

**An Application of the Resilience Assessment Workbook
on the Town of Caledon, Ontario, Canada:**

Resilience of What? Resilience to What? Resilience with What?

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

This research involves conducting a resilience assessment on the Town of Caledon in southern Ontario, Canada, through the use of the Resilience Assessment Workbook authored by the Resilience Alliance. The purpose of the research is to develop a comprehensive understanding of Caledon, and identify ways to enhance its resilience as a linked social-ecological system in the context of urban growth.

Urban growth pressures have brought multiple challenges to Caledon in land use, infrastructure maintenance, farmland preservation and watersheds conservation. Urban growth management in Caledon is situated in the provincial growth strategy for the Greater Golden Horseshoe areas in Ontario. Provincial legislation including the Places to Grow Act (2005), the Greenbelt Act (2005), the Oak Ridges Moraine Conservation Act (2001) and the Provincial Policy Statement (2005) aim to reconcile the needs for population increase, economic growth and environmental protection.

The results of the resilience assessment of Caledon consist mainly of a cross-scalar study and interviews with twenty-six community members. The cross-scalar study examines Caledon in its social, ecological and economic domains on the provincial, regional and municipal levels. The study also identifies potential resilience threats and assets of Caledon in the context of urban growth. Interviews have been conducted to verify and complement findings of the cross-scalar study. Interviewees include Caledon municipal staff, residents, environmental group leaders, politicians, an aggregates industry representative, a social services representative and a local property developer.

The results of this research reveal resilience threats and assets in Caledon, and identify ways for the town to enhance resilience against urban growth pressures. Threats to resilience are found to be associated with urbanization, agricultural land loss, aggregates mining and a lack of affordable housing. Assets of resilience in Caledon are found to be related to civic engagement, participatory planning and agricultural diversification. Based on the cross-scalar study and interview results, emerging themes of resilience and recommendations are developed. Recommendations for Caledon to enhance its resilience include: promoting continual learning and adaptive governance; diversifying agriculture; providing affordable housing; treating urbanization as an opportunity; and developing trade-off principles for the implementation of an integrated plan for resilience.

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Dedication

For my parents, brothers, sisters and husband-to-be who showed me
unconditional love, grace and acceptance.

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Chapter 1. Introduction

1.1 Introductory Comments

The Town of Caledon is facing urban growth pressures that can cause harm to its lands and watersheds, and put pressure on its social services (CEAC, 2006; CVC, 2007; TRCA, 2008). Caledon also faces conflicting interests among various groups including the landowners, the agricultural sector, estate development, aggregates industry and conservation authorities (CEAC, 2006; Dore, 2004; Johnson, 2006; Chamber & Sandberg, 2007; Markvart, 2009; Mackenzie, 2008).

To deal with urban growth pressures and conflicting interests, a more comprehensive understanding of Caledon is needed as a foundation for better growth management strategies (CEAC, 2006; Purell, 2009). This research responds to this need by conducting a resilience assessment of the Town of Caledon. The Resilience Assessment Workbook (RA, 2007) designed for practitioners is used in this research to identify Caledon as a linked social-ecological system, as well as to analyze its history, structuring variables, resilience assets and threats in the context of growth management. The Resilience Assessment Workbook is authored by a team of researchers who recognize that “piecemeal interventions do not prepare a system for dealing with ongoing change and future shocks” (RA, 2007:1). The Workbook uses a list of questions and case studies to guide researchers to identify their systems of interests and intervention options from a resilience perspective (RA, 2007).

Resilience, in this research, refers to the abilities of linked social-ecological systems to learn, respond, adapt and renew after disturbances (Holling, 1973; RA, 2007; Walker & Salt, 2006; Gunderson *et al.*, 1995; Folke *et al.*, 2002; Gunderson & Holling, 2002; Armitage, 2005).

It also means the ability of people to learn, adapt and maintain a desirable state of social-ecological systems (RA, 2007; Walker & Salt, 2006; Gunderson *et al.*, 1995; Folke *et al.*, 2002; Gunderson & Holling, 2002; Armitage, 2005).

This research aims to develop a more comprehensive understanding of Caledon in the context of urban growth from a resilience perspective. The research results are organized into three parts: ‘resilience of what?’; ‘resilience to what?’; and, ‘resilience with what?’ In the following chapters, ‘resilience of what?’ refers to Caledon as a social-ecological system that consists of biophysical, economic and social components (Section 4.1). ‘Resilience of what?’ also refers to a desirable Caledon from the points of view of community members (Section 6.1). ‘Resilience to what?’ refers to the threats to Caledon’s resilience in the context of urban growth (Chapters 4 and 5). ‘Resilience with what?’ refers to the assets Caledon can build upon to maintain and enhance its resilience when dealing with changes caused by urban growth (Chapters 4 and 5). These assets of resilience will be discussed in conjunction with threats to resilience (Sections 5.4, 6.4 and 6.5). This paper concludes with recommendations for Caledon, research limitations and a discussion on the Resilience Assessment Workbook and resilience thinking (Chapters 7 and 8).

1.2 Research Question and Rationale

This research aims to assess resilience of Caledon in the context of urban growth. The primary question reflects this aim: based on resilience thinking, what factors threaten and enhance Caledon’s abilities to respond and adapt to changes caused by urban growth as a linked social-ecological system? A secondary question in this research is: what insights emerge from the findings that may help Caledon to strengthen its resilience and enhance its desirable qualities?

The answers to the research questions are organized in three parts: ‘resilience of what’, ‘resilience to what’ and ‘resilience with what’ (Chapter 4-6).

This study was initiated because the Town of Caledon has been facing increasing urban growth pressures and conflicting interests (MNR, 1994; Gombu, 2008; Fuller & Zhang, 2008, CEAC, 2006). At an early stage of the research, the author of this thesis recognized the complexity of urban growth issues in Caledon through conversations with key informants (also section 3.3). Urban growth issues in Caledon involve multiple parties from different levels (also Chapter 5). Hence, the author believed that Caledon would be an interesting case study of urban growth.

Caledon has been identified for “the majority of the ‘approved’ residential developments” in the Region of Peel (MNR, 1994: 53). The Town will have to accept 60,000 more people under Ontario’s Places to Grow Act (CEAC, 2006: 4). Of particular concern is that not only are opportunities for intensification in Caledon limited, but much of its land base is protected under Oak Ridges Moraine and Niagara Escarpment legislation (CEAC, 2006). “By default, Caledon will be forced to place most of its development onto prime agricultural land” (CEAC, 2006:13). Apart from the loss of farmland, urbanization is likely to cause deterioration of water quality of the Humber and Credit Valley Watersheds (CEAC, 2006; CVC, 2007; TRCA, 2008). In addition, urban growth will pressure Caledon to upgrade its transportation, storm water management and other services (Town of Caledon, 2008c). Since urban growth pressures are likely to bring negative environmental and social impacts to Caledon, this research aims to use the Resilience Assessment Workbook to identify options for Caledon to be more sustainable and resilient in face of changes caused by urban growth.

1.3 Premise, Overarching Goal and Objectives

Premise

Ecosystems and social systems are integrated (Holling, 2001; Walker & Salt, 2006; Liu *et al.*, 2007b). Resilience is important to the health and sustainability of social-ecological systems because it prepares systems to deal with disturbances and remain in a desirable state (Holling, 2001; Folke *et al.*, 1998; Folke *et al.*, 2002). Resilience can be understood and improved through continual learning and collective adjustments (Folke *et al.*, 2003; Lee, 1993; Armitage, 2005).

Overarching goal

The overarching goal of the following objectives, particularly 2 and 3, is to enhance the resilience of Caledon in face of changes caused by urban growth.

Objectives

- 1) Conduct the background research required to conduct a resilience assessment in Caledon
- 2) Apply the Resilience Assessment Workbook through literature review and interviews with community members to answer the questions of ‘resilience of what?’, ‘resilience to what?’ and ‘resilience with what?’
- 3) Develop recommendations for the pursuit of resilience defined in objective 2 with community members.
- 4) Contribute recommendations to the continued development of the Resilience Assessment Workbook based on the Caledon case study
- 5) Contribute a case study of resilience of a municipality as a linked social-ecological system in southern Ontario in the context of urban growth pressures

1.4 Background Discussion

Caledon covers over 700 square kilometres, and is the most northerly municipality in the Region of Peel (Town of Caledon, 2008a) (Map 1). The Town is unique in that it contains both the Oak Ridges Moraine and the Niagara Escarpment, as well as the Credit, Humber and Nottawasaga watersheds (CVC, 2007; Town of Caledon, 2008a). The watersheds support a

wider range of ecological activities and habitats (CVC, 2007; Town of Caledon, 2008a). Oak Ridges Moraine functions as a vital groundwater recharge for the region, and parts of the Niagara Escarpment have been designated as a World Biosphere Reserve by the United Nations (Town of Caledon, 2008a). Caledon’s Peel Plain makes up primary agricultural lands.



Map 1 Location of Caledon relative to other municipalities on the Oak Ridges Moraine.

(Adapted from: Wikimedia Commons (2005))

These biophysical features changed as human activities in the Town of Caledon have evolved since the establishment of First Nations groups (Section 4.3). Approximately 15,955 hectares or 24% of Caledon’s land are identified within the Oak Ridges Moraine Conservation Plan (Caledon, 2008b: 127).

Caledon faces “unprecedented population growth pressures driven by provincial legislation and by the need for regional governments such as the Region of Peel to allocate future population growth to its component municipalities” (CEAC, 2006:2). Nevertheless, opportunities

for urban expansion in Caledon are extremely limited because much land was protected under ORM and Niagara Escarpment legislation (CEAC, 2006). This can cause serious environmental problems to watersheds, and create burdens on social services (CEAC, 2006:15). In a 2008 survey, 24% of 300 interviewed Caledon residents expressed that urbanization was their top environmental concern (Oraclepoll, 2008).

In fact, urbanization around the moraine has already caused multiple negative impacts. Urban development on the moraine has caused the loss of habitat functions; the fragmentation of natural habitats; an increase of surface runoff; pollution and sedimentation of wetlands; as well as the contamination of groundwater (CEAC, 2006; Dougan & Associates, 2002; Diamond *et al.*, 2002, Matlack, 1993). In response to environmental challenges posed by population growth and urban development, the Town of Caledon has established the Environmental Progress Office and the CEAC (Caledon Environmental Advisory Council), and endorsed the Environmental Progress Action Plan (Town of Caledon, 2009b). A number of environmental groups such as the Save the Oak Ridges Moraine Coalition, Caledon Countryside Alliance and Coalition of Concerned Citizens take part in environmental initiatives in cooperation with the town (Town of Caledon, 2009b). They are potential and important actors of social learning and experimentation that are key to social-ecological resilience (Section 5.1.3).

1.5 Thesis Structure

This thesis is divided into eight chapters. It begins here with an introduction, research questions, rationales, objectives and background discussion (Chapter 1). Then it presents a literature review of resilience thinking, complex systems thinking, resilience assessment tools and heuristic frameworks such as Panarchy and adaptive cycles (Chapter 2). Next, the research

methodology (Chapter 3) is discussed, followed by research results of the application of resilience assessment on the Town of Caledon (Chapters 4 - 6). The research results are organized in a study of Caledon based on literature review (Chapter 4), a cross-scalar study (Chapter 5) and interviews with community members (Chapter 6). Based on chapters 4 - 6, this thesis presents recommendations for Caledon to enhance its resilience in face of changes caused by urban growth (Chapter 7). This thesis concludes with research limitations, reflections on resilience thinking, insights into the Resilience Assessment Workbook, as well as future research directions (Chapter 8).

Chapter 2. Evaluation of the Existing Literature

Chapter Structure

The following chapter outlines basic theoretical/conceptual ideas (i.e. resilience thinking, complex systems thinking, adaptive capacity) and a conceptual framework (i.e. Panarchy) of this research.

2.1 Complex Systems Thinking

Before discussing resilience thinking, it is useful to elaborate on complex systems thinking. Complex systems are self-organizing, and are determined by a small number of structuring variables (Holling, 2001). Complex systems thinking is a mode of post normal science that helps people understand complex structures and processes of integrated ecosystem and social systems (Kay, *et al.*, 1999). It relies on qualitative information, quantitative data and public scrutiny to produce several narratives that describe multiple viable system states (Kay *et al.*, 1999).

In contrast, normal applied science relies on quantitative data and objective facts to deduce linear causal relationships (Kay *et al.*, 1999). Normal applied science views the world in a steady state or near-equilibrium (Gunderson *et al.*, 1995). This worldview has dominated natural resource policy, which has been inadequate to address complex social-ecological issues because it failed to take into account non-linear relationships, uncertainties and surprises (Walker & Salt, 2006; Gunderson *et al.*, 1995; Folke *et al.*, 2002). “The dynamics of ecosystems and human systems need to be addressed in the context of post normal science grounded in complex systems thinking.” (Kay *et al.*, 1999:721). Complex systems thinking informs resilience thinking

which emphasizes “complex non-linear relations between entities under continuous change and facing discontinuities and uncertainty” (Folke *et al.*, 2002: 5-6).

2.2 Resilience Thinking

Resilience can mean different things in various fields such as health, local economies and natural hazards (Section 2.6). In this research, resilience refers to the resilience of a social-ecological system. It means the ability of a system to absorb shocks; to avoid crossing a threshold into an alternate and undesirable state; to regenerate after disturbance; and retain essentially the same functions, structures and feedbacks (Holling, 1973; Walker *et al.*, 2004; Walker *et al.*, 2006; Gunderson *et al.*, 1995; Walker & Salt, 2006). It also means the ability of people to learn, adapt and maintain a desirable state of social-ecological system (RA, 2007; Walker & Salt, 2006; Gunderson *et al.*, 1995; Folke *et al.*, 2002; Gunderson & Holling, 2002; Armitage, 2005).

Resilience thinking represents a paradigm shift in natural resource management from top-down, command-and-control optimization to the promotion of resilience and self-organization (RA, 2007). The command-and-control approach has led to resource management failures such as collapsed fisheries, saline farmland and forest pest outbreaks around the world where people want to control a specific variable in the system (Walker & Salt, 2006; Gunderson *et al.*, 1995). Controlling a specific variable usually has to do with achieving optimal production of a natural resource (Gunderson *et al.*, 1995; Folke *et al.*, 2002). It is recognized that controlling one variable (forest fire, pest) is likely to lead to the eventual loss of resilience of a system, and possible collapses (Walker & Salt, 2006; Gunderson *et al.*, 1995).

This research recognizes that social systems and ecosystems are integrated (Chapter 4.1). There are multiple possible states of a social-ecological system (Gunderson & Holling, 2002; Gunderson *et al.*, 1995; Gotts, 2007). A social-ecological state is defined by its functions, feedbacks, structures (Walker *et al.*, 2006; Gunderson & Holling, 2002). Beyond a certain threshold, the functions, feedbacks and structures can undergo drastic changes, leading to a different system configuration (Gunderson & Holling; 2002; Anderies *et al.*, 2006). It is noteworthy that a system configuration may be desired by one group of people and disliked by another because of the different social and economic impacts a system may have on various groups (Walker *et al.*, 2006). This will be further discussed in the case study of Caledon (Sections 6.4 and 6.5).

In short, a resilient system can reorganize itself to “retain essentially the same function, structure, identity and feedbacks” after disturbances (Walker *et al.*, 2004: 2). Resilience thinking is essentially concerned about the sustainability of integrated social-ecological systems (Holling *et al.*, 1998; Holling, 2001; Walker & Salt, 2006; Folke *et al.*, 2002). It attempts to use a heuristic framework known as Panarchy to understand complex social-ecological systems.

2.3 Panarchy

Panarchy is a heuristic framework that is useful for describing the dynamics of complex systems (Appendix A). One important feature of complex systems is self-organization. Self-organization occurs when “the macroscopic system properties and patterns that emerge from the interactions among components feedback to influence the subsequent development of those interactions” (Folke *et al.*, 2002: 6). When they are self-organizing, systems are far from equilibrium, characterized by multiple possible outcomes of management (Levin 1999).

Panarchy describes hierarchical structures in which social systems (e.g. natural resource agency) and ecosystems (e.g. forests) are linked in nested adaptive cycles of growth, conservation, release and reorganization (Holling, 2001) (Figure 1).

It has been suggested that all living systems, ecological and social, “exhibit properties of the adaptive cycle and panarchical relationships across scales” (Holling *et al.*, 1998:355). It is noteworthy that hierarchical structures in a Panarchy refer not to “a top-down sequence of authoritative control” (Holling, 2001: 392). Rather, they are “semi-autonomous levels” (Holling, 2001:392) that self-organize as nested sets of adaptive cycles operating on distinct spatial and temporal scales¹ (Gunderson *et al.*, 1995; Holling, 2001; Walker *et al.*, 2006). The interactions among nested sets of adaptive cycles are shaped by a set of dominant structuring variables and processes (Holling, 2002) (Section 4.5). These interactions across scales lead to flips and nonlinearities observed in systems (Walker *et al.*, 2006). This understanding of cross-scale interactions in system has informed the cross-scalar study of Caledon in this research (Chapter 5).

