grid, worsen air pollution and increase the city’s greenhouse gas emissions (TPH, 2011). Thus, Toronto has already committed itself, through the 2007 Climate Change Action Plan, to ambitious greenhouse gas reductions, with a 2020 target that is 30 percent less than 1990 levels and a 2050 target of 80 percent less than 1990 levels (City of Toronto, 2007a). With these goals in mind, Toronto Public Health (2011) acknowledges the city must “adopt effective alternatives to air conditioning” when it addresses the human health issues caused by growing heat (p. 24).
3 Conceptual Framework

3.1 A Brief Overview of Vulnerability Analysis Approaches

Vulnerability, the “state of susceptibility to harm” (Adger, 2006, p.268) is a concept that has received considerable scholarly attention over the last 40 years (Kasperson et al., 2005). With foundations in fields of “natural hazards, rural livelihoods and poverty literature” (O’Brien et al., 2007, p.74), the term has come to occupy an important place in many disciplines, including ecology, public health and sustainability science (Füssel, 2007, p.155). The concept’s rich history is influenced by contributions from Amartya Sen’s entitlement theory, the idea of ‘coping through diversity’ and C.S.’s Holling’s concept of resilience (Turner et al., 2003).

In general terms, vulnerability is seen as a product of a defined system unit’s exposure, sensitivity and resilience to perturbations (sudden hazards) and stresses (hazards over a longtime) (Kasperson et al., 2005; Turner et al., 2003). Beyond this, however, conceptualizations of vulnerability vary dramatically across the literature (Füssel, 2007, p.156). Kasperson et al. (2005) categorize the different conceptualizations of vulnerability analysis into three different research traditions: Hazard and Risk Analysis, Critical Theory and Political Ecology and Integrative Analyses (Kasperson et al., 2005).

Hazard and Risk analysis, stemming from hazard research beginning in the 1950s-1970s, defines vulnerability as a function of exposure and sensitivity. While this first generation of natural hazards study contributed important concepts like coping capacity and societal resilience to the discussion on vulnerability, this approach is now judged to have overlooked relevant broader structural factors (Kasperson et al., 2005). Subsequent work in critical theory and political ecology analysis addresses this concern, identifying vulnerability to natural hazards as a product of external “social conditions” -- economic, political and social factors that can significantly inhibit response capacity. Recently, integrative vulnerability analysis focuses on internal and external factors impacting vulnerability and considers coupled socio-ecological systems (Kasperson et al., 2005). It is this third holistic approach to vulnerability analysis that informs this thesis.

Emerging from these three distinct research traditions approaches is a huge body of academic writing that, unfortunately, lacks consistency in its treatment of vulnerability (O’Brien et al., 2007), even by researchers in the same field (Füssel, 2007, p.156). This confusion is particularly true in climate change research, where the theoretical discussion of vulnerability has been called “unacceptably cluttered,” to the extent of “overwhelming the effective use of knowledge” (Kasperson et al., 2005, p.247). Semantic disagreements have been identified as the cause of
vulnerability analysis’ failure to function usefully for interdisciplinary sustainability research (Füssel, 2007, p.156). In particular, there is a serious knowledge gap about how vulnerability analysis can inform pragmatic climate change research and decision-making (O’Brien et al., 2007). This examination of Toronto’s situation purposefully uses the lens of integrative vulnerability analysis to analyze considerable recent empirical data and consider potential solutions.

3.2 Turner et al.’s Integrative Analysis

This thesis draws on the integrated framework for vulnerability analysis developed by scholars from the Research and Assessment Systems for Sustainability Program at Harvard University (Turner et al., 2003). Consistent with sustainability science, this integrative framework sees the world in terms of coupled human-environment systems. These systems, also referred to as “nature-society” or “socio-ecological systems” (Kates, 2012), are founded on the idea that “human action and social structures are integral to nature and hence any distinction between social and natural systems is arbitrary” (Adger, 2006, p. 268). Because of the constant “mutual interactions” between humans and the environment, these systems are “non-decomposable,” making it impossible to understand global trends by looking at only a human or an environmental component (Gallopin, 2006, p.294).

In Turner et al.’s framework, vulnerability is seen as a characteristic inherent to these coupled human-environment systems and one that can be analyzed at “any spatial or temporal scale suitable for the problem in question” (p. 8076). In a concerted effort to conduct vulnerability analysis more comprehensively and align analysis with the goals of sustainability science (p.8074), these authors propose expanding the scope of traditional vulnerability assessments, arguing for a systems analysis that considers the many complex multi-scale interactions both within the coupled human-environment system and those beyond the system (Turner et al., 2003, p.8074). By handling the coupled human-environment as one unit in order to consider internal and external system interactions, Turner et al. (2003) have, according to scholar Neil Adger, aimed “to understand vulnerability in a holistic manner in natural and social sciences” and achieved what Adger considers, “a conceptual advance in analysis” (p. 2006, p.272).

Turner et al. identify three key components in their expanded vulnerability analysis. These include the human-environment system’s \textit{exposure} to the hazard (both during and after the hazard has subsided), the system’s \textit{sensitivity} to this exposure and the level of \textit{resilience}, or the ability of the system to adapt to a hazard while retaining one of many fundamental states (Turner et al., 2003; Folke et al., 2002). Moving beyond these traditional dimensions of vulnerability, however, Turner et al. assert that analysis must be cognizant of a system’s adaptation following the hazard and consider
broader elements like multi-scalar interactions between hazard(s), systems and responses (p. 8075). This expanded vulnerability analysis can be seen in **Figure 2**.

**Figure 2.** Turner et al.’s Integrative Vulnerability Analysis (Source: Turner et al., 2003)

Although this framework acknowledges that, “comprehensive vulnerability analysis ideally considers the totality of the system,” the authors recognize that in real-world application, limits become necessary and thus, they provide a framework to conduct a “reduced-form” vulnerability analysis. In this reduced form, the three dimensions of vulnerability fall within the bounded internal human-environment system. However, despite these limits, researchers must always take into account the complex linkages between vulnerability and the broader peripheral human-environment system. Internal factors (shown in detail in **Figure 3**) exemplify the authors’ understanding that factors driving vulnerability within the human-environment system are as dynamic and interactive as external forces.
While the Turner et al. framework has many conceptual merits, this thesis takes a different approach to the third dimension of vulnerability, resilience, and here refers to it as adaptive capacity. This is primarily because resilience, with its biological roots, is a concept driven by thresholds or boundaries. These limits, when surpassed, are said to lead to a system transformation with a new structure and equilibrium. Applying resilience theory to social systems, however, misleadingly attempts to impose one artificial set of ‘thresholds’ for structural transformation on a system with many complex social realities and conflicting notions of its equilibrium and thresholds (Olsson et al., 2015). Adaptive capacity, used as the third dimension of vulnerability by a number of scholars (Adger, 2006; Ford and Smit, 2004; Wilhelmi and Hayden, 2010), provides flexibility to understanding how systems shift and change. Therefore, in this thesis, adaptive capacity is defined as Adger does --“the ability of a system to evolve in order to accommodate environmental hazard or policy change and to expand the range of variability with which it can cope” (2006, p.270).

This thesis also views adaptation more broadly than Turner et al. Its authors understand “coping mechanisms” to be “individual or autonomous actions and/or policy-directed changes” (p. 8077) that are exhibited during the hazard or as a result of it. They do not consider these adjusted coping
mechanisms as ‘adaptations’ unless they lead to “significant system-wide changes in the human-environment condition” (p.8077). This thesis, however, views adaptations more generously as, “adjustments in a system’s behaviour and characteristics that enhance its ability to cope with external stresses” (Brooks, 2003, p.8). For example, a senior seeking out an air-conditioned location, while not a significant system-wide change, is an individual adaptation that informs future coping mechanisms. This broader understanding of adaptation is important in the context of heat waves because it emphasizes individual agency, acknowledging the significance of individual behavioral shifts in reducing vulnerability during short, intensely hot periods. This view of adaptation also aligns with the perspective offered by Smit and Pilifosova (2007) who see “adaptations as either short or long term, localized or widespread” (p.884).

3.3 Justification for using Turner et al.’s Framework

These modifications aside, many aspects of the Turner et al.’s framework make it well suited for understanding the impact for seniors of increasing heat waves in Toronto. Its “integrative and interdisciplinary nature” (Adger, 2006, p. 272) creates opportunities to move between scales and consider simultaneously both physical and human contributory factors. This inclusive perspective is critical for any urban situation that operates at the individual, community and societal level and is as much a social challenge as it is a biophysical one.

Secondly, as the authors note, this framework is flexible: direction of analysis may move forward from the hazards to their consequences on the system or backwards from consequences to the hazard (p.8077). For a situation like Toronto where a severe heat wave has not occurred yet, planning will need to work backwards to develop the adaptation and response strategies to minimize projected consequences.

Lastly, the framework usefully emphasizes the importance of “place-based” vulnerability analysis, whereby every location is seen to have a unique human-environment system. Such an approach becomes highly relevant for analysing seniors’ vulnerability to heat waves in Toronto because the city exhibits some distinct contextual factors in its human-environment landscape. This framework helps develop an in-depth understanding of Toronto, contributing to the type of “usable, place-based knowledge” (Clark, 2003, p.8059) for which sustainability science strives.
4 Heat and Its Toll on Human Health

4.1 The physiological impact of extreme heat

During periods of extreme heat, the body becomes unable to thermoregulate and maintain a safe body temperature (*hyperthermia*) leading to conditions like heat cramps, heat syncope, heat exhaustion and, most serious, heat stroke (Koppe et al., 2004, p.20). Heat stroke is associated with a high likelihood of rapid mortality or “permanent damage” to organs (Kovats and Hajat, 2008, p. 42).

While high outdoor temperatures are the most obvious sign of heat waves, an individual’s thermal environment is actually determined by six components: air temperature, radiant temperature (sunshine), humidity, air movement (wind), metabolic heat produced (dependent on physical exertion and acclimatization) and clothing (Parsons, 2004). Furthermore, as with many people in the Western context, most Torontonians spend long hours inside and so indoor air temperature is a critical variable for determining core body temperature (Kovats and Hajat, 2008).

There are some challenges in establishing the connection between heat and mortality. According to a commonly accepted definition from the U.S. National Association of Medical Examiners, a death can be attributed to heat stroke or hyperthermia if core body temperature antemortem is ≥ 40.6°C or if core body temperature is <40.6°C but the cooling has been unsuccessful or liver and muscle enzyme levels are elevated with altered mental functioning (Donoghue et al., 1997). In instances of unknown body temperature, yet the death location has a known high air temperature and there are no other explanations, heat is labeled as a contributing, or secondary, cause of death (Donoghue et al., 1997; Daanen and Herweijer, 2014). The situation is further complicated by the concept of *early harvesting* to cover extreme heat deaths that would have occurred naturally a few days later (Kovats and Hajat, 2008). It is factors like these that have earned heat the label, “the silent killer” and made establishing indisputable mortality rates difficult.

4.2 Heat’s specific impact on the elderly

Elderly populations have consistently been identified as experiencing a higher rate of mortality during heat waves than the general population (Naughton et al., 2002; Vandentorren 2006; Baccini et al., 2006; Son et al., 2012; Sung et al., 2012; Yang et al., 2014; Zeng et al., 2014; Milan and Creutzig, 2015). Moreover, after fifty, the risk of heat-related mortality increases with age (Kovats and Hajat, 2008, p.47). Scholars explain this phenomenon using a combination of physical and mental factors associated with aging.
Aging impacts an individual’s ability to thermoregulate because cardiac capacity and level of blood vessel functioning is often reduced (Worfolk, 2000). Furthermore, aging, with its skin changes, affects sweat production; fewer sweat glands and less sweat gland activity limits an individual’s ability to cool off by perspiring.

Sweating capacity is also adversely affected by high levels of chronic dehydration commonly found in the elderly population and is attributed to suppressed thirst sensation, decreased urine concentration and lower water retention (Stalworth and Sloane, 2007; Worfolk, 2000). Dehydration during heat waves is particularly dangerous for the elderly since this population cannot effectively store salt and water in the kidneys and are already more susceptible to renal failure (Flynn, McGreevy and Mulkerrin, 2005). Physiological vulnerability is intensified because the thermoregulation disruptions caused by aging may impede individuals’ abilities to recognize they are over-heated and take appropriate protective action (Koppe et al., 2004).

Additional sensitivity factors associated with the elderly make them more vulnerable to extreme heat than the general population. These include lower levels of physical fitness and higher rates of disease (Koppe et al., 2004). Significantly, many medications commonly taken by seniors (for example, diuretics, proton pump inhibitors and beta-blockers) further reduce the body’s thermoregulation capabilities, thus heightening sensitivity to heat-related illness (Slevinski, 2007; Koppe et al., 2004, p.18). Furthermore, mental confusion or physical infirmity typically hinder the ability of the elderly to stay properly hydrated (Flynn, McGreevy and Mulkerrin, 2005), and incontinence challenges, addressed improperly by reducing fluid intake, also heighten dehydration risks (Worfolk, 2000). Being bed-ridden and dependent on others has also been shown to increase the risk of heat-related mortality (Kilbourne et al., 1982; Bouchama et al., 2007).

4.3 Risk and Protective Factors for Heat-Related Mortality

Since the elderly population is far from homogenous, seniors’ vulnerability to heat-related mortality depends on many other general risk and protective factors beyond age. These factors are commonly categorized using the three dimensions of vulnerability discussed earlier: **exposure**, **sensitivity** and **adaptive capacity**. While these three dimensions are useful, their division is, in many ways, arbitrary. A high degree of lateral connection exists, particularly between the dimensions of exposure and sensitivity. For example, socioeconomic class, commonly considered a sensitivity factor, is highly significant in determining quality of housing and access to air conditioning, two important variables that determine individual exposure levels. There has been considerable epidemiological research
devoted to understanding individual risk and protective factors for heat-related mortality, as outlined in **Table 1**.

**Table 1:** Individual Risk and Protective Factors for Heat-Related Mortality (Source: Author's Own Work)

<table>
<thead>
<tr>
<th><strong>RISK FACTORS</strong></th>
<th><strong>Sensitivity</strong></th>
<th><strong>Exposure</strong></th>
<th><strong>Adaptive Capacities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Psychiatric illness</td>
<td>(Naughton et al., 2002; Bouchama, 2007; Price, Perron &amp; King, 2013)</td>
<td>- Living on top floor</td>
<td>(Semenza et al., 1996; Naughton et al., 2002; Vandentorren et al., 2006)</td>
</tr>
<tr>
<td>- Cardiovascular disease</td>
<td>(Bouchama, 2007; Price, Perron &amp; King, 2013; Naughton et al., 2002)</td>
<td>- Living in older building</td>
<td>(Xu et al., 2013; Vandentorren et al., 2006)</td>
</tr>
<tr>
<td>- Pulmonary Illness</td>
<td>(Bouchama, 2007; Zhang et al., 2013)</td>
<td>- Living in a brick house</td>
<td>(Vandentorren et al., 2006)</td>
</tr>
<tr>
<td>- Renal dysfunction</td>
<td>(Zhang et al., 2013)</td>
<td>- Windows in home are kept closed</td>
<td>(Mirchandani et al., 1996)</td>
</tr>
<tr>
<td>- Inability to look after oneself</td>
<td>(Kilbourne et al., 1982)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Bed-ridden</td>
<td>(Bouchama et al., 2007)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Low socioeconomic status</td>
<td>(Zhang et al., 2013; Zeng et al., 2014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Living Alone</td>
<td>(Semenza et al., 1996; Naughton et al. 2002; Zhang et al., 2013)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Not going outside daily</td>
<td>(Semenza et al., 1996; Naughton et al., 2002)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PROTECTIVE FACTORS</strong></th>
<th><strong>Sensitivity</strong></th>
<th><strong>Exposure</strong></th>
<th><strong>Adaptive Capacities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Involvement in group pursuits</td>
<td>(Naughton et al., 2002)</td>
<td>- Air Conditioning</td>
<td>(Kilbourne et al., 1982; Naughton et al., 2002; Semenza et al., 1996; Kaiser et al., 2001)</td>
</tr>
<tr>
<td>- Access to neighbourhood social network</td>
<td>(Semenza et al., 1996)</td>
<td>- Green foliage around house</td>
<td>(Kilbourne et al., 1982)</td>
</tr>
<tr>
<td>- The ability to travel (by car, bus or train)</td>
<td>(Semenza et al., 1996)</td>
<td>- Drinking more fluids</td>
<td>(Vandentorren et al., 2006; Kilbourne et al., 1982)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Wearing light clothing</td>
<td>(Vandentorren et al., 2006; Kilbourne et al., 1982)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Seeking out air conditioned location</td>
<td>(Vandentorren et al., 2006; Kilbourne et al., 1982)</td>
</tr>
</tbody>
</table>
4.3.1 Sensitivity

Among the general risk factors relevant to increased senior sensitivity the level of social contact is especially significant. Semenza (1996) and Naughton et al. (2002) found that individuals who were well connected were at decreased risk of mortality during heat waves. By contrast, social isolation (often but not always associated with living alone) increases risk (Klinenberg, 2002). Seniors living in residential facilities are less likely to be victims of heat-related illness versus those in the community, probably because of the high level of support and social contact these facilities offer (Zhang et al., 2013). Elsewhere, low socio-economic status has also been associated with a high risk of heat-related mortality in studies done of Adelaide (Zhang et al., 2013) and Guangzhou, China (Zeng et al., 2013) although this link has not been conclusively established in European research (Hajat and Kovats, 2008, p.48).

4.3.2 Exposure

Individual levels of exposure to extreme heat naturally vary across a city because they depend on both residential living conditions and the surrounding neighbourhood microclimate. For elderly individuals, inside more often than other groups, indoor temperatures are critical for determining exposure levels (Smargiassi et al., 2008).

Since heat rises, those living on the upper floors of accommodations are also more susceptible to heat-related mortality (Semenza et al., 1996; Naughton et al., 2002; Vandentorren et al., 2006), particularly if ventilation is limited or windows are shut (Mirchandani et al., 1996). In addition, residing in older buildings is also linked to higher mortality in heat waves (Xu et al., 2013; Vandentorren et al., 2006), likely because aging building envelopes do little to stop heat transfer indoors. Since 90 000 Toronto seniors are living in older high-rise buildings, many without air conditioning (Toronto Tower Renewal, 2013), in-home exposure is directly relevant. Among protective features, several North American studies have found that access to air conditioning successfully mitigates heat waves --- individuals without air conditioning are at much higher risk of heat-related illness (Kilbourne et al., 1982; Naughton et al., 2002; Semenza et al., 1996; Kaiser et al., 2001). The cost associated with air conditioning, however, means that socioeconomic status affects its availability and, as will be shown, its environmental deficits make it problematic.\(^5\)

\(^5\) Access to a fan has not been found to reduce the risk of heat-related mortality (Naughton et al. 2002; Semenza et al. 1996), especially in temperatures above 37.2°C. Unlike air conditioning, which works to reduce ambient air temperature (Kilbourne, 2002), fans aim to reduce skin temperature by generating air movement to facilitate evaporation. In temperatures above 37.2°C, however, fans may only be moving hot air, making an individual hotter as opposed to cooler (Perrin et al., 2006, p.37). More research on cooling by fan ventilation is needed to better understand if and when usage should be advocated (Bouchama et al., 2007).
On a neighbourhood level, the temperature of the immediate urban environment also influences exposure levels to extreme heat, with Vandentorren (2006) showing temperature directly outside the home to be correlated with an increasing risk of heat-related mortality.\(^4\) That trees and vegetation adjacent to the home are an effective protective factor (Kilbourne, 1982) has important implications for urban forestry initiatives.

### 4.3.3 Adaptive Capacity

Lastly, studies based on broad populations have shown there are short-term adaptation strategies all individuals can take to decrease serious risks posed by heat: additional baths and showers (Naughton et al., 2002); drinking more fluids; wearing light clothing; seeking out an air conditioned location (Vandentorren et al., 2006; Kilbourne et al., 1982). Whether individuals, seniors or not, engage in these types of individual adaptation, and thus exhibit ‘adaptive capacity,’ is closely linked to their own perceptions regarding extreme heat (Wilhelmi and Hayden, 2010).

\(^4\) Vandentorren (2006) in their study during a heat wave in Paris, found that for every 1°C rise in temperature outside the house, mortality would increase by 50 percent.
5 Research Design and Methods

5.1 Research Philosophy, Strategy and Case Study Design

Critical realism, a research philosophy bridging realist ontology and constructivist epistemology (Maxwell, 2012, p.5) informs this thesis. Critical realism, acknowledges one objective reality --- “a world existing independently of our knowledge of it” (Sayer, 2000, p.1); however, epistemologically, no individual has complete knowledge of this reality. Rather, humans have many diverse, subjective formulations of the world, all of which are imperfect yet credible (Maxwell, 2012, p.5).

Critical realism is valuable for exploring sustainability challenges because it recognizes “the reality of the material dimensions of the problem” while conceding diverse and often conflicting human narratives (Cornell and Parker, 2010, p. 31). This Toronto study takes the perspective that while the problem of extreme heat for the elderly is an objective reality, many different social constructions for understanding the issue and its viable solutions exist. This has motivated the decision to include a wide variety of city and community stakeholders in this study.

A case study design was chosen because this approach explores the particular conditions and strategies unique to the subject (Stake, 1995). Case study research is often critiqued for its lack of application to other contexts (Bryman, 2012, p. 71). However, as Yin (2009) argues, case studies have great value for in-depth study, bringing to light insights that “are generalizable to theoretical propositions and not [just] to populations” (p.10). Since this thesis contributes valuable contextual findings on Toronto’s approach to protecting its seniors from extreme heat, it can also provide generalizable findings for cities of similar size and geographical setting like Chicago.