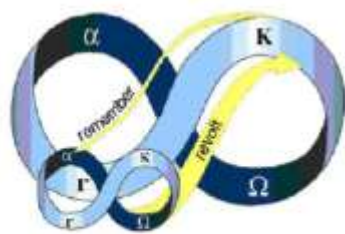


Figure 1 A graphic depiction of cross-scale interactions in a panarchy.

(Source: Gunderson & Holling, 2002)

¹ In a typical boreal forest, for example, needles cycle yearly within a space measured in centimetres; the crown of foliage cycles in a decadal period within a space measured in metres; stand cycles at a period of about a century within a space measured in kilometres and a biome cycles at a period of about 10,000 years within a space measured in 1000 kilometres (Gunderson *et al.*, 1995:23).

From the process of exploitation to conservation in a forest, the seedlings are dominant structuring variables as they grow into a patch of trees. When a patch becomes mature, connectedness and stored energy increase. This marks a process of release in which pest or fire can be a structuring variable (Gunderson *et al.*, 1995: 22). When there is a fire or pest outbreak, stored energy will be released back to the soil. A process of reorganization will then ensue, and a structuring variable could be the plants that colonize the new space.

Adaptive cycle, which is a heuristic model, does not represent all the divergent responses and processes in systems (Berkes *et al.*, 2003). For instance, ecosystems like open-ocean pelagic communities remain largely in the phases of release and reorganization because of a lack of internal regulation and highly adaptive capabilities (Gunderson & Holling, 2002). Another example is that “human systems with foresight and adaptive methods” can be stable and innovative at the same time, and they do not necessarily follow an adaptive cycle of long periods of conservation followed by a shorter period of renewal and reorganization (Gunderson & Holling, 2002: 62). Nevertheless, in general, the processes from exploitation to conservation generally involve a long and slow period of accumulation and transformation of resources (Holling, 2001) whereas processes from release to reorganization are generally shorter (Figure 2).

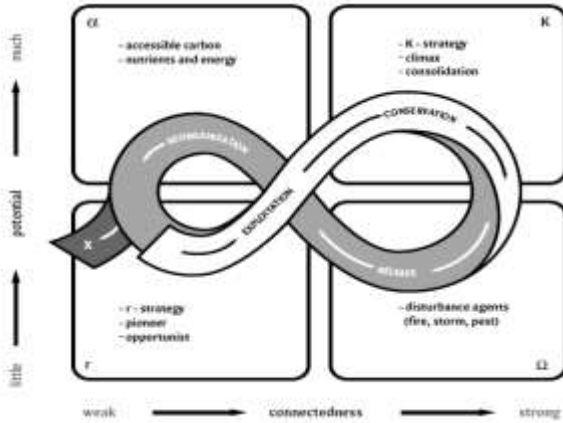


Figure 2 A heuristic model of an adaptive cycle.

Y-axis: the potential in the accumulated resources; X-axis: the degree of connectedness among controlling variables. The exit (i.e. X) takes place at where the potential is released and a system shift is possible. (Source: Berkes *et al.*, 2003: 17)

In this research, the focal system is the Town of Caledon (Section 4.1). Focal systems are nested in slower, larger systems, and are invigorated from below by faster, smaller adaptive cycles of smaller systems (Holling, 2001). Generally, the slower, larger nested cycles maintain stability and integrity of the system; and provide memory for reorganization after disturbances (Holling, 2001; Walker *et al.*, 2006; Bowler, 1981). Small and fast nested cycles can dominate the slow and large ones at the stage of reorganization when the system is under-connected (Gunderson *et al.*, 1995; Walker *et al.*, 2006). “Revolt” happens when smaller scale initiate changes that cascade to the bigger scales, causing system changes (Holling, 2001; Walker *et al.*, 2006). These ideas of adaptive cycles will be integrated into the analysis of the Town of Caledon as the focal system (Sections 4.5 and 6.5).

Based on the heuristic model of adaptive cycles, a system usually loses its resilience when the larger and slower autonomous level is at its late phase (k) of conservation (Holling, 2001; Walker & Salt, 2006). At this phase, connectedness is high, “revolts” from below “can

cause a critical change in one cycle to cascade up to a vulnerable stage in a larger and slower one” (Holling, 2001: 398). A system also loses its resilience when its connectedness, potential and diversity are low, forming a poverty trap (Holling, 2001). Resilience management, informed by Panarchy, is about building and maintaining social and ecological resilience needed to cope with and adapt to disturbances and shocks (Holling, 2001; Gunderson & Holling, 2002; Folke *et al.*, 2002; Walker & Salt, 2006).

2.4 Ecological Resilience and Social Resilience

Ecological resilience can be “assessed by the amount of variability that can be accepted” (Folke *et al.*, 2002:19) by the ecosystem without losing essential structures and processes of the system. An ecosystem comprises communities made up of populations, individual organisms and its physical environment (Townsend *et al.*, 2003). Ecological variability is expressed in functional and response diversity (Walker *et al.*, 2006). Functional diversity has to do with the functions of species in an ecosystem. Organisms have diverse functions – “pollinate, graze, predate, fix nitrogen, spread seeds...” (Folke *et al.*, 2002: 10). Functional diversity allows a system to regenerate after disturbances.

Response diversity is achieved by species in the same functional group that respond differently to environmental changes (Folke *et al.*, 2002). In short, the source of “ecological resilience lies in the variety of functional groups and the accumulated experience and memory that provides for reorganization following disturbances” (Folke *et al.*, 2002: 19).

In a social system, diversity and redundancy of institutions (in functions and response) appear to play a central role in absorbing disturbances, spreading risks, creating novelty and reorganizing following disturbances (Low *et al.* 2002). A social system is regarded as a very dynamic entity where individuals, families, organizations and institutions establish bonds. The

definition is ambiguous because there is no clear measurement that indicates under what circumstances individuals constitute a social system (Bowlder, 1981). Nevertheless, the study of social systems is still very useful because it illustrates how society is formed by subsystems embedded in open and bigger systems (Bowlder, 1981). There has been much research on social structures (Giddens, 1984; Luhmann, 1984); but a discussion of this is beyond the scope of this research.

Identification of issues within complex socio-ecological systems “can only occur in the context of human values and requires bringing a diversity of views to bear on the question at hand” (Kay *et al.*, 1999:732). Generally, social resilience requires diversifying decision-making structures to allow constant adjustments of rules and policies at different spatial and temporal scales, in order to develop institutional structures that match ecological and social processes (Folke *et al.*, 2002). Social resilience will be enhanced through combining different knowledge systems horizontally (across space and interests) and vertically (across levels of organization) to permit different social actors to work in concert, even with much uncertainty and limited information (Folke *et al.*, 2002; Kates *et al.*, 2001).

Social resilience will also be enhanced when people treat policies as hypotheses and management as experiments from which managers can learn, accept uncertainty and expect surprises (Folke *et al.*, 2002: 20). “A resilient community is one that takes intentional action to enhance the personal and collective capacity of its citizens and institutions to respond to and influence the course of social and economic change” (CRPT, 2006). Social resilience will increase when “actors regard difference between how future actually unfolds and how it was anticipated to unfold as learning opportunities as opposed to errors” (Kay *et al.*, 1999: 737). Based on the literature review and the Resilience Assessment Workbook (RA, 2007), key

attributes of resilience that may apply to the Town of Caledon in the context of urban growth are listed below.

- Functional and response diversities of ecosystems (Folke *et al.*, 2002; Walker *et al.*, 2006);
- Ability to learn and innovate continually, and to adjust institutional practices and policies to social-ecological conditions (Wesley, 1995; Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006);
- Ability to reduce vulnerability to rapid changes by not suppressing disturbances or preserving a particular variable (Gunderson *et al.*, 1995, RA, 2007);
- Ability to nurture diversity in social-ecological systems for renewal and re-organizations (Folke *et al.*, 2003; Walker & Salt, 2006);
- Ability to combine different knowledge systems horizontally (across space and interests) and vertically (across levels of organization) to permit different social actors to work in concert (Folke *et al.*, 2002, RA, 2007); and
- Ability to treat crises as a release of opportunities for experimentation and reorganization (Walker & Salt, 2006; Gunderson & Holling, 2002)

2.5 Humans' Adaptive Capacity

The concept of adaptive capacity reflects many of the characteristics of a resilient system described above. It refers to “the ability to monitor, assess, respond, recover and renew following known and unknown disturbances and other change” (RA, 2007: 62). In other words, it is “the capacity of actors in a system to manage resilience” (Walker *et al.*, 2006: 3). Adaptive capacity to manage resilience rests upon institutional and social learning (Lee 1993), and entails “learning to live with uncertainty [and] change”; “nurture diversity for reorganization and renewal”; “combine different types of knowledge for learning”; and “create opportunities for self-organization” (Folke *et al.*, 2003: 355). These features of adaptive capacity vary according to the attributes of organizations, people’s willingness to learn from mistakes and nurture institutional diversity (Folke *et al.*, 2003). Hence, adaptive capacity is highly contextual, and contains “social-

institutional attributes that influence collective action” (Armitage, 2005: 712). These ideas of adaptive capacity are integrated into the assessment of Caledon’s resilience (Section 6.4 and Chapter 7).

Since humans possess foresight and can take deliberate actions, self-organization of complex social-ecological systems is “somewhat different from that [self-organization] in ecological or physical systems” (Westley *et al.*, 2002). Humans can consciously influence slow-changing variables such as worldview and values, as well as fast-changing variables such as operational rules and local knowledge (Armitage, 2005). In the context of fostering adaptive capacity, efforts should centre on things such as learning from mistakes, power sharing and institutional diversity (Armitage, 2005).

2.6 Overview of Resilience Assessment Workbook and Other Frameworks

The Resilience Assessment Workbook designed for practitioners aims to assist researchers to determine management interventions from a resilience perspective (RA, 2007). The Workbook has five goals: 1) to define the boundary and main characteristics of a social-ecological system; 2) to identify structuring variables of the focal system; 3) to consider cross-scale interactions among the focal, smaller and larger systems; 4) to detect vulnerabilities, disturbances and thresholds in complex systems and; 5) to identify ways to increase people’s abilities to learn and re-organize in face of changes (RA, 2007). Chapter three presents how the Workbook is used in this research.

There are various resilience assessment tools related to different topics. Table 1 presents a summary of the Resilience Assessment Workbook and other assessment tools. While other resilience assessment tools focus on relatively specific topics (e.g. of rural economies, hillslope

communities and arctic water resources), the Resilience Assessment Workbook can be applied generally to linked social-ecological systems for the purpose of understanding a system and increasing its resilience (RA, 2007). Therefore, this research has chosen to use the Resilience Assessment Workbook to conduct a resilience assessment on the Town of Caledon.

The Resilience Assessment Workbook has strengths and weaknesses in application. The Workbook is ideal for describing a system (i.e. resilience of what) in relation to resource use, historical events and scales. It is also useful for identifying disturbances (i.e. resilience to what) and ways for a system to enhance resilience (i.e. resilience with what). However, the Workbook is weak in identifying the goals and ends of enhancing the resilience of systems (i.e. resilience for what). The strengths and weaknesses of the Resilience Assessment Workbook are presented in section 8.1.3.

Projects/ Frameworks	Definitions of resilience	Resilience of what	Resilience to what	Critical factors of resilience	Target users
Resilience Assessment Workbook (RA, 2007)	Resilience refers to the capacity of a social-ecological system to absorb shocks, regenerate and remain in a desirable state; and people's ability to adapt and maintain resilience of	Social-ecological Systems	Disturbances that can flip the systems into an alternate undesirable state	Vary according to the type of system and the identified desirable state. Examples include population of a species, concentration of a pollutant, and the ability of a species to adapt.	Individuals, groups and institutions that want to influence long-term welfare of an integrated social-ecological systems

	the system				
The Community Resilience Manual (CRPT, 2006)	“A resilient community is one that takes intentional action to enhance the personal and collective capacity of its citizens and institutions to respond to and influence the course of social and economic change” (CRPT, 2006:10).	Social self-sufficiency Economic vitalities	Volatile markets	People (beliefs, values, attitudes) Organizations (Level of collaboration) Resources (the extent to which the community builds on local resources) Community (The extent and nature of community participation in decision-making)	Communities that face economic difficulties, low employment and heavy reliance on non-local investment
Building Resilience in Rural Communities (University of Queensland & University of Southern Queensland, 2008).	Resilience is “the capacity of an individual or community to cope with stress, overcome adversity or adapt positively to change”. (University of Queensland & University of Southern Queensland, 2008:3).	Individuals and Communities	Personal and social stress/ changes	Social Support Positive Outlook Formal and informal learning Diverse and innovative economy Adaptive leadership	Communities that are interested in improving its abilities to withstand shocks such as drought, unemployment and a lack of services.

Incorporating Resilience in the Assessment of Inclusive Wealth <i>(Walker et al., 2010)</i>	Resilience is the capacity of a system to remain in a given figuration of a preferred state.	Productivity, values of assets and associated social welfare	Risks associated with irreversible changes in the capacity of a system to recover from environmental shocks such as droughts	The threshold of a critical variable in the system (E.g. rainfall determines crop production)	Community, business and government leaders
Assessment of disaster resilience capacity of hillslope communities <i>(Chen et al., 2008)</i>	Resilience refers to capacities of hillslope communities to minimize and mitigate impacts of geological hazards	Hillslope communities facing geological hazards	Landslides	Emergency response capabilities Warning and reporting systems Environmental conditions, hazard of landslide and debris flow	Community and government leaders
Arctic Water Resource Vulnerability Index <i>(Alessa et al., 2008)</i>	Resilience is not controlled by a single or a few variables, but by interactions of multiple factors over a long period of time.	Abilities of remote Arctic communities to respond to changes in water resources	Disruptions caused by changes in water resources	Physical supply and infrastructure Ability to perceive and understand changes in water supply The use pattern of water	Arctic communities whose livelihoods depend on the watersheds

Table 1 An overview of the resilience assessment framework and other frameworks

2.7 Key Legislation Associated with Urban Growth

After reviewing conceptual ideas of this research, it is useful to elaborate on the legislative framework because urban growth in Caledon has been highly driven by provincial policies and legislation. More detailed elaborations on legislation are presented in section 5.1.

Ontario Planning Act and Provincial Policy Statement

The Planning Act details the provincial interest and municipal regulatory powers in land use (Hanna *et al.*, 2007). Section 3 of the Planning Act is the Provincial Policy Statement (PPS). The PPS was released in 1997 to guide the implementation of the Ontario Planning Act on the municipal level (Diamond *et al.*, 2002). Key concepts under the Policy Statement include ecosystems and watersheds, ecological functions and natural connections (Diamond *et al.*, 2002). While this document has now been largely displaced by the Oak Ridges Moraine Conservation Plan (ORMCP) within the Plan area, it remains the effective provincial policy statement for the remainder of Ontario.

Oak Ridges Moraine Conservation Act (ORMCA) (2001)

As early as the 1870s, foresters were calling for extensive replanting on the Moraine because of damaging deforestation carried out by European settlers (Fisher & Alexander, 1993). The next major reforestation effort on the Moraine took place after the release of the Ganaraska Watershed Report in the early 1940s (Richardson, 1944).

The Ganaraska Watershed Study highlighted a comprehensive approach to conservation including surveys of climate, soils, vegetation, agriculture, wildlife and water flow (Richardson, 1944; Fisher & Alexander, 1993). Later, in 1954, the Hurricane Hazel and floods led to a greater focus on watershed protections within the Conservation Authorities (Fisher & Alexander, 1993; McCarthy, 2006). In the 1960s, the Concerned Citizens for the King Township led to the

establishment of the Oak Ridges Moraine sub-committee, which joined other groups across the moraine to form the Save the Oak Ridges Moraine Coalition, a group that was pivotal to the implementation of the Oak Ridges Moraine Conservation Plan (2002) (McCarthy, 2006). Beginning in the 1970s, estate development took place, but its effects on the moraine were not apparent until the mid-1980s (Hanna & Webber, 2005).