5.2 Methods: Literature Review, Documents and Interviews

The material for this thesis was gathered through a literature review, document consultation and semi-structured interviews. Research methods are summarized in Table 2.

In line with a critical realist approach, the interview was employed as a research method. A wide range of interviewees helps provide “the roadmap to multiple realities” (Stake, 1995, p.64) and accords with the transdisciplinary research methods favoured by sustainability science, which sees value in non-expert systems of knowledge (Polk, 2014). Diversity in interview subjects was especially important since many documents analyzed were from the divisions of Toronto Public Health and the Toronto Energy and Environment Division.
### Table 2: Research Methods

<table>
<thead>
<tr>
<th>Research Method</th>
<th>Description</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documents</td>
<td>Wide range of documents consulted (Public reports, Staff Backgrounder files, PowerPoint presentations) from many different city departments and NGOs. Reference lists from major reports augmented original document list</td>
<td>Source for identifying interviewees, understanding current policy and formulating questions. Material from documents also used in thematic analysis.</td>
</tr>
<tr>
<td>Semi-structured Interviews</td>
<td>20-40 minute interviews conducted in Jan-Feb 2016 with city employees, community care agencies, non-profit organizations; majority in-person; some by phone or by email (Appendix A). Used ‘purposive sampling’ (Bryman, 2012) whereby interviewees had experience with strategies for extreme heat or worked closely with elderly populations. Interviews recorded and transcribed verbatim. Where requested, transcripts sent to interviewee for verification. Interviewees signed consent form (Appendix C2), had the right to remain anonymous, could withdraw participation at any time during the interview</td>
<td>Material used for thematic analysis. Interviewees sometimes suggested other valuable leads and sources to consult.</td>
</tr>
</tbody>
</table>

Consulting documents as data requires awareness that they are “social facts” carrying underlying social values, not necessarily reflective of the reality of the situation or even the originating organization (Atkinson & Coffey, 2011, p. 79-80). For this reason, this study consulted a diverse document body, with document validity assessed using J. Scott’s four measures of authenticity, credibility, representativeness and meaning (1990, p.6) and interviews used as an alternative means of understanding social reality. This study analyzed both documents and relevant information from interviews together according to thematic analysis methods as outlined by Bryman (2012). Themes...
were constructed based on research questions and ideas that emerged from both documents and careful reading of interview transcriptions.

There are some important limitations to acknowledge in this interview process. The compressed time period for fieldwork (6 weeks in Toronto) restricted the number of interviews possible to schedule.\textsuperscript{5} More importantly, while this study considers strategies for elderly in extreme heat, it was not possible to include the elderly’s perspective in this project for two reasons. Firstly, a serious heat event, such as the ones in Europe or Chicago has not yet hit Toronto, which means awareness about the danger among the aging population is relatively low. Secondly, in practical terms, a comprehensive survey of seniors in the city (especially reaching those socially isolated but still living independently) was outside the time frame and resources for this project.

\textsuperscript{5} In addition, several individuals contacted for an interview were either unavailable or did not reply (even with follow-up).
6 Results and Analysis

6.1 Current Work in Toronto

A wide range of initiatives exist in Toronto to address extreme heat; some address sensitivity, others exposure, and others, adaptive capacity. Toronto interventions function on both a social scale (individual, community or city level) and an environmental scale (building, neighbourhood or city level).

6.1.1 Increasing Adaptive Capacity

Fostering Individual Level Change: City of Toronto Heat Alert and Response Program

Toronto Public Health (TPH), the main city department for heat mitigation efforts, has worked on the topic of extreme heat for over 15 years (TPH, 2011). TPH operates the Heat Alert and Response Program, which can be considered a citywide adaptation aimed at generating individual level change by increasing adaptive capacity. Specifically, the program focuses on enhancing existing coping mechanisms. The program’s attention to the individual is seen as particularly well suited to situations where the needs of the most vulnerable, like the elderly, need to be addressed (Milan and Creutzig, 2015).

The Heat-Health Alert System, the Hot Weather Response Plan (HWR) and other proactive measures are all key features of this program (TPH, 2011). The Heat-Health alert system6 7 assumes that if individuals are notified during dangerously hot weather, they will modify their behaviour to protect themselves. This alert system is augmented by a year-round public education campaign that increases individual adaptive capacity ('Proactive Components’ Table 1). Turner et al. (2003) would call it promoting different autonomous options for adaptation. High-risk groups, like seniors and their service providers, are specifically targeted through home-care agencies, health care workers, and seniors’ organizations. This messaging spreads awareness about heat-related mortality, and major mitigation strategies (fluids, cold shower, seeking air-conditioned locations). The end goal, as with heat alerts, is to foster an individual adaptation, in this case, ongoing behavioural changes. For example, this might involve a senior, prompted by either the alert or educational material, to adapt to heat by seeking an air-conditioned shopping mall.

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6 A heat alert is called in Toronto when mortality is 25 percent to 50 percent more likely than average levels (based on weather conditions forecasted by Environment Canada) while an extreme heat alert is called when mortality is 50 percent more likely (City of Toronto, 2015a, p. 4).

7 The City of Toronto will become a part of the new provincial system for issuing heat alerts (the Harmonized Heat Alert and Response System) as of May 2016 (City of Toronto, 2015a).
Toronto’s program also astutely recognizes a feature stressed by Turner et al.’s framework: individuals within a population will always exhibit “differential vulnerability”, “maintain different response options” (2003, p.8078) and exhibit different adaptive capacities. Significantly, the socially isolated are recognized as the highest risk group (City of Toronto, 2015a, p. 3). Thus, when a heat or extreme heat alert is issued, the city notifies “900 community agencies and individuals servicing vulnerable populations” and city staff (City of Toronto, 2015a, p. 5)\(^8\) and the reactive components of the HWR are implemented. As is clear from Table 3, an umbrella of organizations is deployed to support elderly at-risk clients during heat waves. Thus, the program enhances adaptive capacity and reduces overall vulnerability for individuals who, because of sensitivity factors like limited mobility or poor health, cannot adapt independently.

**Table 3.** A selection from the City of Toronto’s HWR Plan activities* most relevant to seniors

<table>
<thead>
<tr>
<th>Responsible Party</th>
<th>Action /Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proactive Components</strong></td>
<td></td>
</tr>
<tr>
<td>Healthy Environments Division, Toronto Public Health</td>
<td>-circulates educational material on extreme heat to a wide range of service organizations, institutions and individuals</td>
</tr>
<tr>
<td>Healthy Families Division, Toronto Public Health</td>
<td>- implements public education campaigns on staying healthy in the heat during the summer months; special attention paid to reaching seniors organizations, community agencies, property managers and non-profits that support the senior population</td>
</tr>
<tr>
<td>Toronto Community Housing</td>
<td>-circulates heat education material for tenants</td>
</tr>
<tr>
<td>Canadian Red Cross**</td>
<td>-trains workers at community services organizations who serve at-risk populations (often seniors) regarding symptoms of heat distress and appropriate treatments</td>
</tr>
<tr>
<td>Ontario Community Support Association (OSCA)**</td>
<td>- circulates educational material and runs staff training</td>
</tr>
<tr>
<td><strong>Reactive Components</strong></td>
<td></td>
</tr>
<tr>
<td>Healthy Environments Division, Toronto Public Health</td>
<td>-in prolonged heat wave, visits 300 identified residences for vulnerable individuals (rooming and boarding houses, shelters, lodging homes) to evaluate how well HWR Plan is implemented and support landlords where needed</td>
</tr>
<tr>
<td>Toronto Community Housing (subsidized public housing division of city)</td>
<td>-plan states that buildings with common room with air conditioning must ensure 24 hour access to room</td>
</tr>
<tr>
<td>Toronto Shelter, Support and Housing Administration</td>
<td>- contacts all hostels asking for 24-hour AC common areas and offers support to the homeless, including distributing transit tickets to access cooling centers</td>
</tr>
<tr>
<td>Canadian Red Cross</td>
<td>- operates cooling centres -carries out wellness checks on vulnerable individuals - ensures community agencies have water to distribute to clients (B. Rosolak, personal comm., 2016)</td>
</tr>
</tbody>
</table>

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\(^8\) The degree to which the notification system actually works is beyond the scope of this report, but personal research confirms that both Christie Gardens, a large mid-Toronto retirement home, and Central Neighbourhood House, a community support services agency with many senior clients, receive these alerts (J. Alves, personal comm., 2016; V. MacDonald, personal comm., 2016).
| Community Care Access Centres (CCACs)*** | - notify both their own employees and contracted service providers when alert is called and encourage extra vigilance to clients’ health (C. Mee, personal comm., 2016)  
- required to design individualized plans for supporting certain vulnerable clients during alerts |
| Community Health Centres and the Ontario Community Support Association) | - disseminate heat alerts and connect with their most vulnerable clients |
| Office Of Emergency Management (OEM) | - in the scenario of a heat emergency, Toronto’s Emergency Plan, Operational Support Functions (eg. Emergency Medical Services, Emergency Operations Centre etc.) and Risk Specific Plans will be implemented to strengthen the hot weather response (TPH, 2014) |

*Unless otherwise cited, all chart information drawn from (City of Toronto, 2015a)
**Contracted by the City of Toronto Office of Emergency Management
***The OSCA is an extensive network of home-care organizations
****Providers of at home and community care medical services

**Building Strong Community Networks: Creating Resilience for Extreme Weather (CREW)**

But at the end of the day, if you are going to reach people that are not easily reached, you actually have to walk it out. You have to walk to all those places where they are and talk to people about what affects them directly. I don’t think that there is any other way to get those messages out.”

- Sheila Murray, co-founder, CREW

A current initiative by the non-profit organization, Creating Resilience Against Extreme Weather (CREW), is working to increase community level adaptive capacity to extreme weather in Toronto. As the work of CREW is relatively new, it can be considered an “adjustment or adaptation” where impacts on the system are promising, but not yet fully clear. CREW has just concluded an eight-month pilot project in Victoria Village, an ethnically diverse east Toronto neighbourhood where 18 percent of the population are seniors (2011 census, but this figure is growing) and 34 percent of these seniors live alone (City of Toronto, 2014). The pilot project, working with two groups of low-income seniors to develop their own community strategy for combatting extreme weather, is the type of adaptation that Smit and Wandel (2006) would call, a “bottom-up approach,” for the way it “employs the experience and knowledge of community members“ (p. 285). In the model, pairs of seniors (‘Extreme Weather volunteers) proactively distribute educational material and gather contact information in their buildings, while committing to carry out door-to-door checks in a heat wave emergency (S. Murray, personal comm., 2016). While too early to see the full impacts, this initiative has promising potential to build community adaptive capacity by fostering more permanent relationships and establishing the resources and pre-crisis organization necessary to adapt collectively in an emergency. In this way, community members can “be their own first responders” (L. Rayval, personal comm., 2016). Furthermore, the project’s door-to-door human contact can support

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1 The pilot was funded by a $25 000 New Horizons Grant and has been a collaborative project with Working Women Community Centre and the initiative Action for Neighbourhood Change (S. Murray, personal comm., 2016).
isolated seniors, a population at high-risk of heat-related mortality that may be missed by higher-level city initiatives.

6.1.2 Reducing Heat Exposure Levels in Buildings

Exploring Maximum Temperature Standards

While Toronto’s HWR Plan and CREW’s pilot initiative focus on increasing adaptive capacity, Toronto Public Health has also been working to reduce indoor exposure levels to high temperatures. Residents of older multi-residential apartment buildings without air conditioning are one its major targets. To date TPH’s research has included a ‘cooling’ room pilot project in a Toronto high-rise (with Tower Renewal staff); a commissioned literature and jurisdictional review on cooling options in high-rises; and a 2015 municipal roundtable with consultations ongoing on the question of maximum temperature standards (TPH, 2015; C. Mee, personal comm., 2016). While no action has been taken as of yet, a staff report from 2015 called for a feasibility assessment of making onsite cooling centres obligatory in buildings without air conditioning and mandating a temperature threshold in buildings above which an onsite cooling centre must be provided (TPH, 2015). Either of these citywide adaptations holds promising potential to improve exposure levels for residents without air conditioning and reduce vulnerability.

New Building Resilience Standards to Address Rising Heat

There has also been encouraging work since 2013 by the City of Toronto Energy & Environment Division working with the Building Operations Management Association branch in Toronto (BOMA Toronto) to develop new building resilience standards. BOMA Toronto, which serves 600 commercial building owners (primarily offices but some apartments), outlined their exploratory work aimed at “best practice in resilience for commercial buildings” (Hay, 2015, p.1) in a 2015 discussion paper. In essence, buildings would be constructed to prevent extreme weather from impacting “critical functionality” letting it deliver, “reliable stand-by power and services to cushion and enable tenant response and recovery” (p.10). Prompted by David MacLeod, Senior Environmental Specialist, City of Toronto, who believes that resilience standards should also be available for lower income buildings and who has been working on the issue since 2012, BOMA has agreed to expand the scope of its resilience standards to make them applicable to its residential buildings. Furthermore, BOMA has indicated the possibility it will share resilience standards with non-BOMA apartment properties (D. MacLeod, personal comm., 2016). Clearly this initiative is still in its early stages, but new residential building standards have the potential to reduce heat exposure and improve adaptive capacity for
seniors, including most obviously a dependable back-up power supply during heat waves so that air conditioning and elevators continue to function.

*Cooling Benefits from Retrofitting Older Multi-Residential Apartments*

Toronto’s High-rise Retrofit Improvement Support program (Hi-RIS), while undertaken to improve energy and water efficiency, also works to reduce the cooling load of buildings and reduce summer indoor exposure levels to high temperatures. This three year pilot is especially important since it targets older buildings, over five storeys and largely lacking air conditioning, whose residents (including many seniors) are at considerable risk of high internal temperatures (City of Toronto, 2016b). Window replacements, an improvement eligible under the HI-RIS loan scheme, are believed to be beneficial for mitigating indoor temperature while understanding the impact of retrofits on indoor heat is a current focus for project staff (city official, personal comm., 2016). Like HI-RIS, the Toronto Atmospheric Fund Energy Saving Performance Agreement, also finances retrofits in Toronto apartments that improves energy efficiency and reduces building cooling load (Toronto Public Health, 2015) and indoor temperatures. However, both of these programs are “currently limited in scope and time” (TPH, 2015, p. 12); while they improve exposure conditions in the buildings they have reached, many buildings, and therefore many senior residents, are not covered.

**6.1.3 Improving Citywide Exposure Levels by Reducing the Urban Heat Island (UHI) Effect**

Lastly, the City of Toronto is also making changes to its urban fabric that, along with many other co-benefits, will mitigate the urban heat island effect and help reduce outdoor (and in some cases indoor) temperatures for all residents, including seniors, thus decreasing vulnerability. Remarkably, Guindon and Nirupama (2015) identified 742 City of Toronto policies (including those under review) as contributing in some way to decreasing the UHI effect. This scope of current work in Toronto refutes Milan and Creutzig (2015)’s position that urban planning approaches to mitigate the impact of extreme heat are seldom carried out. Three significant city policies at the building level are outlined below (Table 4). Changes to the urban environmental landscape are promising for two reasons. The city is capitalizing on the research indicating that outdoor temperatures varies considerably between neighbourhoods based on land surface types, especially amount of vegetation (Klok et al., 2012, p.23). Furthermore, unlike measures in the city’s HWR plan that demand a certain level of individual adaptive capacity, the benefits of urban landscape modification automatically accrue to all. Thus, city wide urban planning interventions can play a critical role in improving

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10 As of June 30, 2015, the Toronto Atmospheric Fund had financed ten retrofits, though only some are residential (Stoate, 2015).
conditions for groups with limited individual adaptive capacity, like seniors with mobility or cognitive challenges.

**Table 4:** A Selection of City Policies for Modifying Infrastructure and Reducing the UHI

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
</table>
| City of Toronto’s Green Roof Bylaw | A green roof, a roof that “supports growth of vegetation over a substantial portion of its area,” is mandated for any commercial, institutional, residential or industrial building with a floor area of 2000m² or greater mandated (City of Toronto, 2016c; City of Toronto 2016d)  
In industrial buildings, a cool roof, or a “roofing system with an exterior surface with high “solar reflectivity” and “thermal emissivity” that reflects” solar radiation, can be substituted for a green roof (City of Toronto, 2016c; City of Toronto, 2016d)¹¹ |
| Eco-Roof Incentive Program¹² | Funding provided for green or cool roofs on existing buildings (City of Toronto, 2016d) |
| Toronto Green Standards | New environmental construction standards  
Explicitly reduce UHI by mandating “50% of the site’s non-roof hardscape” in low, mid and high-rise development use methods like “high-albedo surface materials,” “open grid pavement” “shade from tree canopy” or “shade from structures covered by solar panels” (City of Toronto, 2015b; City of Toronto, 2015c)  
Further reduce UHI by requiring any new construction protects and increases the urban tree canopy |

### 6.2 Gaps and Challenges

While Toronto exhibits a wide range of activities working at different environmental and social levels to reduce senior vulnerability to heat, there are areas where its strategies seem inadequate. This portion of the discussion will address challenges associated with implementing these strategies and current gaps in planning, specifically in the context of the elderly.

#### 6.2.1 Reaching High-Risk Groups within the Senior Population

Evidence suggests that while the general population is well aware of Toronto’s heat alerts (TPH, 2011), the public messaging does not seem to reach all seniors living at home. The most recent research conducted solely with the elderly, based on telephone surveys during the 2004 and 2005 heat alerts, reported that 17 percent of respondents were unaware that a heat alert was in effect.

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¹¹ Important to note is that while green and cool roofs decrease the UHI, their effectiveness in reducing street-level temperatures decreases with building height (Santamouris, 2014). Thus green and cool roofs installed on new Toronto high-rises may not significantly impact outdoor temperatures. Regardless of height, however, these roofs bring indoor benefits like reduced indoor temperatures in buildings without air conditioning and reduced cooling load in those with air conditioning (Arabi et al., 2015).

¹² The program has been in place since 2009 with over 100 roofs funded to date (City of Toronto, 2016d).
(Sheridan, 2007). Experts feel that the percentage of “unaware”, however, was likely larger since some high-risk seniors, out of fear or mobility challenges, do not respond to phone surveys (Bassil and Cole, 2010, p.995). While the senior population in Toronto varies widely in its use of broadcast and web-based communication, “technological barriers” can limit access to information for some seniors (City of Toronto, 2013a, p.98). Sheila Murray, of CREW, confirms that many of the elderly she works with are unlikely to consult the City of Toronto website for extreme heat information (personal comm., 2016).

Already in 2007, the municipality recognized the challenge of “reaching those who are most vulnerable” (City of Toronto, 2007b, p.1), and current city staff still acknowledge the difficulty of confirming that heat alert messaging reaches seniors living at home (B. Rosolak, personal comm., 2016; C. Mee, personal comm., 2016). As a result, heat messaging during heat waves “is usually targeted at the general population to have them check on vulnerable people including seniors” (C. Mee, personal comm., 2016). A strategy, however, that relies on friends, family and community agencies to monitor at-risk seniors, does not account for the significant number of socially-isolated seniors already in the higher risk group of heat-related mortality (Semenza et al., 1996; Naughton et al., 2002; Zhang et al., 2013). While it is inherently difficult to identify social isolation rates in a population, living alone does increase the likelihood of being isolated (City of Toronto, 2013a). In Toronto, where 95 000 seniors live alone, including 44 percent of individuals 85 and older, effective strategies to identify, connect with and enhance the adaptive capacity of socially isolated seniors during heat waves are urgently required (City of Toronto; 2013a; City of Toronto, 2016e).

This challenge is far from unique to Toronto. Failing to reach the socially isolated, is, as Turner et al. (2003) would say, “nested” in broader patterns of modern social conditions (p.8075). In the context of his study of the 1995 Chicago heat wave, sociologist Eric Klinenberg argues that it is the “deeper question of why so many Chicagoans lived and died alone” (2002, p. 47) that are often neglected in epidemiological studies of the heat wave. Klinenberg asserts social isolation in American society has many causes, including, but not limited to, more elderly living alone, an emergence of “a culture of fear” preventing them from reaching out, and an ongoing erosion of vibrant community space and collective, supportive housing (p.48). These forces are evident in Toronto too. Individuals working in community non-profits speak of widespread social isolation and fear among the elderly population, compounded by lack of supportive housing (S. Murray, personal comm., 2016; K. Luoma & V. MacDonald, personal comm., 2016). Thus, reducing the vulnerability of Toronto’s socially isolated

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13 Here “socially isolated” will follow Eric Klinenberg’s definition of “having limited social ties” (2002, p. 44).
seniors to extreme heat is not just about making sure messages reach this population to increase their adaptive capacity. It also rests on tackling broader social processes that isolate these individuals in the first place.

Cooling centres clearly have their limitations too as a city adaptation strategy. Community agencies and non-profits criticize them as ineffective, largely because distance to cooling centers disadvantages those with mobility problems (B. Rose, personal comm., 2016; K. Luoma, personal comm., 2016) (Figure 4). In fact, a lack of special transport for seniors with mobility challenges was identified as a significant gap in city responses to heat waves (V. MacDonald, personal comm., 2016). Urban researchers elsewhere have confirmed the ability to travel (by car, bus or train) is a significant protective factor against heat-related mortality (Semenza et al., 1996). The fear of leaving a familiar, if uncomfortable, home environment also bars seniors from visiting cooling centres (S. Murray, personal comm., 2016), a fear confirmed by a 2010 Toronto Public Heath survey that identified “accessible transportation, distance and neighbourhood safety” as the factors that discouraged city residents from seeking a cool location outside the home (TPH, 2011, p.24). B. Rose, a manager at Parkdale Activity-Recreation Centre, has called for more local, familiar, neighbourhood spaces for cooling centres (personal comm., 2016).