Moraine conservation gained momentum in the late 1980s and 1990s. In 1990, development pressure within the Greater Toronto Area prompted the Liberal government to release *the Space for All Study: Options for a Greater Toronto Area Greenlands Study* in which the Moraine was recognized as needing special protection (Dore, 1994). In response, the Ontario government released the “Implementation Guidelines: Provincial Interest on the Oak Ridges Moraine” (Foster, 2005: 123). The guidelines served to work with the Provincial Policy Statement (PPS) to “support the protection of and precautionary treatment of natural heritage features and ecological functions” (Diamond *et al.*, 2002:9). In September 1990 the elected NDP government launched a comprehensive three-year study of the ORM (Dore, 2004). As a result, by 1994, fifteen studies had been commissioned (Foster, 2005: 122) as background for *The Oak Ridges Moraine Area Strategy for The Greater Toronto Area*.

However, when a fiscally-conservative government came to power in 1995, it did not follow through with the strategy (McCarthy, 2006; Whitelaw, 2006). Municipalities were given non-legal binding guidelines in regards to Moraine management (Dore, 2004). As a result, when municipalities denied development proposals, developers appealed to the Ontario Municipal Board, and frequently won (Dore, 2004).

Pressures from civil society reached its height when the controversial Official Plan Amendment 129 proposed new residential developments across the moraine in Richmond Hill in

2000 (Foster, 2005; Dore, 2004). In response to intense public pressure, the Conservative government imposed a six-month moratorium on development on the ORM (Whitelaw, 2006). The government then appointed a multi-stakeholder ORM Advisory Panel.

In response to the panel's recommendations and public pressure, the province eventually passed the Oak Ridges Moraine Conservation Act (ORMCA) in December 2001 (Foster, 2005). Planning decisions, zoning and official plans of municipalities must comply with the Oak Ridges Moraine Conservation Plan (ORMCP) (Diamond *et al.*, 2002). An adaptive learning process is integrated in the ORMCP through a review mechanism, which provided both stability and flexibility. Provisions of the ORMCP direct a review every 10 years.

Smart Growth – Places to Grow Act (2005), Greenbelt Act (2005) and Planning and Conservation Land Statute Law Amendment Act (2006)

Smart Growth is Ontario's long-term strategy for promoting growth in a way that builds communities, economies while protecting the environment (Dore, 2004; Diamond *et al.*, 2001, EPA, 2010). The Oak Ridges Moraine Conservation Act (2001) is part of this Smart Growth strategy. The Places to Grow Act (2005) was passed to work in conjunction with the Greenbelt Act (2005) and the Provincial Policy Statement (2005) to promote Smart Growth (Ministry of Public Infrastructure Renewal, 2006).

The vision of the Places to Grow Act (2005) is to build “complete communities” that offer “transportation choices, accommodate people of all states of life and have the right mix of housing...and easy access to stores and services” (Ministry of Public Infrastructure Renewal, 2006:13). To centralize the coordination role of the Province, the Province passed the Planning and Conservation Land Statute Law Amendment Act, 2006 (Bill 51) to make the Ontario

Municipal Board more effective and accessible to the public, and provide municipalities new tools to implement growth plans (Ministry of Public Infrastructure Renewal, 2006).

The Greenbelt Act (2005) is built on the legislative framework of the Planning Act and the Provincial Policy Statement (MMAH, 2005). The Greenbelt protects 1.8 million acres of agricultural land and some environmentally sensitive areas around the Greater Golden Horseshoe, including the Oak Ridges Moraine and Niagara Escarpment (MMAH, 2005). The implementation piece of the Greenbelt Act is known as the Greenbelt Plan, and is carried through municipal Official Plan conformity (MMAH, 2005). Municipalities need to modify their Official Plans to ensure that they conform to the provincial legislation.

Chapter 3 Methodology

There are two research components. The first component corresponds to objective 1 in this proposal, which is to conduct a background research required to apply a resilience assessment in Caledon (also Section 1.3). The second component corresponds to objectives 2 and 3, which involves applying the Resilience Assessment Workbook (also Section 1.3). Both research components are qualitative in nature, and rely primarily on academic, grey literature reviews and semi-structured interviews. As a whole, this research has used Caledon as a case study for conducting a resilience assessment.

Chapter Structure

Section 3.1 elaborates on the use of a case study. Section 3.2 elaborates on methods used for the background research that prepares for conducting a resilience assessment on Caledon. Section 3.3 elaborates on resilience assessment methods.

3.1 Caledon as a Case Study

A case study “is an intensive study of a single unit with an aim to generalize across a larger set of units” (Gerring, 2004: 341). It is an inquiry that “investigates a contemporary phenomenon within its real-life context” that is suitable for exploring and explaining phenomena (Yin, 2003:13). Case studies use various methods including “interviews, participant observation and field studies” (Hamel *et al.*, 1993:1). Depending on the scale of study, the unit of analysis will change accordingly. The unit of analysis for this research is the Town of Caledon.

Case study methodology has been commonly challenged for its lack of representativeness; lack of rigor in empirical analysis, subjectivity and biases introduced by the field researcher; and the lack of ability to establish causal effects (Gerring, 2004; Hamel *et al.*, 1993; Hammersley *et*

al., 2000). Nevertheless, many studies on case study methods have pointed out that case study methodology has advantages in a number of circumstances (Gerring, 2004). Case studies are usually more useful for 1) descriptive rather than causal inferences; 2) studies prized for depth over breadth; 3) case study comparability rather than case representativeness; 4) building causal mechanisms rather than causal effects; 5) exploratory rather than confirmatory research (Gerring, 2004).

Since this research aims to describe in-depth and explore urban growth issues in Caledon, a case study method is appropriate. Furthermore, “the detail and depth of the description rendered by the case study permit an understanding of the empirical foundations of the theory,” (Hamel *et al.*, 1993:33). A case study of Caledon can provide some empirical understanding of a social-ecological system and resilience in the context of growth management in southern Ontario. The Resilience Assessment Workbook states that “decades of theoretical research and case study comparisons by members of the Resilience Alliance and other researchers, have contributed to a better understanding of the dynamics of complex social-ecological systems” (RA, 2007: 1).

Moreover, Caledon represents an atypical case of urban growth in Ontario (also Section 1.4). Atypical cases “often reveal more information because they activate more actors and more basic mechanisms in the situation” (Flyvbjerg, 2004: 425). Methods that emphasize representativeness such as random and stratified sampling will not be able to deliver insights into fundamental causes and mechanisms behind a situation (Flyvbjerg, 2004). Caledon is an atypical case because it is the only municipality in the Region of Peel that contains both the Oak Ridges Moraine and the Niagara Escarpment (Town of Caledon, 2008a). Also, the Town is expected to experience more population increase than other moraine municipalities (MNR, 1994).

Another advantage of conducting a case study in Caledon is that it has the potential to produce rich narratives. “Case studies often contain a substantial element of narrative” (Flyvberg, 2004: 429), and can reveal “the complexities and contradictions of real life” (430). Such a case study may be hard to be generalized into rules or a theory, but it contains a rich ambiguity that helps people gain understanding to address complex issues that a heuristic framework and standard rules cannot address (Flyvberg, 2004).

3.2 Methods for Background Research

This part of the research is mainly qualitative research. Qualitative research is the “non-numerical examination and interpretation of observations, for the purpose of discovering underlying meaning and patterns of relationship” (Babbie, 1986: 385). It suits the inquiry into social or human problems, and also the building of a holistic picture of the problem (Creswell, 1994).

“There is no single best way to conduct a resilience assessment”, and it may take both quantitative and qualitative data to conduct one (RA, 2007:9). The Resilience Assessment Workbook advises researchers to devise their own data collection methods because methods change according to the system and researchers’ goals (RA, 2007). Since the goal of this research is to develop an understanding of Caledon’s people and history in relation to urban growth, the use of qualitative research is most appropriate. This research uses literature review, secondary research, relevant provincial and municipal government documents and conference calls to broaden the understanding of growth management in Caledon. As a result, a basic understanding of Caledon as a social-ecological system is generated, and the contacts that are required for a resilience assessment are established.

3.3 Methods for Conducting a Resilience Assessment

The use of Resilience Assessment Workbook

This part of the research is qualitative in nature, and has selected the Resilience Assessment Workbook section 1 (“Resilience of What, To What?”); section 3 (Assessing Cycles of Change); section 4 (“Adaptability and Transformative Change”); and the final section 5 (Next steps: Interventions and management”) to answer the main research question. The main research question is: ‘Based on resilience thinking, what factors threaten and enhance Caledon’s abilities to respond and adapt to changes caused by urban growth as a linked social-ecological system?’(also Section 1.2). The answers to this research question are organized into three parts - ‘resilience of what’, ‘resilience to what’ and ‘resilience with what’ (Chapter 4-6).

Sections 1 and 3 of the Workbook address the questions of ‘resilience of what?’ and ‘resilience to what?; while sections 4 and 5 address the question of ‘resilience with what?’ Section 2 of the Workbook is not selected because it is concerned about thresholds and alternate states of systems, and is more suitable for quantitative research (RA, 2007).

Innovative approaches in the resilience assessment

Since this research was exploratory work, this research has taken four innovative approaches in the resilience assessment. Firstly, this research integrates an analysis of potential resilience threats and assets into a cross-scalar study of Caledon (Chapter 5). Whereas the Resilience Assessment Workbook focuses on using cross-scalar studies to understand the focal system (RA, 2007); this research expands the use of a cross-scalar study to identify potential resilience threats and assets of the focal system (Chapter 5). The purpose is to identify what factors threaten and enhance Caledon’s abilities to adapt to changes caused by urban growth (Section 5.4 and Chapter 7).

Secondly, this research identifies assets of the focal system (i.e. Town of Caledon) that can build resilience of Caledon. Whereas the Resilience Assessment Workbook looks into what constitute threats to the resilience of a system, it does not explicitly investigate assets of a system that can enhance its resilience.

Thirdly, this research incorporates an investigation of desirable characteristics of the focal system (i.e. the Town of Caledon) into the resilience assessment (Section 6.1). The Resilience Assessment Workbook does not address directly the final goals of enhancing systems' resilience (also Section 2.6). To shed light on the final goals of enhancing resilience, this research investigates desirable characteristics of Caledon through interviews with community members (Section 6.1).

Fourthly, this research incorporates an identification of emerging themes of resilience into the resilience assessment of Caledon (Sections 5.5 and 6.5). The purpose is to develop recommendations for Caledon to enhance resilience in face of urban growth pressures based on the emerging themes of resilience (Chapter 7). Another purpose is to synthesize research results of the cross-scalar study and interviews (Section 6.5).

The use of interviews

A portion of the resilience assessment is completed with the use of semi-structured interviews. I have conducted twenty-six interviews with community members from diverse backgrounds to verify the findings from literature review (Chapter 6). Interview questions are documented in Appendix D. The semi-structured interviews were based on a set of pre-established questions, and yet, respondents were allowed to deviate from the main question and talked about associated issues based on their experiences or expertise (Fontana & Frey, 2000).

This allows greater flexibility in collecting a broader scope of in-depth data for a research (Fontana & Frey, 2000).

This research began with twelve key informants. These informants are selected based on the recommendation of Ms. Debbe Crandall, who is this research's informal advisor and the first key informant. Crandall has been a resident in Caledon for over 35 years, and she is the founding chair of the Caledon Environmental Advisory Committee. Crandall has also been the executive director of the Save the Oak Ridges Moraine Coalition (STORM) since 1999. In the interviews, the first twelve key informants were asked to suggest other people and literature that I should follow up on. If the key informant highly recommended a person, or a few informants have suggested the same person, I would include that person in future interviews.

As a result of this snowball sampling, I have interviewed a total of twenty-six people representing the governmental (11), non-governmental (13) and private sectors (2). They included: individuals who have lived in Caledon for more than 10 years, municipal staff (local & regional), politicians, environmental group leaders, a social service representative, an aggregates industry representative and a local property developer. Elaborations on interviewees are presented in Table 2.

It should be noted that more than half of the interviewees are selected based on snowball sampling. As a result, the interviews are not intended to be representative. For example, this research has interviewed ten people (out of a total of twenty-six) who are involved in environmental initiatives. They are likely to have biased views about urban growth issues in Caledon. The research could have addressed potential biases by conducting surveys through random sampling. Owing to time constraint, I chose to conduct interviews through purposive and

snowball sampling. The interview list is designed not to be a representation of the population in Caledon, but rather to include opinions about urban growth issues from different sectors. I intended to interview the Caledon Chamber of Commerce, the Credit Valley Conservation Authority and the Toronto and Region Conservation Authority. However, after many contact efforts, no interviews were able to be arranged.

All interviews, except for two², were transcribed manually. Note-taking replaced transcriptions for the two interviews. General interview results have been sent back to interviewees for comments, either electronically or through the mail. They were asked specifically to contribute ideas on how to enhance the resilience of Caledon in face of urban growth pressures (Chapter 7). Furthermore, for verifications, interview quotes were sent back to interviewees who had requested a review before the quotes were to be published in this paper.

The analysis of the transcribed interviews is informed by grounded theory. Grounded theory intends to “identify categories and concepts that emerge from text and link these concepts into substantive and formal theories” (Ryan & Bernard, 2000: 783). The “interpretations of data shape his or her [the researcher] emergent codes in grounded theory” instead of making data “fit into preconceived standardized codes” (Charmaz, 2000: 515). The benefit is that it helps researchers to “remain attuned to our subjects’ views of their realities (Charmaz, 2000: 515).

I did not ask interviewees about resilience per se to avoid the use of academic jargon and to establish categories and emerging themes about resilience after conducting and transcribing

² One interviewee declined audio-recording. Another interview was not audio-recorded because of technical problem.

the interviews (Chapter 6). I have read through all the transcriptions and responses to particular questions several times before interpreting the data.

In the process of data interpretation, I have established categories like ‘A Desirable Caledon’ and ‘Assets of a Desirable Caledon’ and sub-categories (Chapter 6). Subcategories were established based on repetitions of similar ideas expressed by interviewees. For instance, when asked about what they appreciated most, many interviewees mentioned trees, trails and the moraine. These responses were categorized as ‘Natural & Cultural Heritage’. Another example was that when asked about the strengths of Caledon, many interviewees mentioned advocacy groups and active citizens. This was categorized as ‘Civic Engagement & Effective Volunteerism’. These categories led to the establishment of emergent themes of resilience (Section 6.5).

Advantages and disadvantages of the Resilience Assessment Workbook will be further discussed in chapter seven. A resilience assessment report called the *Caledon’s Resilience Assessment Report 2010-2011* will be released to research participants, and is still in progress at the point of the writing of this thesis. Some of its results are presented in this paper in addition to reflections on resilience thinking.

Chapter 4. Research Results: ‘Resilience of What’ based on Literature Review and Interviews

Resilience of What

The research on ‘resilience of what’ is guided by sections 1 and 3 of the Resilience Assessment Workbook. Exploring the question ‘resilience of what’ is to identify Caledon as an integrated social-ecological system shaped by its people, biophysical environment, history, scales and structuring variables in the context of urban growth (Chapter 4). The research on ‘resilience of what’ is also informed by interviews with community members (Section 4.2.2). The Workbook does not discuss desirable characteristics of a system. To address this deficiency, this research has investigated desirable characteristics of Caledon to enrich the findings about the end goals of resilience (Section 6.1).

Chapter Structure

This part of the research intends to investigate what enhance and threaten the abilities of Caledon to deal with changes caused by urban growth pressures through a resilience lens. Section 4.1 presents research results on the identification of Caledon as a linked social-ecological system in the context of urban growth. Section 4.2 discusses the people and biophysical features of the Town of Caledon. Sections 4.3-4.5 present the system’s history, structuring variables and adaptive cycles in the context of urban growth respectively.

4.1 Resilience of What - A Social-ecological System of Caledon Identified

The Resilience Assessment Workbook guides researchers to begin a resilience assessment by determining boundaries of the focal system (RA, 2007). Bounding a system has to

do with identifying “a specific key issue; then a geographic scope and time horizon” (RA, 2007: 12). In this research, the focal system is the Town of Caledon.

The first step is to elaborate on the nature of social-ecological systems before looking into Caledon’s key issues, geography and history. Linked social-ecological systems are influenced by local factors (e.g. economic conditions, political climate) and “contextual factors in which local processes are shaped by larger-scale and ultimately global-scale processes” (Liu *et al.*, 2007a: 1514). Ecosystems and social systems interact reciprocally across time, space and organizations (Liu *et al.*, 2007a). The reciprocal interactions between ecosystems and social systems, as well as time lags between human activities and environmental impacts are two important features of linked social-ecological systems (Liu *et al.*, 2007a; Liu *et al.*, 2007b). These two features are observed in the Town of Caledon.

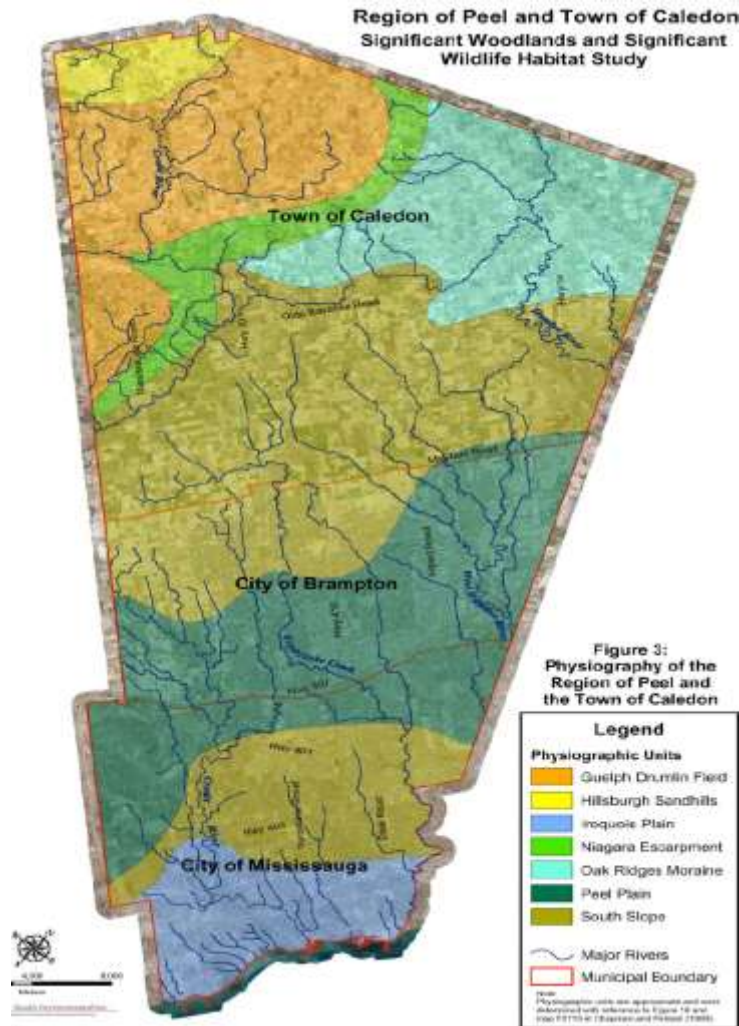
For example, beginning in the 18th century, extensive tree clearings were undertaken for agriculture in Caledon. The impacts were not felt until after the mid-1800s when river siltation, soil erosion and severe flooding led to mill closures (Ross, 1999). Today, Caledon faces increasingly complex environmental problems such as the loss of farmland and urban development. In response, the Town starts to take a comprehensive look at its current planning and conservation policies through an official plan conformity exercise in 2007 and a Caledon-wide strategic planning initiative in 2010 (Town of Caledon, 2007).

4.2 Resilience of What - Caledon’s People and its Biophysical Features

4.2.1 Resilience of what - Caledon’s people and its biophysical features based on literature review

The Town of Caledon covers over 700 square kilometres, and is located north-west of the City of Toronto (Town of Caledon, 2008a). Caledon exhibits distinct rural characteristics and is

under increasing pressure from expanding urban areas (Town of Caledon, 2008a). The town is the most northerly municipality in the Region of Peel. It is the only municipality in Peel that contains portions of both the Oak Ridges Moraine and the Niagara Escarpment (Map 2). Oak Ridges Moraine functions as a vital groundwater recharge and discharge for the region, and the Niagara Escarpment has been designated as a World Biosphere Reserve by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Town of Caledon, 2008a). Caledon's Peel Plain makes up its primary agricultural lands. Two major watersheds - the Credit and the Humber – support a wider range of ecological activities and habitats (CVC, 2007; Town of Caledon, 2008a).



Map 2 Locations of the Oak Ridges Moraine, Niagara Escarpment and other landforms in Caledon, Brampton and Mississauga.

(Source: North-South Environmental Inc. *et al*, 2009: figure 3)

There is a strong tradition of maintaining the sense of community by preserving unique rural characteristics (Macaraig & Sandberg, 2007; Ross, 1999). Caledon has a number of environmental groups, and a strong culture of stewardship (Macaraig & Sandberg, 2007; Markvart, 2009). In a 1999 study, Caledon residents mentioned “quiet”, “anti-growth” and “respect for privacy” the most as they described things they valued (Baxter *et al.*, 1999: 104). They mentioned “small town”, “place to raise family” and “farming/gardening” most frequently

as they described what they expected from the community (Baxter *et al.*, 1999:105). In 2007, Caledon won the "greenest" town award in Ontario in a competition set up by the TVO station (Macaraig & Sandberg, 2007) (Photograph 1). In a 2008 survey, Caledon residents expressed that they preferred a slow-growth model (Oraclepoll, 2008).



Photograph1. Caledon's sign of the Greenest Town in Ontario on Highway 50 in Caledon.
(Taken by the author in June 2010)

A decreasing portion of Caledon residents are engaged in agricultural activities, while there is an increase in the local population who are educated urban workers or retirees (Chambers & Sandberg, 2007; Baxter *et al.*, 1999). Housing costs in Caledon are high, and there is a limited amount of rental housing (Chambers & Sandberg, 2007). Caledon has the lowest population density in the region at $51/\text{km}^2$, and the highest median household income (Baxter *et al.*, 1999: 95). Major economic activities in Caledon are industrial, commercial and service-based (Ross 1999; Town of Caledon, 2009c). More information about the people and biophysical features of Caledon is collected from interviewees, and is presented in the next section.

4.2.2 Resilience of what- Caledon's people and its biophysical characteristics based on interviews

Twenty-six interviews were conducted with various community members (Table 2).

Interview methods are presented in section 3.3.

Sectors	Subsectors	Codes of Interviewees' Subsectors	Number of Interviewees	Additional information about interviewees
Governmental (11)	Municipal Staff (5 Local, 1 Regional)	MS	6	Four are not Caledon residents
	Politicians (4 Local, 1 Regional)	PL	5	Three Town Councillors are also farmers. One is Caledon's Mayor, and one is a regional politician.
Non-Governmental (13)	Environmental Groups' Leaders	EG	6	All are Caledon residents. One interviewee is also a member of the Chamber of Commerce
	Individuals	IN	6	All individuals are residents of Caledon who have lived in Caledon for more than 10 years. They have knowledge about development and growth of Caledon. One of them is a former Town staff, while another is a former Town Councillor. Four interviewees have been involved in environmental initiatives.
	Social Services Representative	SS	1	Caledon Community Services
Private (2)	Aggregates Industry	AI	1	Caledon Resident
	Local Property Developer	LPD	1	Caledon Resident
			Total Number of Interviewees: 26	

Table 2 Interviewee's information by sectors

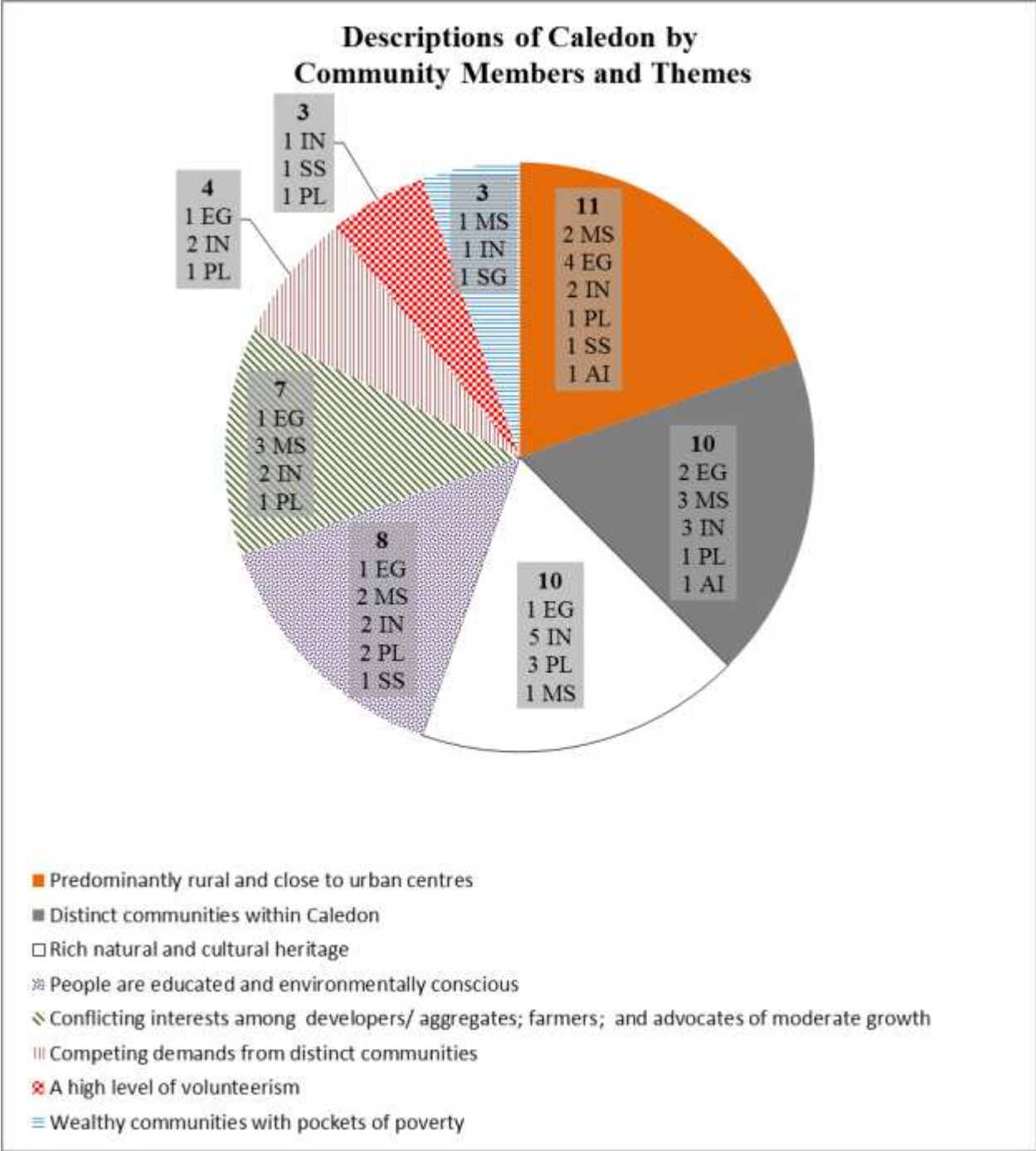


Chart 1. Description of Caledon by interviewees and themes

AI=Aggregate Industry; EG=Environmental Groups' Leaders; IN=Individuals; MS= Municipal Staff; PL=Politician; SS=Social Services

Twenty-six interviewees from different sectors were interviewed to describe Caledon (Chart 1). The list of interviewees is not representative of the population, but it allows this research to collect information about Caledon from different sectors. The top four responses described Caledon as predominantly rural (11); distinct communities (10); rich in natural and cultural heritage (10) and inhabited by people who are environmentally conscious (8). All these features, except the description of distinct communities, confirm the findings from literature review presented earlier (Sections 4.1 and 4.2). The other four responses associated Caledon with conflicting interests (7); competing demands (4); a high level of volunteerism (3); and wealthy communities with pockets of homelessness (3). These responses show features of Caledon that are not been commonly documented. Though it is commonly documented that Caledon faces conflicting interests between developers and conservationists (Chambers & Sandberg, 2007; Foster, 2005; Markvart, 2009; Johnson, 2006), it is not well studied that conflicting interests cut across various groups. These groups include farmers, conservation authorities, municipal planners, land owners, the Town's heritage office, local businesses, aggregates industry, rural residents and urban dwellers. The feature of conflicting interests informs recommendations for Caledon to enhance resilience (Chapter 7).

Predominantly Rural and Close to Urban Centres (11)

Environmental group leader (EG) 1 said, "I guess it's [Caledon] still has a large rural component, but it's close to city, cities, Toronto, Brampton, Mississauga. So it's a mixture of commuters, and farmers and horse farms." EG 2, who has lived in Caledon for more than 30 years, described that, "People lived and worked in [Caledon], there was a good infusion of

worldly people, worldly perspectives. At the same, that's overlaid on a very strong rural lifestyle, very strong rural connections.”

A social services (SS) representative pointed out that “Caledon is a very large urban rural mix municipality. An aggregates industry (AI) representative said that, “I would say Caledon is a typical mix of a border line rural environment close to a large metropolitan city.”

Distinct Communities within Caledon (10)

Ten interviewees described Caledon as a community of distinct communities because they saw people in rural villages/hamlets having different lifestyles and needs. Politician (PL) 2 emphasized that “Caledon is a community of communities; there are hamlets and villages throughout Caledon connected by agricultural lands, environmental lands.” Municipal staff (MS) 1 expressed that,

You should recognize that there are distinct communities here [Caledon], really different. You have Bolton which is really, mostly industrial in terms of what its economy is. And we have Caledon East here, which is you know just a starting community, a centre of government... And then we have Inglewood, Alton, Caledon Village, Mono Mills, Palgrave, all different. Belfountain, Terra Cota. They are all very distinct and different.

MS 3 pointed out that “It [Caledon] has a number of settlements within it. Previous Mayor and current Mayor call it a community of communities.” Individual (IN) 3, who has lived in Caledon for 37 years, said that, “Caledon now is this geographic term for this area that's made up of little pockets of little hamlets and towns. So maybe one of the best description now is

Caledon is using in their strategic plan, the community of communities.” An aggregates industry (AI) representative identified that, “Bolton, Palgrave, where that’s the majority of the commerce and majority of the business are there. And the west side of Caledon, Caledon East, Alton, Inglewood, Belfountain are the smaller, remnant villages, so to speak. They are very much different.”

While many interviewees saw distinct communities within Caledon, municipal staff (MS) 4 pointed out that Caledon people share a common interest. MS 4 pointed out that, “What I just get is that they care about the environment. They are across the board.”

Rich Natural and Cultural Heritage (10)

Ten interviewees identified Caledon with natural heritage features. Individual (IN) 1, who has lived in Caledon for 40 years said, “And we have four heritage Conservation Authorities areas...In addition, we have a large piece of Oak Ridges Moraine, and we have an even larger piece of Niagara Escarpment.” IN 1 was the only interviewee who pointed out that the natural environmental is part of a cultural heritage. IN1 said that,

People here would say they’ve come to live here because of the natural environment. But in reality, it is all a cultural landscape...for the last almost two hundred years, every square inch has been altered by human hand. Yes, we have great conservation areas, we have trees, we have marshes, we have wild flowers, lovely vistas. It’s a cultural landscape, not a natural landscape. It has natural things. And my rationale for that is that humans cannot live where geography doesn’t allow them to do.

IN 2 described Caledon as “a quite unique physical environment because we are right on the Oak Ridges Moraine and the Niagara Escarpment right near Toronto, a nice Greenbelt here.” Municipal staff (MS) 6 pointed out that, “[I]n the GTA [Greater Toronto Area], it’s where the Oak Ridges Moraine and the Niagara Escarpment meet. It’s an enormously varied landscape, and all kinds of wonderful environmental areas.”

Educated and Environmentally Conscious Residents (8)

Eight interviewees expressed that Caledon residents were generally environmentally conscious. Politician (PL) 1 pointed out that, “a vast majority of the people, I would say, are very in tune with what’s going on, well educated, well-informed both about what’s going on around them and also the natural environment.” PL 2 recognized that “Caledon is populated by engaged and educated residents. They are environmentally conscientious, protecting the environment, protecting the headwaters, protecting forests or wetlands are extremely important to our community.”

Municipal staff (MS) 4 observed that, “So engaged, committed and knowledgeable...there are a lot of community environmental groups. There is a lot of what I refer to as community capacity within the community.” A social service (SS) representative observed that, “The people are very community minded. There are peers groups, advocacy groups. They are very protective of their Caledon, and their environment.” Individual (IN) 2 said that, “I am just amazed at how involved how some people are in the community, how much they know what’s going on, both the environment, socially, politically.”

Conflicting Interests (7)

Seven interviewees revealed that there have been on-going tensions between the Town government who wanted to pursue moderate growth model, and developers/local businesses who wanted to intensify development, particularly in Bolton (Section 5.1.3). Some landowners wanted to expand the development boundaries to sell their land for development, while the Town wanted to restrict certain areas to remain rural. Tensions also existed between farmers who wanted to expand their agricultural operations, and the Town which controlled development in rural areas. In addition, urban dwellers who lived in Bolton have demanded more recreation and social service facilities, while residents in rural areas often felt they were neglected. Three interviewees have described this as a sharp rural-urban divide within Caledon. These conflicting interests posed challenges to a desirable and resilient Caledon (Sections 6.2 and 6.5).

Municipal staff (MS) 1 pointed out that,

there are actually 3 groups because you do have the people that want to retain the farm, the rural scenic components, period, right? And you have others that think that growth will be better for the community, more services, that kind of stuff. And then you also have the farm community which is like a lot of farms here in Ontario, which is their land is their pension. And they really want to see the growth come so they can sell out their farm.