Do some city strategies that seem to offer what Turner et al. labels “autonomous options” (2003, p. 8077) actually fall short for the most vulnerable elderly? Despite the city’s well-intentioned desire to target the vulnerable, the heat alert messaging system and cooling centres are both adaptation
measures more useful for the general population than for high-risk senior sub-groups. In this sense, both of these citywide strategies seem guilty of the trend in adaptation towards reducing “the vulnerability of those best placed to take advantage of governance institutions” versus genuinely reducing “the vulnerability of the marginalized” (Adger, 2006, p. 277). Another aspect of the city response that is problematic concerns the city’s Long Term Care Homes and Services department. While the HWR plan states that this department will provide “relief short-term stay beds for use by frail isolated seniors during an extreme weather event” (City of Toronto, 2015a, p. 8) a recent inquiry with this division revealed that, rather than supplying beds, the city’s long-term care centres have provided neighbourhood cooling centres (city official, personal comm., 2016), a measure already shown to have limited effectiveness with the most vulnerable. Here again, the city’s apparent offer of a valuable autonomous option for high-risk seniors falls short.

6.2.2 Changing Risk Perception

A further challenge for many current Toronto Public Health heat interventions is that these strategies depend, not just on awareness of new autonomous options and the capacity to adapt, but also on motivation to take action. Motivation for behavioral shift is closely connected to individual risk perception: is a hazard like a heat wave seen as a particular personal threat or not? (Coppola, 2011). Thus, low levels of risk perception, both in this population and in the broader community, pose another significant challenge for protecting seniors from extreme heat. As Carol Mee at Toronto Public Health, explains, regardless of the extent of public messaging, “unless you feel that you are personally at risk, it is hard for you to decide that you are going to take action or not” (personal comm., 2016).

Other international studies on the awareness of the elderly concerning heat waves also demonstrate low levels of risk perception and limited behavioural change during heat waves (Smoyer, 1997; Abrahamson et al., 2009). Interestingly, Wolf et al.‘s 2010 study in England found that, although the elderly individuals interviewed did not see heat as a danger to them personally, they were able to identify other at-risk groups (people older than they or with limited mobility or ill health). One Toronto study corroborates this kind of finding. Sheridan (2007), when surveying a portion of the Toronto senior population during a heat alert, found that although 83 percent were aware of the alert, only 46 percent adjusted their behaviour. The problem is further complicated because Toronto has not yet had a heat wave the scale of Chicago in 1995 or Europe in 2003, creating a dangerous widespread complacency towards extreme heat in the city. In fact the 2013 ice storm with its prolonged power outages is much closer to Torontonians’ top of mind than heat threats. In the
circumstance, fostering behavioural change through current public awareness programs can be challenging.

Interviews with multiple city officials and analysis of city documents demonstrate well-entrenched awareness at the policy level of what Turner et al. (2003) would call the differential vulnerability between social units. Put simply, the city knows that many seniors and, particularly ones with mobility and social challenges, are more at risk for extreme heat than others. However, shifting the attitudes of the elderly about their level of personal risk to improve adaptive capacity to extreme heat events is a real challenge. As Wolf et al. (2010) argue, “unless those at risk are able to identify themselves as such and feel able to take action, merely disseminating information about preventative strategies has limited value” (p.28). Thus, heat-related messaging in Toronto needs both more urgency and more nuance to reach, support and shift perceptions about risk.

6.2.3 Gaps in Residential Infrastructure

Heat mitigation strategies in Toronto have not yet effectively addressed the inadequacies of some residential infrastructure. Ongoing conditions in both older multi-residential high-rise apartment buildings and rooming houses in the city raise concerns over high exposure levels and the ways in which buildings limit residents’ adaptive capacity.

Multi-Residential Apartment Buildings

Of particular concern for high temperatures is a group of close to 1200, primarily concrete, apartment buildings, constructed from 1945-1984 that stand at least eight storeys and house 25 percent of all Toronto’s residents (TPH, 2015, p.3; Toronto Tower Renewal, 2013). These buildings represent 500 000 Torontonians, 18 percent of whom are seniors (Toronto Tower Renewal, 2013). However, central air conditioning in these apartments is rare; natural ventilation is limited since safety regulations dictate windows can only open 10cm when situated above 2 metres above the ground; and building envelope components (roof, windows, walls) at the end of their lifespan do little to keep heat out (TPH, 2011). While there has been no comprehensive study of indoor temperatures in this building stock, some troubling evidence does exist. When the United Way, a large charitable organization, conducted a study in 2009 and 2010 of over 2000 renters of high-rise apartments in the city’s inner suburbs, “16.4 per cent of survey respondents said that their apartment was always too hot in the summer and a further 33.4 per cent said it was sometimes too hot” (2011, p.63). These figures are alarming in light of future climate projections of 57°C daily maximums (with humidex) by the 2040s (SENES Consultants Ltd., 2011).
Beyond high temperatures, Toronto’s older high-rise building stock is projected to face other extreme heat impacts, such as more malfunctioning elevators and electricity overloads from increased air conditioning use. Since both these scenarios significantly impact the adaptive capacity of residents and, in particular, seniors, they increase overall vulnerability. Problems are attributed not just to the deterioration of the building fabric, but also to the fact that original climatic design standards were based on historical climate trends no longer sufficient for a hotter city (GRG Consultants, 2011). A 2012 risk assessment for a Toronto public housing apartment building is illustrative of how the city’s aging high-rise infrastructure is increasingly inadequate for extreme heat (Table 5).

Table 5: A Case Study of 285 Shuter Street

<table>
<thead>
<tr>
<th>Building</th>
<th>Type</th>
<th>Year</th>
<th>Components</th>
<th>Risk Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>285 Shuter Street</td>
<td>Public Housing</td>
<td>1964</td>
<td>Envelope, Electrical System</td>
<td>Medium Risk</td>
</tr>
</tbody>
</table>

In 2012, GRG Building Consultants completed the Climate Change Vulnerability Assessment of the Toronto Community Housing building on 285 Shuter Street. Built in 1964, the 16-storey high rise is typical of its era. Virtually no building envelope upgrades (walls, roof, windows) have been completed since construction, central air conditioning is non-existent and only 15-25 percent of suites have a self-installed air conditioning window unit. While the study focused on the impact of future climatic conditions on building components (building envelope, electrical system etc.), it forecast worrying conditions for residents. Based on the premise that extreme heat projections would make air conditioning “a necessity” (p.15) and that residents would increasingly self-install and operate their own window air conditioning, the study foresaw a ‘high-risk’ situation with accompanying electricity overloading, as well as possible death or injury from improper installation (p.80). It identified future extreme heat as a ‘medium risk’ for elevator electrical equipment, raising concerns about how elderly individuals with compromised mobility would exit the building during a heat wave if the elevators failed. Lastly, the study pinpointed the building’s generator, already beyond its lifespan, as at “medium risk” from extreme heat projections, a scenario that would leave air conditioning units and the elevator compromised in the case of a neighbourhood or city-wide power outage during a heat wave.

**Rooming Houses**

If conditions in some apartment buildings are a concern in a hotter Toronto, so too are conditions found in some of Toronto’s rooming houses (defined as a shared accommodation with four or more renters). According to a review from 2004, 701 of these exist in the city although, in reality, illegal rooming houses make this number much higher. Incomplete statistics on this housing suggest a diverse demographic, some of whom are senior renters (Social Housing Strategists, 2004). The City of Toronto Rooming House Review Public Consultations confirms seniors do use this kind of affordable housing but does not provide numbers (Public Interest, 2015). Typically constructed pre-1925, these rooming houses are often run-down, with residents at a 2015 public consultation voicing concerns over “poor quality” and “substandard living conditions” (Public Interest, 2015, p. 29; Social Housing Strategists, 2004). It is not surprising, therefore, that between 2010-2013, indoor
temperatures from 32°C to 39°C were recorded by officials visiting rooming houses on extreme heat alert days (TPH, 2015).14

The situation for senior residents in both older high-rises (20 percent of residents) and rooming houses is further compound by other factors judged to increase this group’s sensitivity to heat-related mortality. Poverty and recent immigration are characteristics of many living in older high-rises (United Way, 2011; TPH, 2011). Likewise, rooming house residents are primarily “low income” with “limited housing options” (SHS Strategists, 2004, p. 8). While no specific statistics exist about air conditioning access in these accommodation types, a 2010 Toronto Public Health survey showed apartment tenants, other renters, recent immigrants and those of low socioeconomic status all had a lower likelihood of having air conditioning (TPH, 2014). Turner et al.’s framework, in which sensitivity factors, like socioeconomic class, impact an individual’s exposure to a hazard, becomes particularly relevant here. The city’s 2011 heat vulnerability mapping project draws attention to the facts that areas highly vulnerable to heat waves “often coincide with clusters of large apartment buildings built prior to 1986” (TPH, 2015, p.3), and that high vulnerability is also seen in Parkdale, a west Toronto neighbourhood with one the three highest concentrations of rooming houses in the city (SHS Strategists, 2004).

6.2.4 Situating Infrastructural Challenges in a Social Context

High indoor temperatures and aging buildings combined with additional sensitivity of elderly residents in Toronto’s older high-rise apartments and rooming houses, are gaps that need to be addressed. The roots of these problems, however, need to be recognized in the city’s broader human and environmental conditions --- what Turner et al. label as the “suspect causal structures that affect vulnerability” (p. 8075). Here Sen’s theory of entitlements, a foundational work for the current concept of vulnerability, is relevant. Sen, discussing famine, defined entitlements as “alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces” (1984, p. 497) and argued that it was these entitlements, not the food supply itself, that determines whether people starve or survive in a famine. Different degrees of entitlements mean different degrees of vulnerability. Since access to varying economic, institutional and social structures account for an individual’s entitlements, in this way, his or her vulnerability to a

14 Ironically, city regulations contribute to the problem of high indoor temperatures in both rental apartments and rooming houses. Under the municipal code, between September 15 and June 1 landlords must keep the unit air temperature at least 21°C. Due to the time and energy required to shut off heat in old buildings, many landlords decide to run heating until June 1st, even, in some instances on heat alert days (TPH, 2011).
hazard or another stress can be seen as a “socially controllable” phenomenon (Kasperson et al., 2005, p. 253).

The theory of entitlement is relevant in Toronto because, as Adger (2006) says, it emphasizes that “social differentiation” accentuates vulnerability (p.271). Poverty rates and income inequality have increased significantly in the city over the last thirty years (United Way, 2015), while, in the race to erect thousands of new condo units, there has also been a decrease in affordable housing (Rosen and Walks, 2015). Toronto’s older high-rise apartments, in particular, are characterized as increasing pockets of “concentrated poverty” with the poverty levels to “worsening housing conditions” (United Way, 2011, p.iv; p.5). Furthermore, “unsafe living conditions” “not suited for human occupancy” have been detected by city staff in Toronto rooming houses, the accommodation of some of Toronto’s most economically marginalized (Public Interest, 2015, p.4; SHS Strategists, 2004).

Urban geography scholars G. Rosen and A. Walks (2015) have claimed that the city’s planning policies are increasingly aligned with neoliberal market forces that drive “social polarization of the city” (p. 306). This polarization is reflected in municipal policy where low development levies and loopholes in high-density zoning have made new condo development economically favourable in the downtown core while, at the same time, public financial support for more, much needed, building of social housing has decreased (Rosen and Walks, 2015). A “spatial dichotomy” exists in Toronto between neighbourhoods with and without new condos, a trend that partly explains the urban decay and inadequate conditions in older high-rises and rooming houses (Rosen and Walks, 2015, p. 304). The current composition of Toronto’s labour force, with stark divisions between “high income jobs and low-income service jobs” creates economic divisions to accompany spatial ones (United Way, 2015, p. 13). The elderly residents of these sub-standard high rises and rooming houses are, and will likely be, increasingly people of diminished individual ‘entitlements’ and heightened vulnerability, irrespective of the heat wave itself. Thus, tackling inequities in housing and income that have emerged in Toronto is a critical piece of reducing senior vulnerability to heat.

6.2.5 Air Conditioning Dependency

Torontonians’ current dependence on air conditioning as an individual adaptation strategy to extreme heat has important consequences at other system scales. These consequences actually appear to increase current and future vulnerability of the population and, particularly, seniors to heat waves.
For some time residential air conditioning has been widely identified as an effective individual adaptation for reducing the risk of heat-related morality (Kilbourne et al., 1982; Naughton et al., 2002; Semenza et al., 1996; Kaiser et al., 2001) and, based on findings from a necessarily selective 2010 telephone survey, 85 percent of Torontonians have household air conditioning (TPH, 2011). However, as Adger et al. (2005)’s research on multi-scale adaptation argues, evaluating the success of adaptations considers, not only whether the adaptation achieves its goal, but also its impact on “externalities at other spatial and temporal scales” as well as other individuals’ “capacity to adapt” (p. 80). These “scalar dynamics” (Turner et al., 2003, p. 8075) illustrate how Toronto’s widespread use of air conditioning is a clear maladaptation, an adaptation taken “to avoid or reduce vulnerability to climate change that ... increases the vulnerability of other systems, sectors or social groups” (Barnett and O’Neill, 2009, p. 211).

Since air conditioning is energy intensive and a substantial source of greenhouse gas emissions (Calm, 2000), current intensive air conditioning usage in Toronto, contributes to climate change regionally and globally. Paradoxically, a current adaptation strategy meant to protect individuals from heat waves in Toronto actually worsens local environmental conditions and thus increases exposure to extreme heat for future residents. In Turner et al.’s words, there is a clear negative “feedback” across spatial and temporal scales in the system (p. 8077). The negative effects of air conditioning are not confined to future generations, but also have immediate impacts locally. Air conditioning produces waste heat, which exacerbates the urban heat island effect (Rizwan, Dennis & Chunho, 2007). A study by Salamanca et al. (2011) in Houston, Texas found that waste heat from air conditioning can cause night temperatures to rise by as much as 2°C. Thus, while protecting some, air conditioning use in Toronto can actually worsen exposure levels for others who cannot afford air conditioning themselves and thus it increases the vulnerability of the already marginalized, such as the elderly living in the city’s ‘hotter spots.’

Air conditioning use also increases air pollution, already adversely affected by rising temperatures (TPH, 2011; Hogrefe et al., 2004). High air pollution levels are harmful to human health and are especially associated with higher rates of cardiovascular and respiratory illness in more sensitive populations like the elderly (Dominici et al., 2006). Thus, the local consequences of air conditioning adversely impact those populations already more vulnerable, a clear maladaptation that may actually “reinforce existing inequalities” (Adger et al., 2005, p. 83).

Extensive air conditioning in Toronto also poses challenges to the city’s electrical system now and in the future, with alarming consequences for residents’ vulnerability to heat. In Toronto, the energy system experiences peak usage in the summer months and particularly during heat waves (TPH,
2011) with on average, 50 percent of summer electricity consumption in a Toronto home from air conditioning (City of Toronto, 2007c). However, The city’s electrical system infrastructure is old and the energy grid is “strained” (ICLEI, 2015, p.8; TPH, 2011). Increased demand from air conditioning has caused overheated transformers and power outages (‘blackouts’). Furthermore, electricity cables, both under and above ground, expand in periods of extreme heat with negative effects: there is reduced energy transmission capacity for underground cables, while drooping ground cables may cause line disruptions (AECOM & RSI, 2015). Several smaller and larger scale power outages have been seen in Toronto in recent summers and even last July, 2015 during an extreme heat alert, Toronto Hydro advocated that consumers reduce air conditioner usage in order to prevent electricity blackouts (City News, 29 July 2015).15

Power outages in Toronto linked to widespread air-conditioning usage clearly demonstrate how an effective adaptation strategy at the individual level can bring undesirable collective citywide consequences. Power outages naturally affect all citizens, except those with alternate sources of energy in subsidiary generators. The loss of access, whether in individual units or in shared air-conditioned community spaces, clearly limits elderly individuals’ adaptive capacity during extreme heat and increases their vulnerability. For elderly residents of high-rise apartments, heat wave power outages may also dangerously disrupt elevator service, narrowing their adaptive options. If outages continue to increase, as expected in the future, their vulnerability will worsen. Yet, if the response to rising temperatures by property owners and tenants is just the installation of more air conditioning units, the response is misguided. As Toronto Public Health (2011) readily acknowledges, in light of the many scalar and temporal feedbacks from air conditioning, there is a clear need for those in private development and public policy to re-evaluate its growing role in Toronto as the dominant cooling option.

6.3 Alternative Pathways

A review of the Toronto situation reveals that, while city strategies are attentive to seniors’ vulnerability to heat, current implementation of interventions is inconsistent and some strategies insufficient. But what are viable steps forward from here? In line with sustainability science’s aim of “a solution-oriented approach” (Spangenberg, 2011, p. 276), this section explores some possible alternatives drawing on material from interviews, documents and literature.

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15 Toronto Hydro attributes 15 percent of its power outages to extreme weather and 40 percent to aging infrastructure (Toronto Hydro, 2016).
6.3.1 Building Strong ‘Social Infrastructure’ for the Elderly

Since the increasing social isolation of many high-risk seniors lies at the root of their vulnerability to heat waves, mitigation strategies must pay more attention to human interventions. As expressed succinctly by Sheila Murray of CREW, “it’s not good enough to say to a senior, ‘you need to get to a cooling room’ if you can’t or you are afraid to” (personal comm., 2016).

In this respect, there is promising potential to scale up and fund securely the type of community-based work represented by a 2008-9 pilot heat registry at Parkdale Activity-Recreation Centre (PARC) and CREW’s current Victoria Village initiative outlined earlier. In PARC’s pilot a database of high-risk individuals (including seniors) in the Parkdale neighbourhood allowed community members (“peer workers”) to check in on vulnerable neighbours by phone, or in some cases, through home visits during periods of heat alerts (Gulliver & Ali, 2010). Bob Rose, manager at PARC, saw the project’s broad benefits: it encouraged the creation of “a social network ...where community awareness about heat, heat risk and looking after your neighbour, all those kinds of things, start to become embedded in people’s minds and then in their hearts” (personal comm., 2016). The Victoria Village initiative, also rooted in local volunteerism and targeting senior peers who might be otherwise missed, is inspiring another CREW project in the High Park neighbourhood. Sheila Murray’s vision of creating many linked volunteer groups across the city is a cause to be encouraged.

These kind of adaptations commendably demonstrate what Klinenberg (2013) calls developing the “social infrastructure” of a neighbourhood. Support systems like these, he argues, are key in the ability of residents to withstand natural disaster, yet their value is often overlooked. Klinenberg illustrates this insight acutely with a 1995 Chicago heat wave example: Auburn Gresham and Englewood, two comparable south-side neighbourhoods (both mainly African American populations suffering from high rates of violence and poverty) experienced very different mortality rates. With only 3 deaths per 100 000 residents, Auburn Gresham was lightly affected, while Englewood with 33 per 100 000 residents had one of the highest rates of mortality in Chicago. For Klinenberg, the “key difference” between these two communities was the relative strength of their social infrastructures. Auburn Gresham’s vibrant neighbourhood, with its strong local businesses and active community groups, could support its most vulnerable, but the decline of businesses and dwindling population in Englewood had eroded a sense of a supportive neighbourhood. Community level response seems to be the key to effective support of the elderly and it needs ongoing financial support. CREW cites lack

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16 Encouragingly, Toronto Public Health is already “consulting on the creation of a vulnerability registry” in some high-risk apartment buildings (C. Mee, personal comm., 2016).
of secure funding as a significant barrier to scaling up its efforts. Clearly, developing a more extensive community-led heat outreach would not only enhance the adaptive capacity of Toronto seniors, but have, what Turner et al. would see as the long term benefits of bettering ‘human conditions’ and reducing individual vulnerability to future risks.

Attention to the issue of reaching isolated individuals, through more community heat registries and neighbourhood volunteer networks, is commendable, but a sense of greater public awareness of the urgency of the issue is needed. While one interviewee in this study indicated that she felt the public was cognizant of the threats posed by extreme heat (C. Mee, personal comm., 2016), others stated that they felt perceived risk was low (B. Rosolak, personal comm., 2016; S. Murray, personal comm., 2016; V. MacDonald, personal comm., 2016). Complacency in Toronto likely exists because a heat disaster on the scale experienced by other cities, has not yet occurred to threaten the frail. Before it does, and before the senior population expands rapidly, Toronto’s neighbourhoods need to address social isolation and transform themselves.

It is the large issue of the social isolation of the vulnerable in a modern metropolis that justifiably concerns community agencies. They speak of better ongoing social support to counter year-round senior isolation, ultimately making individuals less vulnerable to other stressors besides extreme heat. According to Kaarina Luoma, Director, Special Initiatives of The Neighbourhood Group, “one off support” during a heat wave, without ongoing connections, fails to give individuals the “confidence to reach out” when they are really in need (personal comm., 2015). These permanent supports will be required to build an “inclusive” and “age-friendly” city, the aim expressed in the 2013 Toronto Senior Strategy. To do this, irregular interventions should be replaced by more systemic responses to the needs of a growing aging population: more dedicated supportive housing for seniors (V. MacDonald, personal comm., 2016), improved assisted transportation and stronger inter-generational neighbourhood programming. All such programs will help create the type of ‘social infrastructure’ Klinenberg advocates; yet, they are not so much a response to extreme heat as attention to the underlying sensitivity factors that intensify vulnerability.
6.3.2 ‘Cool’ Homes for All: Addressing Residential Infrastructure Inequalities

“Because if there is an increasing divide between those that are rich and those that aren’t, that is not what we call a good quality of life, a good place to live. We need to ensure a sense of equity and equal access to services and equal access to decent housing.”