MS 6 observed that, “you got the tension between lands being purchased by developers for speculative reasons versus families that have been farming for generations.” MS 6 also noted that land use conflicts occurred also in mineral aggregate applications which were seen as a significant catalyst for community mobilization.

Politician (PL) 4 pointed out that “Conservation Authority regulates, and farmers don’t want to be regulated. With the use of fertilizers, land drainage, the protection of woodlots. Just generally, they consider the conservation authority a pain ...”

Competing Demands (4)

Four interviewees observed competing demands from communities in Caledon. Environmental group leader (EG) 3 noted that, “When they build [the Town] the arena in Caledon East, the residents in Bolton felt that it should be built in Bolton rather than Caledon East. So it took some convincing.” Politician (PL) 4 observed that, “Politically, there has always been a bit of rivalry between the need of the urban people and rural people. Sometimes, it gets tough ... and this time, again, we have a urban-rural probably contested election.” An individual (IN) 1 added that, “Others resented the fact that Bolton was earning so much less levies, and having to provide soft services like arenas and football fields.”

High Level of Volunteerism (3)

Volunteerism of Caledon is not commonly documented in the literature reviewed in this research. Three interviewees pointed out that volunteerism formed the social fabric of Caledon, helping the municipality and non-profit sector to accomplish many environmental and social objectives. These include park maintenance, local food movement, watershed restoration, fire services, meals on wheels and free heating for people in poverty. Interviewees also identified volunteerism as a major asset of a desirable Caledon (also Section 6.3). Local politician (PL) 3 pointed out that “You look at the percentages of volunteerism. You look at people, you know

having an understanding. They are the ones always out there volunteering, trying to make a difference, and help people.”

Wealthy Communities with Pockets of Poverty (3)

Inequities in Caledon, particular the pockets of poverty in a generally wealthy community, is a feature that is not documented in the literature reviewed in this research. A lack of affordable housing and public transit is identified as a threat to a desirable Caledon (also Section 6.2). In terms of pockets of poverty, a social service (SS) representative said that, “And it is a wealthy community, but there is also you know issues of homelessness and other issues that may not seem obvious. We have clients who during the summer live in the bush, in the conservation areas, in their cars.” Individual (IN) 3 identified that “they [Caledon residents] are pretty privileged, most of the people. That isn’t to say there aren’t poor areas and pockets. It must be tough for some of the old farm families, weren’t wealthy, didn’t have the land.” Municipal staff (MS) 3 pointed out that “When you go to look at some housing issues, for example, there is a less affluent segment of population.”

4.3 Resilience of What – History of Caledon in the Context of Growth Management

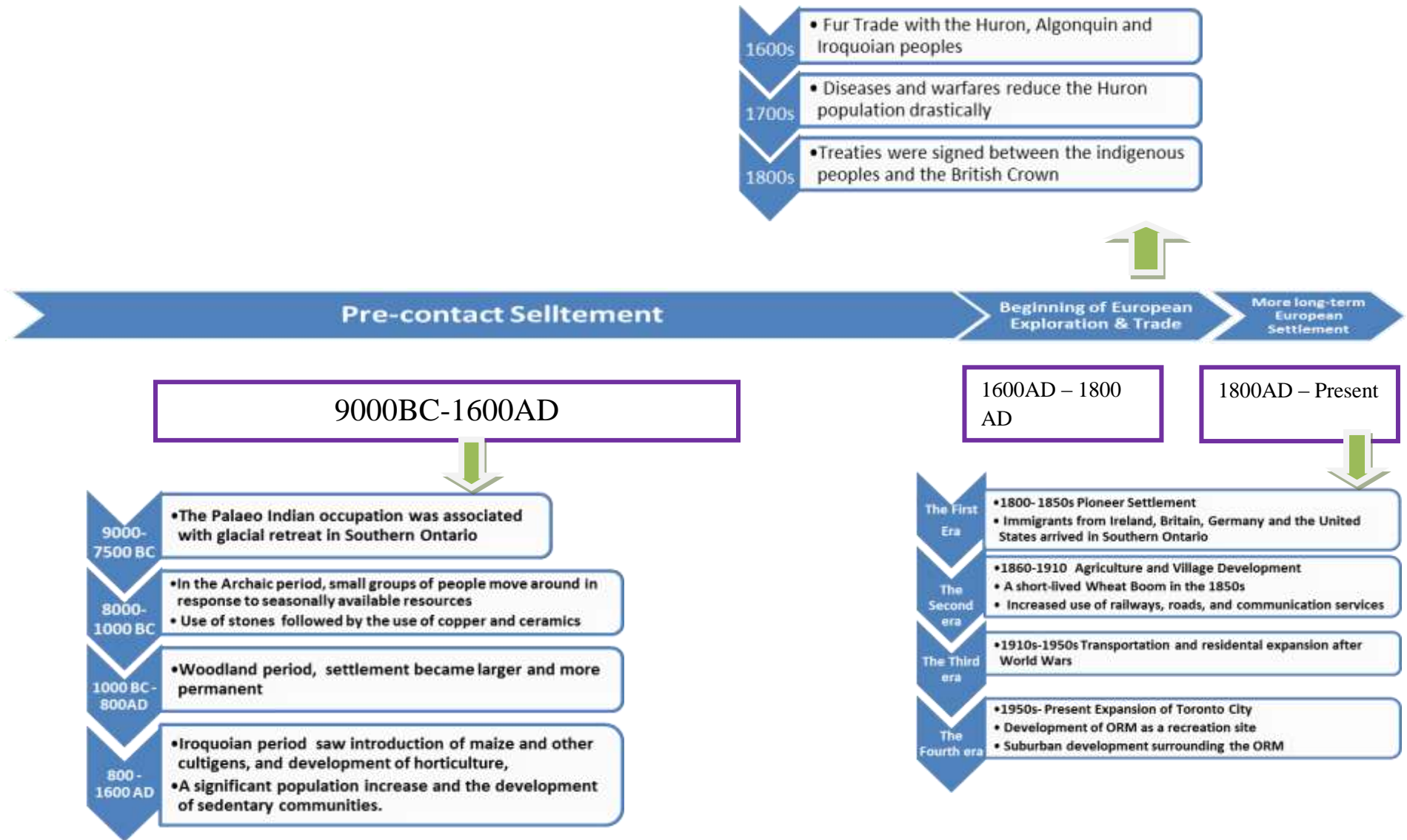
Exploring the question ‘resilience of what’ in this research has to do with identifying Caledon as a linked social-ecological system, its people and biophysical features (Sections 4.1-4.2) Section 4.3 uses section 1 of the Resilience Assessment Workbook to explore Caledon’s history in the context of growth management. The Workbook states that “social-ecological systems undergo change over time...Historical profiles can reveal how human interventions and management actions can lead to the loss of resilience” (RA, 2007: 24). The research results in

section 4.3 are verified by the former and current Heritage Officer of the Town of Caledon. Based on a better understanding of Caledon's history, sections 4.4 and 4.5 will identify Caledon's structuring variables and adaptive cycle in the context of urban growth respectively.

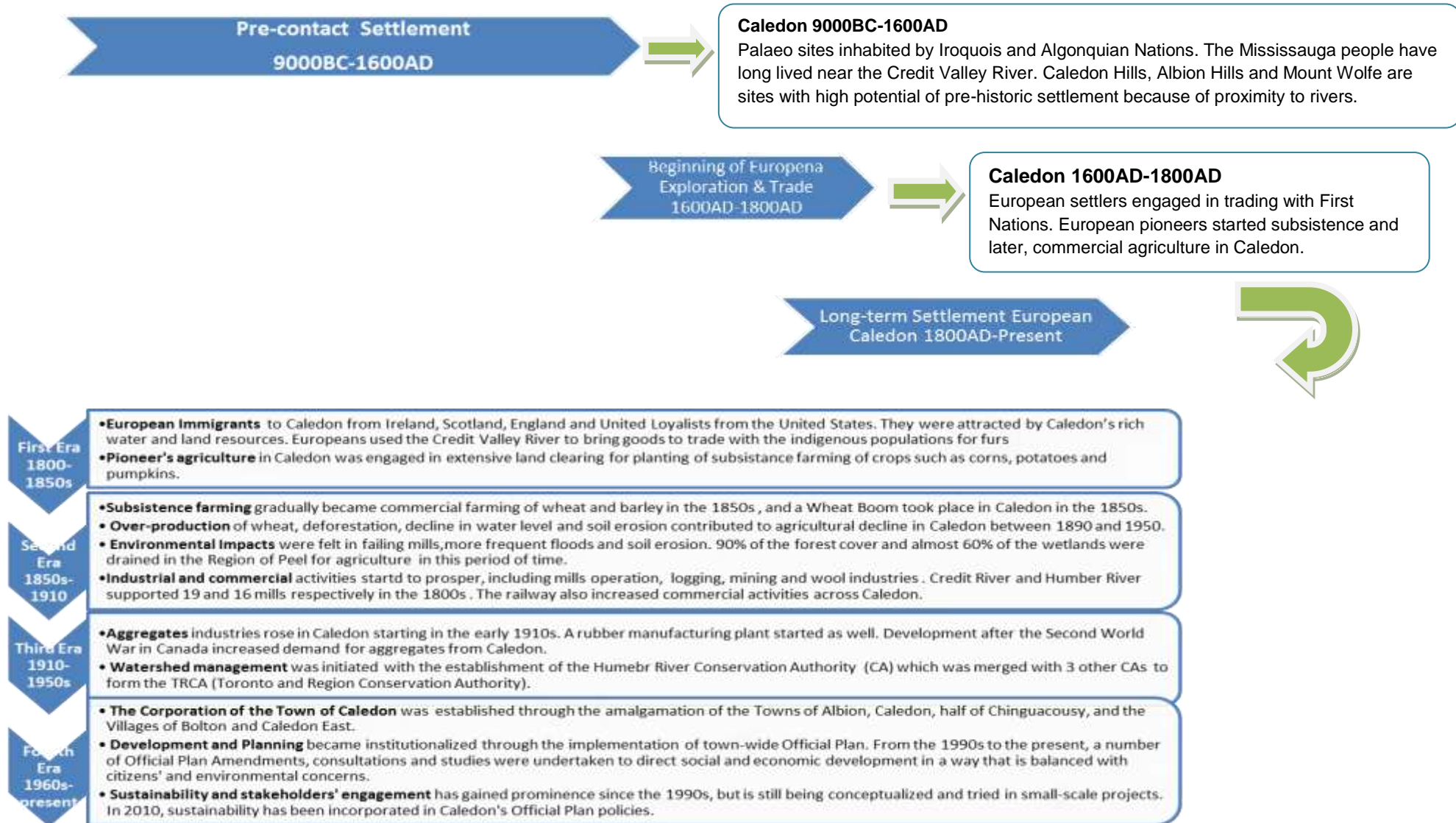
History of Caledon from Pre-contact Period to the Present

Studying resilience requires understanding how historical development shaped the current system. Timeline 1 and Timeline 2 present major historical development of the Oak Ridges Moraine area and Caledon respectively. Nearly one quarter (24%) of Caledon is in the Oak Ridges Moraine area, and Caledon's history has been highly influenced by the development of the Moraine (Algonquin Associates, 1993; MNR, 1994; *Historica et al.*, 1994; Ross, 1999). Therefore, it is useful to present Caledon's history in the context of the development of the Moraine. The timelines are followed by an elaboration on the historical events and a summary of Caledon's history in the context of urban growth from a resilience perspective.

Timeline 1. Historical Timeline of the Oak Ridges Moraine Areas (Sources: Historica *et al.*, 1994; Fisher & Alexander, 1993; McCarthy, 2006)



Timeline 2. Historical Timeline of Caledon (Sources: Ross, 1999; Markvart, 2009; Algonquin Associates, 1993; Former Heritage Officer, 2010).



4.3.1. Caledon in the pre-contact period

A number of Palaeo Indian sites were identified in the Albion Hills area in Caledon (Historica *et al.*, 1994). The Iroquois and Algonquian Nations inhabited the area for hundreds of years before the European pioneers arrived (Markvart, 2009). In addition, the Mississauga people have long lived near the Credit River (Ross, 1999). Caledon contains multiple registered sites and areas with high potential for pre-historic and significant sites because of its topography and proximity to river systems (Algonquin Associates, 1993). The majority of these registered sites and areas of very high potential are found across the Caledon Hills, Albion Hills and on Mount Wolfe (Algonquin Associates, 1993).

4.3.2 Caledon 1600- 1800s, beginning of pioneer settlement

European settlers engaged in trading with First Nations. European pioneers started subsistence and later, commercial agriculture in Caledon (Ross, 1999). This was the period when First Nations people had contact with Europeans. Motivated to trade fur and explore new lands, Europeans established contacts with Algonquin and Iroquoian peoples inhabiting in Ontario. Fur trade introduced by Europeans greatly intensified inter-tribal warfare between the Huron and the Iroquois (Fisher & Alexander, 1993; Historica *et al.*, 1994). By the mid-17th century warfare and epidemic disease reduced the Huron population drastically and led to the dispersion of inhabitants (Historica *et al.*, 1994).

4.3.3 Caledon: 1800- 1850s, continued pioneer settlement

Settlement and Trade

European settlers began to arrive in this part of southern Ontario after the land was surveyed in 1818-1819 (Town of Caledon, 2008a). Caledon attracted immigrants mainly from Ireland (due to the Potato Famine), Scotland, England and United Empire Loyalists from the

United States (Ross, 1999). They were attracted by Caledon's rich water, soil and aggregates resources (Ross, 1999). Europeans used the Credit River to bring goods to trade with First Nations groups for furs (Ross, 1999).

Agriculture and Environmental Impacts

The first settlers were heavily engaged in felling trees to clear lands for agriculture (Town of Caledon, 2008a; Ross 1999). Farmers would have to spend four to five years to wait for the trees' roots to rot before ploughing the land (Ross, 1999). In the first few years, most settlers struggled to feed their families, and they planted potatoes, corn, grains, squashes and pumpkins in small patches (Ross, 1999). After land clearing for agriculture in certain areas dominated by fine glacial outwash sands, topsoil was exposed to erosion. Agricultural decline ensued in the late 1800s due to soil erosion (Ross, 1999).

4.3.4 Caledon in the period of 1850-1910

Commerce and transportation

In the late 1870s, three railways including the Credit Valley Railway, Toronto Grey & Bruce Railway (later the Canadian Pacific Railway) and Hamilton & North Western Railway (later the Canadian National Railway) started to operate across Caledon, connecting with other towns and cities in the Greater Toronto Area (Ross, 1999). A number of entrepreneurs opened businesses next to the railways (Ross, 1999). Though the railways improved the movement of goods and services to Caledon, they also increased the inflow of cheap products from other major cities such as Toronto and Brampton (Ross, 1999).

Agriculture and environmental impacts

Subsistence farming gradually became commercial farming of wheat and barley in the 1850s in Caledon. The price of wheat went up due to the California Gold Rush and the Crimean

War (1854-1856) (Ross, 1999:22-23). About the same time, agricultural productivity increased in Caledon as the government introduced tractors and electricity during the First World War (Ross, 1999). In this period of time, 90% of the forest covers and almost 60% of the wetlands were drained in the Region of Peel for agriculture (Ross, 1999: 23). Over-production of wheat, deforestation, decline in water level and soil erosion contributed to a long period of agricultural decline in much of southern Ontario including Caledon between 1890 and 1950 (Ross, 1999: 23).

Industries and environmental impacts

Trees were first cut and burned as fuel, and were used as construction materials and lumber for sale (Ross, 1999). By the late 1820s, water-powered sawmills were built (Ross, 1999). The Credit River was once supporting 19 mills in Caledon starting in the early 1800s (Ross, 1999). Similarly, the Humber River and its tributaries supported 16 mills (Former Caledon Heritage Officer, 2010). Second to sawmills, gristmills became important in the 1800s (Ross, 1999).

A number of environmental and social factors contributed to the decline of mills in Caledon. By the early 1900s, 90% of forest cover in the Region of Peel was gone (Ross, 1999: 71). Natural floods became more severe and caused major damages to major mills (Ross, 1999). Furthermore, water velocity was greatly reduced due to deforestation and river siltation.

From the 1880s to early 1900s, intensive quarrying took place in Caledon. Toronto's Old City Hall, Ontario Parliament Buildings and some of the University of Toronto's buildings were built from Caledon's sandstone deposits (Ross, 1999). Aggregates extraction continues today in Caledon, and has brought environmental and social impacts.

Conservation

In response to deforestation and soil erosion, the province carried out tree-planting projects in what is now the current Region of Peel; however, the land was never restored to its previous state (Ross, 1999).