— David MacLeod, Senior Environmental Specialist, City of Toronto

While combatting social isolation is critical, social solutions must be complemented by dramatic modifications to the built environment, especially addressing housing inequities. As demonstrated earlier, exposure levels are unequally distributed in the city, with individuals with diminished entitlements living in older high-rise buildings and rooming houses at particular risk. Turner et al.’s integration of the human-environmental system to conceptualize vulnerability appropriately reminds us of the inseparable connection between social inequities and environmental conditions. If the city accepts that all citizens require “equal access to decent housing,” (D. MacLeod, personal comm., 2016), that means access to housing that reduces exposure to high temperatures and facilitates, instead of inhibits, adaptive capacity in a heat emergency.

Retrofitting Older High Rises and Rooming Houses: cooling the hottest homes

High current indoor temperatures in many older multi-residential buildings, the sensitivity of the predominantly elderly resident population and the projected climatic conditions point to the need to reduce indoor exposure. In light of regional and global climate concerns, Toronto’s strained energy grid and municipal environmental objectives, however, adaptation strategies must, as Toronto Public Health acknowledges, be “environmentally sustainable” (ICLEI, 2015, p.3). Central air conditioning, or at least the kinds of conventional air conditioning used now, cannot be considered the default strategy for cooling because of environmental impacts, strain on the electricity grid and, as David MacLeod notes, for its impracticality in many older buildings that lack air duct space (personal commun., 2016). Furthermore, in high-rises, there is a need to ensure proper installation of individual air conditioning units to reduce safety hazards of units falling from windows (D. MacLeod, personal comm., 2016). Passive cooling strategies are a better route.

Attention to passive cooling, demonstrated to decrease inside temperatures and air conditioning requirements (Santamouris, 2007a), has significant application for increasing the adaptive capacity of vulnerable seniors who live in older buildings. There is already a valuable resource in the 2015 ICLEI Review on cooling multi-residential buildings commissioned by Toronto Public Health. Emphasizing how many elements in Toronto’s older high-rises “have reached the end of their intended lifespan” (p.49), it notes that enhanced cooling techniques are compatible with necessary renovations and
energy efficiency upgrades. Renovations would include, for example, building envelope improvements such as new double or triple pane windows, reflective roofing and better roof and wall insulation, complete with better suite ventilation, all of which would reduce exposure levels for residents during extreme heat. As the Shuter Street Risk Assessment also illustrated, such improvements should also focus on upgrading elevators and generators so they can withstand extreme heat. While barriers to passive building design exist,\textsuperscript{17} justification for these changes is strong if they are justified within the larger need for building improvements and the costs saved through increased energy efficiency, on top of the value of protecting residents from extreme heat (ICLEI, 2015).\textsuperscript{18} Since significant time and resources are required for these retrofits, the interim solution already being explored by Toronto Public Health of an ‘obligatory’ onsite cooling room should be adopted.

\textbf{Cooling Existing Homes Through Green Landscaping}

In addition to retrofits, there is the need for more targeted greening projects around specific buildings highly vulnerable to extreme heat. For example, greening of roofs or walls and tree planting can be successful for decreasing both indoor and outdoor temperatures (Kleerekoper et al., 2012). In particular, trees are effective for indoor cooling when they cover the building’s west side or windows (McPherson, 1994). Tree planting could be completed in combination with establishing a more permanent outdoor cooling space with ample shade, seating and a wading pool.

Retrofitting of older apartment building, stricter inspections for maximum allowable temperatures and targeted greening would better protect the most marginally housed of Toronto’s seniors as they face a hotter Toronto. These changes would also contribute to tackling larger inequities between neighbourhoods and ensure environmentally just conditions for all, not just those who can afford it. While such strategies will be helpful, they are insufficient for the scale of the problem. There is also a need for improved housing options for seniors in Toronto. Veronica MacDonald, director of in-home services at Central Neighbourhood House, sees “more supportive housing” and “better housing conditions overall for seniors” as a critical component needed to reduce seniors’ vulnerability to extreme heat (personal comm., 2016). Improved housing, especially for the low-income group, has the significant potential to address all three dimensions of vulnerability: exposure, sensitivity and adaptive capacity. Housing based on effective cooling design would reduce exposure levels; access to

\textsuperscript{17} Obstacles include restricted air flow in these buildings, windows above 2m prevented by city by-law from opening wide for ventilation, and the considerable expense (TPH, 2015)

\textsuperscript{18} Expanding energy efficiency programs like the Hi-RIS program for high-rises and the Home Energy Loan Program (HELP) for residential homes to include financing for heat mitigation or providing another heat mitigation incentive program will be necessary to motivate landlords to undertake expensive retrofits.
reliable community help during extreme heat would enhance seniors’ adaptive capacity during extreme heat; and building that social infrastructure will help decrease the sensitivity of this group.

6.3.3 A Key Cooling Transition: Replacing Conventional Air Conditioning

Just as the concern to provide vulnerable seniors with less exposure to heat raises the larger issue of improving their housing quality, so to is their situation connected to reimagining the way the city is cooled for all citizens.

As indicated in 6.2.4, the local and global feedbacks of air conditioning as a ‘maladaptation’, coupled with Toronto’s precarious energy grid, suggest the need for a citywide cooling transition. While a comprehensive discussion of this transformation is outside the scope of this thesis, the newly developing technologies outlined below demand attention, particularly passive building design mandated by new building standards and deep-water cooling.

New Climatic Standards and Passive Building Design

Designing and implementing new climactic standards for new buildings and retrofits will be key. In Toronto, where buildings have traditionally been “designed for winter conditions,” “using climatic parameters calculated from historical climate data,” construction standards must shift to reflect future climate projections suited to both summer and winter extreme temperatures (GRG Consultants, 2011, p.3; p.4). In this way, construction standards, can adopt the necessary forward-looking perspective that is necessary across all of society. Making a set of standards, like BOMA’s resilience standards, mandatory for all new-construction would be an effective mechanism for spurring the necessary change. Such standards should also require new buildings to incorporate passive building design so they can be cooled without, or with significantly less, air conditioning.

As David MacLeod points out, introducing resilience standards for new construction is more feasible than suddenly applying the standards retroactively to existing infrastructure, where landlords cite economic challenges (personal comm., 2016). In existing buildings, the focus should be on incentivizing passive cooling retrofits to reduce the amount of mechanical cooling required or eliminate air conditioning entirely. The Philadelphia Cool Homes Program provides a potential model, especially relevant to the vulnerable; there, low-income seniors are given “a window mounted whole house fan, interior air sealing and elastomeric roof coating to decrease the roof temperature” (Santamouris, 2007b, p.18), changes that reportedly brought a decrease of 2.5°C in household temperatures. These kind of changes will be crucial both to reducing the vulnerability of Torontonians in the short term and still works towards sustainability of a future Toronto.
Expanding Toronto’s Lake Deep Water Cooling System

Developing further Toronto’s already extensive Lake Deep Water Cooling System will also be an important area to develop further. A technique that pumps up cold water from the bottom of a large water body and then uses it “as a heat sink” to cool hot air, deep water cooling has significantly fewer environmental externalities than conventional air conditioning, using up to 90 percent less energy (Newm and Herbert, 2009, p. 227). Toronto’s Deep Water Cooling System already services 62 buildings, has been credited by the city with greenhouse gas reduction (79,000 tonnes annually), substantial air pollution reduction and significantly less electricity use (61MW annually) than air conditioning (City of Toronto, 2013b). Deep water cooling decreases outdoor exposure to heat by reducing the UHI effect, improves adaptive capacity citywide by withdrawing pressure from the electricity grid and reduces greenhouse gases that drive climate change and more heat waves in Toronto in the first place. The city’s proximity to Lake Ontario and the discernible trend to develop this lakeside area with high-density residences means this method is well positioned to become a promising part of Toronto’s cooling transition, especially for large properties in the city’s south end. Encouragingly, the corporation responsible, Enwave Energy Corporation, already has plans to expand its current system by 41 percent (City of Toronto, 2013b). With its proven success, deep water lake cooling indicates another promising pathway to revolutionize cooling in Toronto.

There will be clear challenges related to these new technologies. As Miller et al. (2014) reflect, factors such as “social values” and “political contexts” as well as “the obduracy of infrastructure” can be barriers to change (p. 240). In Toronto, air conditioning as a maladaptation is deeply entrenched in the city and the realities of existing physical infrastructure obstruct change. Property owners are inclined to see the high initial costs for passive retrofitting or hooking up deep water cooling as too great, even if they can bring energy savings in the long run (Newton & Herbert, 2009). Therefore, significant political will to mandate the necessary legislation (eg. resilience standards) and financial incentives (eg. grant or loans for cooling transition projects) will be required to push forward this cooling transition.

6.4 Considering Limitations

There are certain limitations to acknowledge both with this study and with Turner et al.’s framework. Firstly, Toronto’s emergency medical services have not been considered though they can play a

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19 Enwave Energy Corporation is also considering operations in other locations, including the Harris water filtration plant (Kennedy, 2015).

20 Monetary incentives are already in place from the Canadian government and Toronto Hydro to mitigate high initial costs (Newman and Herbert, 2009).
significant role in reducing heat-related mortality. Furthermore, for reasons discussed previously, the investigation does not use interviews with seniors. These are both areas where further research would be valuable. In addition, the study boundaries (the city of Toronto), like all geographic boundaries, are artificial lines; vulnerability to heat extends well beyond city boundaries into the densely populated Greater Toronto Area. The scope of the project means that I have had to omit a discussion of the complicated ways in which Canada’s provincial and federal levels of jurisdiction contribute to the problem and its solutions. Lastly, the final section (‘Alternative Pathways’), while derived from identified gaps and perspectives from both interviewees and the literature, naturally carries subjectivity in the solutions proposed.

The multi-level nature of Turner et al.’s framework, by ambitiously setting place-base vulnerability analysis within a broader context, and making it inseparable from larger human-environment systems, poses considerable obstacles for any empirical research (Eakin and Luers, 2006). In particular, the complex way in which Turner et al.’s analysis considers the human and environmental system together has made it challenging to decide what system elements to include in analysis and which to omit. This study, therefore, considers a wide scope of elements and perhaps carries more breadth than depth. What is clear, however, is that when considering vulnerability of the elderly to extreme heat, boundaries are porous since this issue rests at the intersection of health, the environment, community responsibilities, social equities and new technologies.
7 Conclusion

Using Turner et al.’s integrated framework, with its coupled human-environment system as a lens, this thesis has investigated the current work in Toronto to reduce seniors’ vulnerability to extreme heat; it has evaluated the gaps and challenges that impact current strategies; lastly, it has explored viable future pathways to protect this growing population better. This place-based analysis has been guided by sustainability science’s goal of bridging disciplinary boundaries and bringing expert and non-expert knowledge together to understand a complex problem (Kates, 2012, p.6; Polk, 2014). While the exploration has been location specific, protecting at-risk populations like seniors from increasing heat waves is not a problem unique to Toronto. Insights about what Toronto is and what it could be for its elderly population thus have valuable application to other cities internationally.