4.3.5 Caledon in the period of 1910-1950

Industries during the World Wars

Some of the 19-century mills were converted to other uses such as the Western Rubber Mill in Alton and a fibreglass business in Inglewood (Ross, 1999). For instance, the Western Rubber Corporation supplied prophylactic rubber during the war.

Aggregate Industry in Caledon

According to Chambers and Sandberg (2007), Caledon's aggregate deposits were among the first in Ontario to be commercially mined starting in the 1940s. There was limited provincial control over aggregates extractions. Demand for the resource was low and based on local needs.

Conservation

Caledon is located in the Humber and Credit River watersheds. In 1948, the Humber River Conservation Authority was created to manage the watershed. The Authority reported that agricultural lands were eroded by poor farming practices and deforestation (Ross, 1999). An action plan recommended by the Humber River Conservation Authority was implemented. In 1954, Hurricane Hazel struck Ontario, and places along the Humber River in Caledon suffered severe floods (Ross, 1999). In 1956, the Humber River Conservation Authority was merged with three other conservation authorities to form today's Toronto and Region Conservation Authority

(Ross, 1999). In 1954, the Credit Valley Conservation Authority was formed to oversee conservation of the Credit River watershed (CVC, 2005).

4.3.6 Caledon in the period of 1950s to present

Formation of the Town of Caledon

The Corporation of the Town of Caledon was created by Provincial statute (the 1973 Regional Municipality of Peel Act) on January 1, 1974. The Town of Caledon was established by the amalgamation of the Townships of Albion, Caledon, half of the Township of Chinguacousy, and the Villages of Bolton and Caledon East (Ross, 1999).

Conservation Efforts

The first Official Plan for the Town was approved by the Minister of Housing in 1979 (Town of Caledon, 2008a). Beginning in 2007, Caledon initiated its Official Plan conformity exercise to make the Town's policies conform to Provincial legislation such as the Greenbelt Act (2005), Places to Grow Act (2005) and Oak Ridges Moraine Conservation Act (2001) (Section 2.7, 5.1.1 and 5.1.2).

Economy

The Town has evolved from a rural-based economy to one that is increasingly influenced by demands of the adjacent urbanized area (Town of Caledon, 2008b). In the 21st century, two-thirds of Caledon residents are employed outside of Caledon (Ross, 1999). This is remarkably different from the past two centuries during which residents stationed to work and farm on the land. In spite of a decline of agricultural jobs, 490 farms in Caledon generated \$47 million in 1996, (Ross, 1999:25). Between 1994 and 1997, some 164 companies opened up in Caledon (Ross, 1999: 26). Recreation such as golf clubs, ski resorts and fly-fishing have provided employment opportunities in Caledon (Ross, 1999).

4.3.7 Summary of Caledon's past to present

Caledon's evolution as a linked social-ecological system has undergone changes that reflected broader social and environmental changes in the Moraine and the Province. Prior to European settlement, the Moraine was forested and sparsely inhabited by hunter-gatherer groups who were also engaged in rudimentary farming and trading (Historica *et al.*, 1994). From the 1600s to the early 1800s, land use was not regulated until the competition for land was too great. The colonial government started to impose a land purchase system, and initiated property rights and royalty fees on forestry and mining operations (McCarthy, 2006; Fisher & Alexander, 1993). As the government earned revenues from resource extraction, negative environmental impacts of deforestations, soil erosion and flooding also emerged. These environmental impacts also occurred in Caledon, leading to closure of mills, flooding and loss of infrastructure (Ross, 1999).

Throughout the 19th century the Moraine was progressively brought into agricultural production. The population grew slowly at first and then rapidly as roads allowed settlers to travel inland (Historica *et al.*, 1994). The Depression of the 1930s, however, severely affected the industries, and a shift to recreational uses of land helped make up some of the loss of local businesses (Historica *et al.*, 1994). The development of Caledon went through similar experiences (Timeline 2).

Conservation efforts such as reforestation began as early as the 1870s on the Moraine (Fisher & Alexander, 1993). In Caledon, there were also calls for reforestation, but soil could not be restored to its previous state because of deforestation and intense agriculture (Ross, 1999). On the Moraine, conservation efforts did not materialize until after the establishment of Conservation Authorities in the early 1940s (Section 2.7).

Into the second half of the 20th century, Caledon was subject to development pressures from the Greater Toronto Area. After the Second World War, rapid urbanization took place in Toronto. The Moraine began to be “part of the area subject to Toronto regional development planning” (Historica *et al.*, 1994: 16). Beginning in the 1970s, demands for Caledon to provide residency and recreational sites increased.

More recently, the province passed legislation such as the Places to Grow Act (2005), Greenbelt Act and the Oak Ridges Moraine Conservation Act (2001) for conservation and growth management purposes. Caledon had to implement them at the municipal level (Section 5.1.3). Beginning in 2007, the Town of Caledon initiated an extensive Official Plan conformity exercise to bring its planning in areas of land use, conservation, aggregates extraction, transportation, agriculture and water management into conformity with the Provincial and Regional policies (Section 5.1.3). This period marked a time when Caledon began to integrate concepts of sustainability into its overall Official Plan and planning (Town of Caledon, 2009i). It can be observed that the trend of Caledon’s governmental planning has expanded over the few decades from a focus on watershed management to management that recognized the interdependence of ecological (e.g. watersheds, habitat) and social (e.g. land use intensifications, public education) components.

4.4 Resilience of What - Dominant Structuring Variables in Caledon as a Linked Social-ecological System

This chapter is concerned about the question of “resilience of what?” It is guided by section 1 of the Resilience Assessment Workbook (RA, 2007). The Workbook states that, “once the system boundaries are determined, consider only the critical components. It is useful to reassess what is and isn’t critical as understanding of the system and issue(s) advances” (RA, 2007: 12). Dominant structuring variables are critical factors that determine the state of a social-ecological system (Gunderson *et al.*, 1995; Gunderson & Holling, 2002; Walker *et al.*, 2006). Based on the research on Caledon’s historical events presented in chapter 4.3, the next step is to “draw connections between related events...[and] determine if the event caused a dramatic change in the characteristics of the system” (RA, 2007).

4.4.1 Resource use and associated economic development

On the larger/provincial scale, beginning in the 1600s, immigrants from Europe and United States introduced more extensive agricultural systems (Timeline 2). This led to immense changes in societal and environmental systems. Hunter-gatherer societies were gradually replaced by European commercial farming from the 1600s to the early 1900s; and later by manufacturing and small-scale commercial activities from early 1900s to 1950s; and most recently, by financial and servicing activities since the 1960s. On the local/municipal level, Caledon experienced parallel changes (Historica *et al.*, 1994; Fisher & Alexander, 1993; Ross, 1999; McCarthy, 2006) (Timeline 2).

Resource use of land, water, aggregates mining from the 1800s to the present has contributed to continual changes of ecosystems and social system of Caledon (Ross, 1999). In

Caledon, agricultural land-use from the 1600s to 1800s witnessed subsistence farming, village development, the Wheat Boom, agricultural decline, extensive deforestation, river siltation, soil erosion and increased flooding. Into the early 1900s, river siltation and increased flooding, mills and associated businesses were gradually replaced by more large-scale manufacturing and aggregate industries from late 1800s to 1950s (Ross, 1999).

In the post-1950s period, tertiary productions in sectors such as tourism, recreation and finance replaced agricultural productions as the main employer in Caledon (Ross, 1999; Greenwood *et al.*, 2010). Demand for land and water continued to increase despite an agricultural decline because Caledon experienced population growth.

4.4.2. Legislation and policies

On the larger/provincial scale, colonial government policies drastically changed the landscape and social systems in Ontario after the 1800s. For example, veterans and loyalists were promised lands in Ontario by the British Crown. The colonial government also implemented land surveys, and distributed land to pioneer settlers. It was also in this period that what is now the Town of Caledon began to be developed by Europeans.

Also in the 1800s, in response to widespread deforestation and soil erosion, the government initiated numerous conservation plans in the early 1900s. Later beginning in the 1940s, Conservation Authorities were established to manage watersheds in Ontario. In the 1970s, the Provincial government legislated to amalgamate the townships to form the Regional Municipalities of York, Peel and Durham in order to manage population growth.

On the town's level, since 1974, Caledon has developed an Official Plan to oversee natural heritage, water, agriculture, intensification and transportation. The direction of

development saw increasing consideration for balancing both economic development with environmental concerns (also Section 5.1.3).

4.4.3 External political and technological conditions

On the larger/provincial scale, the American Revolutionary War, Irish famine and religious persecutions led to an influx of immigrants who settled in southern Ontario beginning in the 18th century. The Crimean War and California Gold Rush gave rise to the higher wheat prices, which directly contributed to the Wheat Boom in the 1850s. Caledon, on the focal scale, shared similar experiences (Timeline 2). Technological advances in railway and communication (e.g. telegraph, postal office) systems also made possible movement of goods and services across Central Ontario.

On the town's level, in the late 1800s, railways such as the Credit Valley Railway and Canadian National Railway improved transportation between Caledon and the Greater Toronto Area. Caledon business and agriculture were able to take advantage of the new railway system. The introduction of electricity and tractors during the First World War also made farming easier in Caledon. In regards to aggregate resource extractions, aggregate processing technologies made Caledon a main aggregates supplier for Ontario. Agricultural and aggregate operations, in turn, led to negative environmental effects such as soil erosion and destruction of wildlife habitats (Sections 4.3.4 and 5.3.3).

4.5 Resilience of What - Caledon Growth Management Depicted as an Adaptive Cycle on the Focal Scale

This part of the research is guided by section 3 of the Resilience Assessment Workbook (2007). The Workbook uses a “very general model of system dynamics (the adaptive cycle) to assess patterns of change in a focal system” (RA, 2007: 48). The Workbook states that

“managing resilience requires understanding cycles of change and the vulnerabilities and windows of opportunity these cycles of change introduce” (RA, 2007: 49).

The conceptual model of an adaptive cycle highlights what resilience practitioners should focus on. If a focal system is in the fore loop and at the peak of conservation, people should work to reduce the system’s rigidity and avoid vulnerability to sudden shocks (RA, 2007; Walker & Salt, 2006). If a focal system is in the back loop and is going through changes, people should work to preserve its resources (human, natural, etc.) and collective memory to facilitate reorganization of the system (RA, 2007; Walker & Salt, 2006).

An adaptive cycle describes four phases of change (growth, conservation, release, and reorganization) that are characteristic of many systems (RA, 2007) (also Section 2.3). This research focuses on growth management, and hence, it is useful to understand in which phase Caledon lies in the context of growth management (Figure 3). Caledon has been going through a phase of renewal and reorganization in the past several years in its Official Plan conformity exercise. This presents both resilience threats and opportunities to Caledon, which will be further elaborated in chapters five and six.

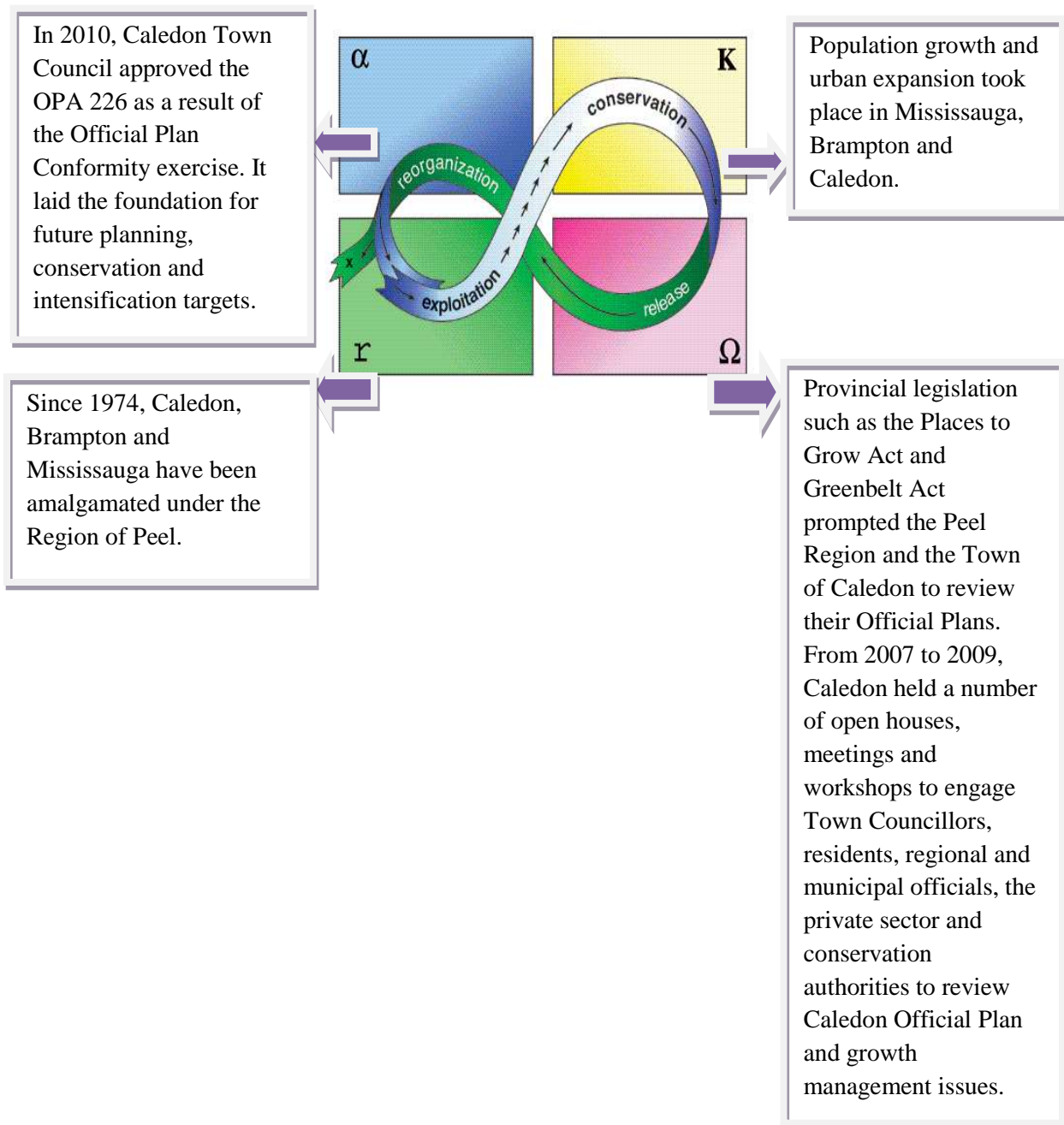


Figure 3 Depiction of an adaptive cycle of growth management in Caledon

4.6 Conclusion on “Resilience of What?”

The Town of Caledon contains many significant biophysical features including the Oak Ridges Moraine, Niagara Escarpment, Humber River Watershed, Credit River Watershed and the

Peel Plains (Town of Caledon, 2008a) (Section 4.1). Caledon has evolved from a rural-based community to a community that is now attracting urban dwellers and development (Sections 4.2-4.3). Caledon's history has been shaped by European settlement, agricultural practices, aggregates extractions, the establishment of the Region of Peel, commercial and residential development, and more recently, urban growth pressures (Section 4.3).

By highlighting and connecting significant historical events of Caledon (Section 4.3), major factors that shaped Caledon as a social-ecological system are identified (Section 4.4). These factors include resource use, economic development, legislation, external political and technological conditions (Section 4.4). Lastly, an adaptive cycle of Caledon in the context of urban growth is identified, which shows that Caledon has been going through the phase of renewal and re-organization (Section 4.5).

The purpose of finding out 'resilience of what?' is to develop an in-depth understanding of the focal system (i.e. the Town of Caledon) in order to answer 'resilience to what?' and 'resilience with what?' Chapter five will use some of the research results in chapter four to identify resilience threats (i.e. 'resilience to what?') and resilience assets (i.e. 'resilience with what?').

Chapter 5 Research Results: ‘Resilience to What And With What’ – Potential Resilience Threats and Assets Based on a Cross-Scalar Study of Caledon as a Linked Social-Ecological System in the Context of Urban Growth

The main research question of this paper is: ‘Based on resilience thinking, what factors threaten and enhance Caledon’s abilities to respond and adapt to changes caused by urban growth as a linked social-ecological system?’ The answers to this question are organized into three parts: ‘resilience of what’, ‘resilience to what’ and ‘resilience with what’.

Chapter four answered the question ‘resilience of what’ by identifying Caledon as a linked social-ecological system on the focal scale. The questions of ‘resilience to what?’ and ‘resilience with what?’ are concerned about threats to a system’s resilience and assets for a system’s resilience respectively (Section 1.2 and Chapter 4). This chapter will identify Caledon’s potential resilience assets and threats through the use of a cross-scalar study (Sections 5.1-5.3).

The Resilience Assessment Workbook states that,

any system is influenced both by things that lie outside of its boundaries, as well as by what lies within the boundaries. A full resilience assessment must consider the cross-scale interactions of system components across boundaries” (RA, 2007: 12)

Chapter five will use sections 1 and 4 of the Resilience Assessment Workbook to structure a cross-scalar study of Caledon. The Workbook points out that “it is necessary to consider ecological, social, and economic features of the system in the resilience assessment” (RA, 2007: 12). Thus, this cross-scalar study will explore Caledon’s social, ecological and social domains on different scales as a linked social-ecological system in the context of urban growth.

In each domain, information about the focal scale, smaller scales and larger scales are presented. There is nothing ‘purely’ ecological or social in the following sections. A park can be regarded as a social construct or a natural feature. Nevertheless, in order to avoid a perceived duality between nature and culture, it is important to recognize that they are part of a bigger social-ecological system, being formed physically and discursively. There are three reasons behind teasing apart a social-ecological system.

First, human activities have impacts on the ecosystem in Caledon. These activities are not biologically determined, but rather shaped by social values, institutional policies and economic factors. “Understanding even the most local human-nature interactions required ‘progressive contextualization’ in which local actions were understood in terms of landscape, regional, and national factors” (Liu *et al.*, 2007b: 645). Hence, it is important to understand the social-cultural dimension of human activities that affect ecosystems.

Secondly, feedback loops between ecosystem and human activities may not seem apparent. For example, expansion of real estate development is likely to increase impervious surface and storm water runoff in Caledon. The long term effects of estate development on watersheds may not be apparent without long-term research. Hence, it is important to identify the scales on which human activities affect the ecosystems in Caledon.

Thirdly, ideas of resilience are not objectively deducible ideas, but rather learned, taught, interpreted and produced by various actors. To learn about what ideas and values people hold for resilience in Caledon, the first step is to identify a group of major social actors. Therefore, it is useful to tease apart social components of a social-ecological system of Caledon.

Chapter Structure

Sections 5.1-5.3 present the potential resilience threats and assets in Caledon within the context of urban growth. Based on the resilience features discussed in section 2.4, potential resilience threats and assets in each domain will be identified. A table that illustrates key elements of the smaller, small, focal, large and larger scales in each domain is presented in each section. Elaborations on potential threats to resilience and assets of resilience in Caledon focus only on the larger, large and focal scales. Section 5.4 summarizes the findings about potential resilience and threats based on the cross-scalar study. The findings about resilience threats and assets through the cross-scalar study are then analyzed with the findings about resilience threats and assets based on interviews (Section 6.5).

5.1 Resilience to What and with What – Potential Resilience Threats and Assets based on a Cross-scalar Study of Caledon in the Social Domain

The cross-scalar study in the social domain of Caledon focuses on legislation and their implications on land use and growth management in Caledon. This is done for two reasons. Firstly, in 2008, a series of asset mapping exercises were carried out with diverse stakeholders across the Moraine. In Caledon, the asset-mapping exercise identified legislation as key resources that supported the assets such as green space; water and agriculture (Fuller & Zhang, 2008). By exploring the policy context we can learn how legislation may address development pressure in Caledon (Fuller & Zhang, 2008). Secondly, by looking at policies, we can identify the linkages among government policies across scales. In addition, many non-governmental groups play a key role in the design and implementation of these plans. Hence, the role of non-governmental groups can also be analyzed.

Elaborations on the different scales focus only on the larger, large and focal scales. Specific areas that can potentially enhance or threaten resilience of the Caledon in the context of urban growth are presented in boxes. Table 3 below illustrates key elements of the smaller, small, focal, large and larger scales in the social domain.

Scale	Describe the Scale
Larger	Government level <ul style="list-style-type: none"> • Provincial ministries such as the Ontario Municipal Board (OMB), Ministry of Municipal Affairs and Housing (MMAH), and Ministry of Infrastructure Renewal • Provincial legislation such as Places to Growth Act, Greenbelt Act and Oak Ridges Moraine Conservation Act
Large	Government level <ul style="list-style-type: none"> • Region of Peel, Regional Official Plan • Moraine-wide conservation authorities Citizen level <ul style="list-style-type: none"> • Environmental and moraine-wide groups such as STORM (Save the Oak Ridges Moraine), Moraine For Life and Oak Ridges Trail Association
Focal	Government level <ul style="list-style-type: none"> • Municipal governmental bodies such as Caledon Planning and Development, Environmental Progress Office and Caledon Environmental Advisory Council • Local watershed Conservation Authorities - Credit Valley Conservation Authority and the Toronto and Regional Conservation Authority Citizen level <ul style="list-style-type: none"> • Major town-wide environmental groups such as Caledon Countryside Alliance, Our Caledon Our Choice, and The Coalition of Concerned Citizens
Small	Government level <ul style="list-style-type: none"> • Villages • Town's Rural Service Centres Citizen level <ul style="list-style-type: none"> • Local businesses, families residing in Caledon • Smaller environmental groups such as Citizens for a Cool Caledon
Smaller	Governmental level <ul style="list-style-type: none"> • Individual officials such as Town Planners and Town Councillors Citizen level <ul style="list-style-type: none"> • Individual members of environmental groups Individuals who consume social and ecological services in the Town of Caledon

Table 3 Scales in the social domain of Caledon in the context of urban growth

5.1.1. Resilience to what and with what- on the social domain's larger scale: provincial level Smart Growth and Associated Legislation

The Oak Ridges Moraine Conservation Act (2001), Places to Grow Act (2005), the Greenbelt Act (2005), the Provincial Policy Statement (2005) and the Planning and Conservation Land Statute Law Amendment Act, 2006 (Bill 51) are initiatives to promote Smart Growth in Ontario (Ministry of Public Infrastructure Renewal, 2006; Town of Caledon, 2009d) (Section 2.7). Smart Growth principles include preserving farmland, developing compact buildings, and encouraging stakeholder collaboration in development decisions (EPA, 2010).

The Places to Grow Act (2005) aims to direct growth in the Greater Golden Horseshoe which encompassed Region of Durham, York, Peel (municipality of Caledon), Halton, Waterloo, Niagara, City of Toronto, and over a dozen of smaller cities/counties (MOEI, 2010) (Map 3). The Act aims to achieve intensification (MOEI, 2010). It establishes density requirements: 50 people / jobs per hectare in the greenfield areas (Region of Peel, 2010a).

The rationale behind the broad legislative framework of growth management is that the Greater Golden Horseshoe is a very fast growing urban region in North America. It is home to more than 7.5 million people, and is forecast to grow by 3.7 million people by 2031 (MOEI, 2010). The province believes that uncoordinated growth will lead to many negative effects such as traffic gridlock, urban sprawl, loss of farmland and habitats and automobile dependence (MOEI, 2010).




SCHEDULE 1
Context: Study Area for the Greater Golden Horseshoe Growth Plan


 DRAFT PLAN | FEBRUARY 2005

Map 3 The Greater Golden Horseshoe Area

Source: Ministry of Public Infrastructure Renewal (2006: Schedule 1)

Box 1 Provincial legislation – potential resilience assets and threats

Asset 1 Growth plans help reduce impacts of future shocks

The ORMCP, Places to Grow Plan and other legislation aim to direct growth and curtail urban sprawl, reducing shocks to the systems caused by urban sprawl. It can nurture resilience by enabling regional and municipal governments to anticipate disturbances and changes in the future. When these disturbances (such as an increased demand for drinking water and healthcare) are taken into account, communities will have a better chance to absorb the impacts and remain in a desirable state (Folke *et al.*, 2002; Walker & Salt, 2006) (also section 2.4).

Asset 2 Growth plan review mechanism nurtures continual learning

The 10-year review built into the ORMCP, Places to Grow Plan and Greenbelt Act helps ensure a learning mechanism that allows policy implementers to revise the policy accordingly based on experience accumulated. Organizational memory can be tapped to adjust policies and practices according to environmental, social and economic changes (Walker & Salt, 2006; Label *et al.*, 2006; Folke *et al.*, 2002; Folke *et al.*, 2003).

Threat 1 Downloading of moraine conservation onto municipalities reduces motivations and flexibility

Conservation implementation under the Oak Ridges Moraine Act is characterized by downloading of responsibilities on municipalities (Hanna *et al.*, 2007). A lack of implementation resources can reduce resilience of a system because people lack opportunities to adjust policies and innovate (also section 2.4).

**5.1.2 Resilience to what and with what- on the social domain's large scale: regional level
Region of Peel's Official Plan**

The Regional Municipality of Peel Act (1973) created the regional municipality and three constituent municipalities: Caledon, Brampton, and Mississauga (Town of Caledon, 2008a:4). The regional government has responsibility for regional-scale planning, while the municipal government of Caledon is responsible for land use decisions through development approval and zoning.

Regional Official Plan Conformity Exercise and Growth Management

In order to conform to the Provincial Places to Grow Plan, the Peel Regional Government has to amend its Official Plan. One amendment that deals specifically with growth management is Regional Official Plan Amendment 24 (ROPA24). ROPA 24 allocates population growth to lower tier municipalities (Table 4) (Town of Caledon, 2009 i). ROPA 24 requires the municipalities of Caledon, Mississauga and Brampton to plan to meet 50 persons/jobs per hectare by 2031.

Municipality	Population**			Employment		
	2011	2021	2031	2011	2021	2031
Brampton	510,000	646,000	738,000	182,000	274,000	319,000
Caledon	75,000	88,000	113,000	28,000	38,000	49,000
Mississauga	738,000	775,000	812,000	455,000	500,000	519,000
Total	1,323,000	1,509,000	1,663,000	665,000	812,000	887,000
Peel Growth Plan Target	1,320,000	1,490,000	1,640,000	730,000	820,000	870,000
Difference	3,000	19,000	23,000	-65,000	-8,000	17,000

• - All numbers have been rounded to the nearest 1000.

•** - Population figures include 4.2% 2001 Census undercounts.

Table 4 Population and employment allocation from the Region of Peel to municipalities

Source: (Town of Caledon, 2009 i).

Under, ROPA 24 settlement expansion is allowed only when a Comprehensive Municipal Review is approved (Town of Caledon, 2009 i). Settlement expansion will be allowed when allocated growth cannot be achieved through intensification (Town of Caledon, 2009i; Ministry of Public Infrastructure Renewal, 2006).

Box 2 Provincial legislation – potential resilience assets and threats

Asset 3 Growth plans reduce impacts of future shocks:

The Peel's Regional Official Plan aims to direct growth and curtail urban sprawl, reducing shocks to the systems caused by urban sprawl (Town of Caledon, 2009 i). It can nurture resilience by enabling Caledon to anticipate disturbances and changes in the future. When these disturbances (such as an increased demand for drinking water and healthcare) are taken into account, communities will have a better chance to absorb the impacts and remain in a desirable state (Folke *et al.*, 2002; Walker & Salt, 2006).

Regional Non-governmental Groups

Oak Ridges Moraine Foundation

The Oak Ridges Moraine Foundation was created in 2002 to help preserve, protect and restore the environmental integrity of the Oak Ridges Moraine through research, public education and funding projects (ORMF, 2003; ORMF, 2009). The foundation has funded projects across the Moraine in the past. In 2009, it funded the ORM as Biosphere Reserve project to develop a nomination for the Moraine as a UNESCO World Biosphere Reserve (ORMF, 2009). In Caledon, for instance, the Credit Valley Conservation Authority received funding for re-naturalization projects (ORMF, 2009).

Citizen's Environment Watch (now EcoSpark)

The Citizen's Environment Watch (CEW) partners with the Save the Oak Ridges Moraine Coalition and the Centre for Community Mapping to launch the Monitoring the Moraine program to engage citizen volunteers in science, stewardship and decision-making (MTM, 2009).

STORM (Save the Oak Ridges Moraine Coalition)

STORM has worked with local and regional governments since 1989 to participate in planning and policy development (STORM, 2007). STORM's well-developed local and regional network has been critical to its campaign efforts (STORM, 2007).

Box 3. Regional non-governmental groups – potential resilience asset

Asset 4 Monitoring and different knowledge systems nurtures learning and adjustments

Regional citizen groups contribute to constant learning and monitoring of the ecosystems. The Monitoring the Moraine program by Citizen's Environment Watch, for example, has engaged a wide pool of citizen volunteers to provide data (MTM, 2009). Thus, this monitoring program can help municipalities and Conservation Authorities plan for emergent phenomenon such as non-point source contamination and climate change. Planning with anticipation of disturbances is a key feature of resilience thinking (Walker & Salt, 2006; Gunderson & Holling, 2002) (also Section 2.4).

Non-governmental groups such as Save the Oak Ridges Moraine Coalition and the Oak Ridges Moraine Foundation enable networking. This networking allows knowledge sharing and learning, which is key to nurturing resilience (Lee, 1993; Folke *et al.*, 2002; Folke *et al.*, 2003, RA, 2007) (also Section 2.4).

5.1.3 Resilience to what and with what- on the social domain's focal scale: municipal level Caledon Official Plan Conformity

Legislative and policy changes enacted by the Province require the Town of Caledon to review and revise its Official Plan. The new Provincial requirements flow from the following policies:

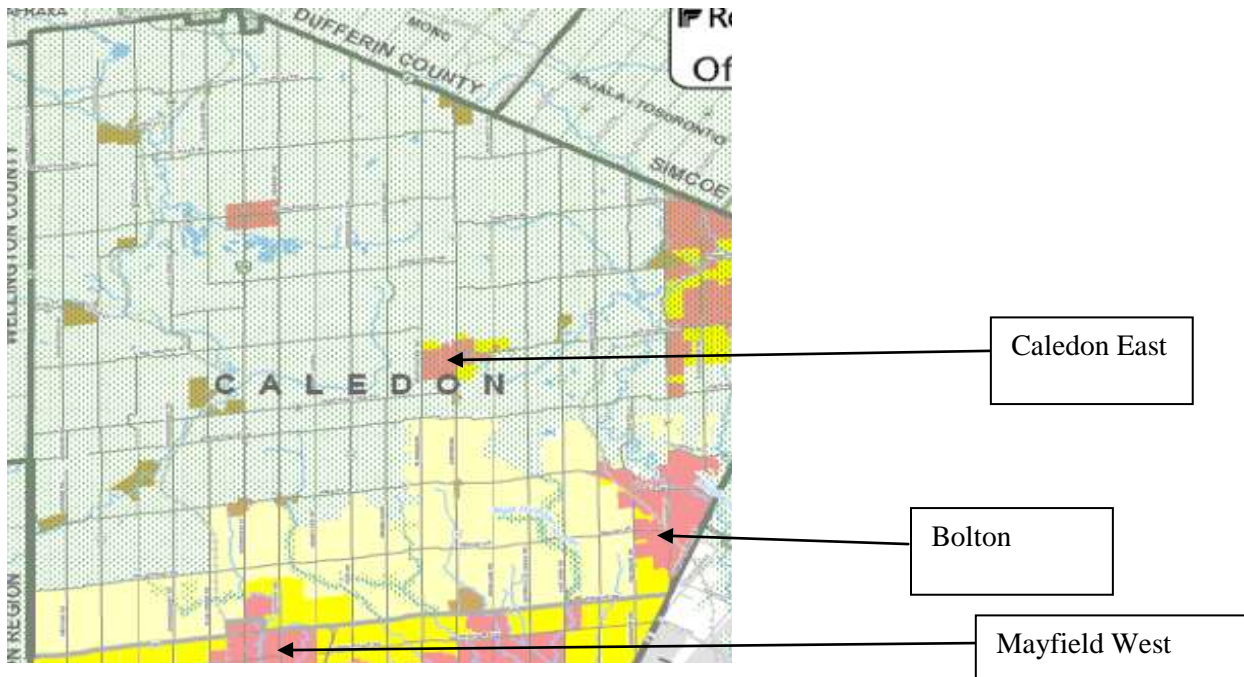
- 1) The Provincial Policy Statement 2005 (PPS 2005);
- 2) Bill 135, *The Greenbelt Act*, approved in 2005 and the Greenbelt Plan, which took effect December 14, 2004;
- 3) Bill 51, *The Planning and Conservation Land Statute Law Amendment Act*, approved in 2006; and,
- 4) Bill 136, *The Places To Grow Act*, approved in 2005, and the "Growth Plan for the Greater Golden Horseshoe" (also called "Places to Grow Plan"), which took effect June 16, 2006.

(Source: Town of Caledon, 2007)




On May 15, 2007, Caledon Council formally initiated the Town's Provincial Policy Conformity exercise and the 5-Year Official Plan Public Meeting process (Town of Caledon, 2007). The consultation involved town residents, town councillors, Conservation Authorities, Regional officials, municipal officials from Brampton and Mississauga. The private sector

including land developers (such as Solmar Development Corporation) and the Chamber of Commerce were consulted (Town of Caledon, 2007).