This research reveals that, since the problem is complex, so too must be its solutions. While heat-mitigation strategies across Toronto are extensive and growing, supporting socially isolated and mobility-impaired seniors in increasingly inadequate older buildings remain ongoing challenges. Low public risk perception complicates the issue. So too does the city’s dependency on conventional air conditioning for it poses scalar and temporal feedbacks, ironically exacerbating vulnerability for citizens most at risk now and in the future.

What future actions does the issue demand? Responding to heat challenges requires the city to address more deeply rooted issues like the ‘social construction’ of isolation of the elderly, the inequitable distribution of ‘entitlements’ producing dramatic differences between buildings and neighbourhoods, and the troubling dependency on a maladaptive technology. This project has emphasized several other possible pathways forward, including building strong, cohesive neighbourhood networks to support the most vulnerable. There is also a need to shift how buildings are designed, constructed and renovated so that they reflect future city environmental conditions, instead of past trends. Targeted renovations on high-risk buildings are urgently required as is a dramatic expansion in the provision of senior supportive housing. Redesign of buildings must be combined with strategic urban planning and financial incentives for property owners to undertake passive cooling renovations and replace conventional air conditioning with more sustainable cooling technologies.

In 2015, The Economist Intelligence Unit ranked Toronto as the best city in the world to live in, based on an aggregation of indices such as safety and livability (Finamore, 2015). The truth of this claim, however, is challenged by some of the findings of this thesis, and, as a growing number of senior residents must contend with a hotter Toronto. Both the projected size of the senior population and
the level of high future temperatures, necessitates immediate action. However, lack of funding for strengthening social infrastructure and a ‘stubbornness’ in elements of Toronto’s current infrastructure and technology with pockets of deteriorating, aging infrastructure and widespread use of conventional air conditioning are significant barriers to change. The commendable work of Toronto Public Health, the Toronto Energy and Environment Division and CREW to tackle extreme heat must be supported wholeheartedly by other city divisions, community agencies, non-profits and the private sector across Toronto so that solutions to heat-mitigation can be truly integrative. Only in this way can a city of this size and diversity adequately support its elderly and other vulnerable populations from increasing heat waves and become truly liveable for all residents, now and in the future.
8 References


City of Toronto. (2013a). *The Toronto Senior’s Strategy: Towards an Age Friendly City*. Toronto, Ontario: City of Toronto.


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Appendices

Appendix A – Interviewees

Interviews for this study followed the general structure outlined in the interview guide (Appendix B). For recorded interviews, interviewees signed a consent form (Appendix C), giving them the right to remain anonymous in the study and withdraw their participation at any time. More details including how interviewees were selected can be found in Table 2: Research Methods. All interviews took place between February 3, 2016 and March 5, 2016.

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Interview Type</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Community Organizations</strong></td>
<td></td>
<td></td>
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<tr>
<td>Sheila Murray, CREW</td>
<td>In-person, recorded</td>
<td>February 5, 2016</td>
</tr>
<tr>
<td>Luanne Rayvals, Manager Victoria Park Hub</td>
<td>In-person, recorded</td>
<td>February 16, 2016</td>
</tr>
<tr>
<td>Betty Muir, Climate Change Toronto</td>
<td>In-person, recorded</td>
<td>February 16, 2016</td>
</tr>
<tr>
<td>Donna Lang, Faith &amp; the Common Good</td>
<td>By telephone, informal</td>
<td>February 3, 2016</td>
</tr>
<tr>
<td>Jocelyn Alves, Director of Health and Wellness,</td>
<td>In-person, recorded</td>
<td>February 18, 2016</td>
</tr>
<tr>
<td>Christie Gardens (Toronto Retirement Home)</td>
<td></td>
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<tr>
<td>Kaarina Luoma (Director, Special Initiatives)</td>
<td>In-person (together), recorded</td>
<td>March 1, 2016</td>
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<tr>
<td>and Veronica MacDonald (Director, Independent</td>
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<tr>
<td>Living), The Neighbourhood Group</td>
<td></td>
<td></td>
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<tr>
<td>Bob Rose, Manager Parkdale Activity-Recreation</td>
<td>In-person, recorded</td>
<td>March 4, 2016</td>
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<tr>
<td>Centre</td>
<td></td>
<td></td>
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<tr>
<td><strong>City Officials</strong></td>
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<tr>
<td>David MacLeod, Senior Environmental Specialist,</td>
<td>In-person, recorded</td>
<td>February 3, 2016</td>
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<tr>
<td>Energy &amp; Environment Division</td>
<td></td>
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<tr>
<td>Carol Mee and Kate Bassil, both Managers at</td>
<td>In-person (together) recorded</td>
<td>February 10, 2016</td>
</tr>
<tr>
<td>Healthy Public Policy, Toronto Public Health</td>
<td></td>
<td></td>
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<tr>
<td>City official</td>
<td>By telephone, recorded</td>
<td>February 23, 2016</td>
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<tr>
<td>Boris Rosolak, Coordinator, Office of Emergency</td>
<td>Email correspondence</td>
<td>n/a</td>
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<tr>
<td>Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City official, Long-Term Care Homes &amp; Services</td>
<td>Email correspondence</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Appendix B – Interview Guide

Below are the two interview guides (one for community organizations and one for city departments) used as a general framework when creating interview questions for recorded interviews. Other more specific questions were also asked unique to the projects or expertise of the interviewees or as needed by the direction of the answers. Other specific details regarding current city operations were clarified by email correspondence.

1. Interview Guide for Community Organizations

1.1 General Questions (subject to change depending on type of organization)
  • What is the mandate of your organization?
  • Can you describe your client base?
  • How many of your clients would be seniors?

1.2 Current Work
  • Are there any initiatives in your organizations that work to protect seniors from extreme heat? If so, what are they?
  • Do you receive heat alerts and educational material about extreme heat from the City of Toronto?

1.3 Future Interventions
  • What types of initiatives to mitigate extreme heat do you hope to establish in the future? What types of resources will you need to do this?
  • What city and community services would you like to see further developed to support seniors in adapting to increasing heat waves?
  • If you could receive substantial assistance for one resource important in your programming, which resource would you prioritize and why?

1.4 Challenges
  • What do you see as the greatest challenges in developing strategies to protect seniors from increasing heat waves in Toronto?
  • What do you see as viable strategies for overcoming these challenges?

1.5 Public Awareness
  • Would you say that there is awareness in Toronto communities about the severe impacts prolonged heat wave might have on vulnerable residents?
  • How do you think this awareness can be further developed?

1.6 Other Relevant Individuals
  • Are there other individuals, NGOs or community agencies you would advise I speak to for more information?
2. Interview Guide for City Officials

2.1 Current Work

• Can you describe any initiatives in your department that work to protect Torontonians from extreme heat?
• Is your department involved in any initiatives to protect seniors specifically? If so, what are they?

2.2 Future Measures

• Are there steps that your department is taking to protect seniors in Toronto from increasing heat waves? If so, what are they?
• What more would you like to see done to protect seniors from increasing heat waves in the future?

2.3 Challenges

• What do you see are some of the largest ongoing and future challenges to protecting seniors from heat waves in Toronto?
• If Toronto were to experience a heat emergency like we saw in France, Russia or India, what do you foresee as the greatest challenges for the city?

2.4 Public Awareness

• Would you say that there is awareness in Toronto communities about the severe impacts prolonged heat wave might have on vulnerable residents?
• How do you think this awareness can be further developed?

2.5 Other Relevant Individuals

• Are there other individuals, NGOs or community agencies you would advise I speak to for more information?
Appendix C – Consent Form

A study on reducing vulnerability of seniors (65+) to increasing heat waves in Toronto, Ontario

Researcher:
Rosalind Pfaff, MSc Student, Environmental and Sustainability Science (LUMES)
Lund University, Sweden
rosalind.pfaff@gmail.com, 647-866-1074 (or +46 0730726810 after mid-March)

Study Purpose and Background
The purpose of this study is to explore strategies for reducing the vulnerability of seniors (+65) to increasing heat waves in Toronto due to climate change. This research is being conducted for my Master thesis as part of my MSc in Environmental and Sustainability Science at Lund University, Sweden. Data will be collected January – March 2016.

What will happen during the study?
This interview will take approximately half an hour. You will be asked questions related to topics such as current vulnerability of seniors to heat waves in Toronto, adaptation strategies that exist so far and potential measures for the future. I will be taking notes on your responses and, with your permission, I will be audio-taping the interview.

Potential Risks or Discomforts:
I do not anticipate many risks or discomfort from your participation in this study. One risk is that you feel a comment you make runs contrary to the views of your organization or that divulges confidential information. To mitigate this risk, you do not need to answer questions you do not want to answer or make you feel uncomfortable.

Potential Benefits:
The findings from this study can be used to inform strategies for better protecting Toronto’s senior population from increasing heat waves. They can also be applied and adapted to other urban contexts that are also facing the challenges of heat waves and an aging population.

Confidentiality:
It is your right to participate in this study anonymously unless you explicitly provide me with permission to release your identity. If you wish, you can choose to have your organization identified and released in this study but keep your personal identity private.

Participation and Withdrawal:
Your participation in this study is completely voluntary. You have the right to withdraw and stop participating at any time. In cases of withdrawal, any data (notes, audio recordings) that you have provided will be destroyed.

Study Results:
My Master thesis will be available online on the Lund University website at http://www.lumes.lu.se/alumni/lumes-alumni-and-theses after it is completed. If you would like a copy of my thesis, I am happy to send you one by email.
Further questions?
If you have any further questions about either this research project or your rights in this study please do not hesitate to contact me at the above email address or telephone number. You may also contact my Thesis supervisor Sara Gabrielson at sara.gabrielsson@lucsus.lu.se or my Director of Studies, Lena Christensen at lena.christensen@lucsus.lu.se.

Consent
- I have read the information presented in the information letter about a study being conducted by Rosalind Pfaff, MSc Student, Lund University.
- I have had the opportunity to ask questions about my involvement in this study and to receive additional details I requested.
- I recognize that participation in this study is completely voluntary and I have the right to withdraw at any time.
- I agree to participate in the study.

Signature: ___________________________

Participant Name (Printed): ______________________________

Date: ________________

1. I agree that this interview can be audio recorded.
   ... Yes.
   ... No.

2. I agree that any information and quotations drawn from the interview may be attributed to me and to the organization I am affiliated with.
   ... Yes.
   ... No.