The conformity exercise led to the approval of a number of Official Plan Amendments (OPAs) including OPA 226 (Intensifications & Population Forecast) and OPA 179 (Agriculture). OPA 226 adds a new Section 3.1 entitled “Sustainability to the General Policies of the Official Plan” to make sustainability a primary theme. Caledon’s Official Plan defines ‘sustainable’ as “the use of land or a resource without the loss or reduction of ecosystem integrity” (Caledon, 2008 g: 34).



Map 4 Locations of Caledon East, Bolton and Mayfield West in Caledon

 Delineated Built-up Area
 Designated Greenfield Area
 Agricultural and Rural Areas
(Source: Town of Caledon, 2009h)

Caledon Official Plan Growth Management and Land Use Planning

Under OPA 226, the majority of new residential and employment lands will concentrate in the Rural Service Centres - Mayfield West, Bolton and Caledon East (Map 4) (Caledon, 2008b). This is known as the tri-nodal strategy (Town of Caledon, 2009h).

It is noteworthy that there have been ongoing conflicts between developers and the municipality regarding housing development and population growth, particularly in Bolton (also Section 4.2.2 and 6.5). Caledon's mayor said “development-related” issues were behind an assault on her husband (Gombu, 2008). In 2008, Caledon Council put a freeze on the urban boundary of Bolton because Bolton hit its projected 26,500 population target almost 13 years earlier than expected (Gombu, 2008). The Bolton freeze led the Coalition of Concerned Residents & Businesses of Bolton and the Chamber of Commerce to lobby councillors to lift the ban (Gombu, 2008). Marotta, whose millions of investment suffered the development freeze, started Caledon Perspectives, a local newspaper to present a “pro-growth” narrative in Caledon (Gombu, 2008). On-going conflicts between the business sector (particularly in Bolton) and the Town in regards to development are likely to create disturbances to Caledon. From a resilience perspective, it is important to prepare to deal with these disturbances and resolve them before they escalate to costly lawsuits and institutional gridlocks. This will be addressed in chapter seven.

Caledon Official Plan and Aggregates Operations

Aggregates operations in Natural Linkage Areas, prime agricultural lands and Environmental Protection Areas are not allowed unless the site will be rehabilitated to its former or a better state (Caledon, 2008b).

Box 4 Caledon Official Plan– Potential resilience assets and threats

Asset 5 Development approval mechanism keeps options open:

The Official Plan integrates continual learning by requiring developers to submit Environmental Impact Studies (EIS) and Management Studies (MS) (Caledon, 2008b). Specific conditions are placed on EIS and MS depending on the scope and nature of the proposed development (Caledon, 2008b). This gives the Town flexibility to determine if future development proposals benefit its overall sustainability objectives. Keeping options open and decision-making process flexible is important for nurturing resilience (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006) (also Section 2.4).

Caledon Adopting Adaptive Environmental Management and Sustainability

The Town of Caledon expresses its intent to adopt adaptive environmental management in the Official Plan Amendment 226 (OPA 226). In OPA 226, adaptive environmental management is defined as a framework “evaluating the effectiveness of environmental management and mitigation practices and identifying the need for changed/improved practices/policies in order to meet established objectives” (Planning and development, 2010:121). This adaptive approach coincides with resilience thinking’s emphasis on continual learning and experimentation (Lee, 1993; Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006) (also Section 2.4).

With respect to sustainability, the Town hired the Natural Step consultants to conduct a sustainability study on Caledon’s Official Plan. The consultants recommended that Caledon set clear objectives, specific actions and outcomes to achieve sustainability (Purell, 2009). From a resilience perspective, setting clear objectives helps define what desirable state of a social-ecological system people want to achieve.

Box 5 Caledon's Official Plan – Potential Resilience Assets and Threats

Asset 6 Intention to adopt adaptive management:

Adaptive management can nurture continual learning and experimentation: In its Official Plan Amendment 226, the Town expresses an interest in adopting adaptive environmental management (Planning and development, 2010). This adaptive approach coincides with resilience thinking's emphasis on continual learning and experimentation to keep options open in order to maintain resilience of a system (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006) (also chapter 2.4).

Threat 2 Lack of indicators hinders continual monitoring and adjustments:

In its study of Caledon's Official Plan, The Natural Step consultants found that indicators "from a total systems perspective" were needed to audit progress towards sustainability (Purell 2009: table 4). The Caledon Environmental Advisory Council (CEAC) agreed that indicators were needed to assess the effectiveness of the Official Plan, especially OPA 226, in achieving sustainability (CEAC, 2006). The Town has recognized the need, and stated that it would work with the Province and Region to develop indicators (Town of Caledon, 2009 i). Monitoring allows learning and continual adjustment of policy to ecological, social and economic conditions, which is a key resilience feature (Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006). A lack of clear indicators and monitoring can therefore weaken resilience of a socio-ecological system.

Threat 3 Lack of a vision of a desirable and sustainable future

In a review of Caledon Official Plan in 2010, CEAC pointed out that without a detailed vision of what a sustainable Caledon looked like, "the effectiveness of the OP in this particular regard is potentially compromised" (Planning and Development, 2010: 126). A study of Caledon's Official Plan agreed with CEAC that Caledon needed a vision of sustainability (Purell, 2009). Defining what a sustainable future looks like coincides with the idea of deciding on what a desirable state of a social-ecological system looks like. Therefore, lacking a clear vision is likely to weaken resilience of a socio-ecological system.

Caledon Citizen Groups

In the context of growth management, a major group is the Caledon Environmental Advisory Committee (CEAC). CEAC is made up of citizens and Councillors, and it has played a significant role in developing and advising the Town of Caledon on development and environmental issues. It has contributed a great deal to the tri-nodal development strategy of Caledon (CEAC, 2004). The tri-nodal strategy is central to Caledon's growth management policy (Section 5.3.3)

In face of development pressures, a group called the Caledon Countryside Alliance has lobbied the Town to maintain its rural nature (Markvart, 2009). After Bolton was proposed for regional non-hazardous waste, two community groups Don't Assault Rural Environments (DARE) and Protect and Respect Our Bolton Environment (PROBE) were formed between 1990 and 1993 (Baxter *et al.*, 1999). Resistance from these groups and election of a new government finally led to the withdrawal of the proposal (Baxter *et al.*, 1999).

In 1997, the Concerned Citizens of Caledon (CCC) was formed after an aggregates company proposed a quarry at the Rockfort farm (Johnson, 2006; Markvart, 2009). CCC hired consultants, geologists and lawyers to conduct studies and represent them at Ontario Municipal Board hearings (Johnson, 2006). With its constant involvement, the Rockfort quarry application was eventually rejected by the Ontario Municipal Board in 2010 (Ontario Municipal Board, 2010).

Box 6 Caledon Civil Groups – Potential resilience assets and threats

Asset 7 Civil groups promotes learning

Civil groups have played a role in nurturing resilience of Caledon by engaging diverse stakeholders including citizens, officials and corporate leaders in learning environmental issues. They have pushed the focal system authorities to adjust and change their policies with anticipation of future disturbances brought by development such as quarry and landfills.

Threat 4 NIMBY (Not in my backyard) strategy can reduce resilience of other places

Increasing the resilience of a local place may reduce resilience of another place (Walker *et al.*, 2006; Walker & Salt, 2006, RA, 2007). In Caledon, local initiatives banned landfills, pesticides use and the Rockford Quarry. They are likely to increase resilience of local ecosystems and reduce disturbances to the community. Yet, they may reduce resilience of other places. “Efforts to increase the resilience of a system to a specified set of disturbances can sometimes reduce the resilience of that system to other disturbances.”(RA, 2007: 65).

Chamber & Sandberg (2007), Johnson (2006) and Macaraig & Sandberg (2007) characterized local resistance in Caledon as NIMBY. This strategy has been successful in blocking many environmentally destructive activities. Nevertheless, NIMBY may move local environmental impacts to other places, reducing options for other municipalities and towns. For example, groups in Caledon have focused on banning landfill in Caledon. As a result, it might just move the landfill to another town instead of pushing the government to implement policy to reduce waste or cut down the need for aggregates.

Though NIMBY strategy tends not to focus on the broader issues (such as development policies, aggregates policies), one could argue, based on resilience thinking, that revolts from small scales may trigger transformation of the bigger social-ecological system, moving it to a more desirable socio-ecological state (also Section 2.3). For instance, local efforts in Caledon to ban pesticide-use and a new quarry may provide lessons to other municipalities to push for broader policy changes.

5.2 Resilience to What and with What – Potential Resilience Threats and Assets based on a Cross-scalar Study of Caledon in the Ecological Domain

Section 5.1 answers the question of ‘resilience to what?’ and resilience with what?’ by identifying potential resilience assets and threats through a cross-scalar study of the social domain of Caledon. This section focuses on the ecological domain. The Workbook guides researchers to identify “the key features of scales above and below your focal scale that are critical for understanding the ecological context of your issue or challenge” (RA, 2007: 20).

Elaborations on the different scales in this section will focus only on the larger, large and focal scales. Specific areas that can potentially enhance or threaten resilience of Caledon in the context of urban growth are presented in boxes. Table 5 below illustrates key elements of the smaller, small, focal, large and larger scales in the ecological domain.

Scale	Describe the Scale
Larger	The NOAH System (Niagara Escarpment- Oak Ridges Moraine- Algonquin to Adirondack Heritage System)
Large	Niagara Escarpment to the North-West of Caledon Oak Ridges Moraine to the North-East of Caledon
Focal	Significant Woodlands and Habitats Credit River and Humber River Watersheds
Small	Creeks, kettle lakes, wetlands woodlands, shrubs, trails, parks, flora and fauna populations
Smaller	Individual species of flora and fauna, and surrounding living space

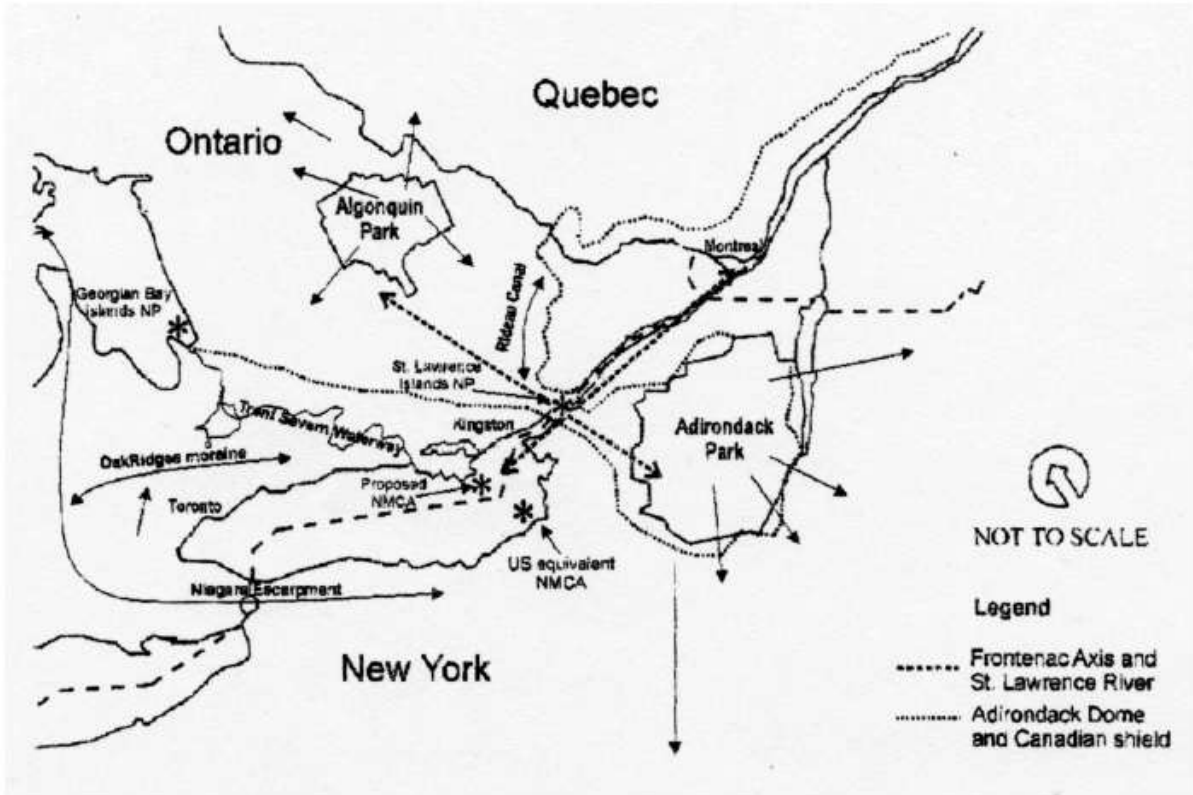
Table 5 Scales in the ecological domain of Caledon in the context of urban growth

This section focuses on the Oak Ridges Moraine landforms and watersheds, which are significant natural features of Caledon (Town of Caledon, 2008a). Made up of smaller systems of kettle lakes, rivers, wetlands, woodlands and forests, the Moraine is embedded in a larger ecosystem known as the NOAH (Niagara Escarpment - Oak Ridges Moraine - Algonquin to Adirondack Heritage) system (Foster, 2005) and is the headwaters for many southern Ontario rivers and streams. The discussion of the Moraine and other ecosystems will be tied to legislation mentioned in the pervious section 5.2.1.

5.2.1 Resilience to what and with what- on the ecological domain’s larger scale: regional level

On an inter-regional level, a system known as NOAH, or the ‘Niagara Escarpment - Oak Ridges Moraine - Algonquin to Adirondack Heritage System’, provides long-term vitality for ecosystems, allowing species to migrate over a distance of 100 km (Map 5) (Dougan &

Associates, 2002:4). The ORM contains headwaters of the Humber, Don, Holland and Rouge Rivers (Dougan & Associates, 2002:4). NOAH acts as the “rain barrel” of much of the Greater Golden Horseshoe region. It also acts as an ‘Ark’ to preserve biodiversity and watersheds leading to the Great Lakes (Diamond, *et al.*, 2001:13).



Map 5 An illustration of the NOAH system encompassing Central and Eastern Ontario

(Source: Stephenson, 2001: 306)

5.2.2 Resilience to what and with what- on the ecological domain’s large scale: moraine level

The Moraine covers about 24 % of the Town of Caledon (Caledon, 2008b). It acts as the headwaters draining southward to Lake Ontario and northward to Lake Simcoe, providing key ecological links across south-central Ontario and into interior forests (Foster, 2005). The Oak Ridges Moraine “facilitates landscape connections along the Niagara Escarpment – Trent

Severn – Frontenac axis (the Algonquin to Adirondacks Corridor)” (Foster, 2005: 126). It is an inter-regional landform with highly significant biotic and cultural complexity, and extensive functions (surface drainage, groundwater, and terrestrial and aquatic ecology) (Igor, 2002; ORSC, 2009). The Moraine was formed by a series of glacial advances and retreats (Fisher & Alexander, 1993; Igor, 2002). At least four periods of Pleistocene glaciation took place over North America, removing and depositing sand, silt, gravel and other materials that formed today’s Oak Ridges Moraine (Fisher & Alexander, 1993; Igor, 2002). Maintenance of a substantive non-urban natural heritage system is recognized as one of the most viable strategies to achieve inter-regional natural heritage objectives (Diamond *et al.*, 2002: 12). If one sub-population declined, the Moraine can facilitate movement of species to re-colonize the area (Dougan & Associates, 2002).

Box 7 Conservation efforts – potential resilience assets and threats

Asset 8 Legislated conservation of natural corridors facilitates renewals after disturbances:

The ability of renewals after disturbances is identified a key resilience feature (Walker & Salt, 2006; Folke *et al.*, 2002; Gunderson & Holling, 2002) (also Section 2.4). The preservation of Oak Ridges Moraine helps preserve natural corridors in Caledon, which facilitate migration and re-colonization of species after disturbances caused by fires/floods in an areas (Diamond *et al.*, 2002; Dougan & Associates, 2002).

5.2.3 Resilience to what and with what- on the ecological domain’s focal scale: local ecosystems in Caledon

Woodlands, Forests and Habitats in Caledon

Containing the most biodiversity in the Region of Peel (North-South Environmental Inc., *et al.*, 2008), the Town of Caledon undertook a joint study with the Region of Peel in 2008 to plan for regional woodlands and habitat protection (North-South Environmental Inc., *et al.*,

2008). Local landscape and watersheds provide movement among diverse habitats, and these functions depend on locally connected habitats such as wetlands, agricultural fields and woodlands (Dougan & Associates, 2002). Caledon has the highest percentage of forest cover in the Region of Peel (Table 6), concentrated in the eastern part of Caledon (

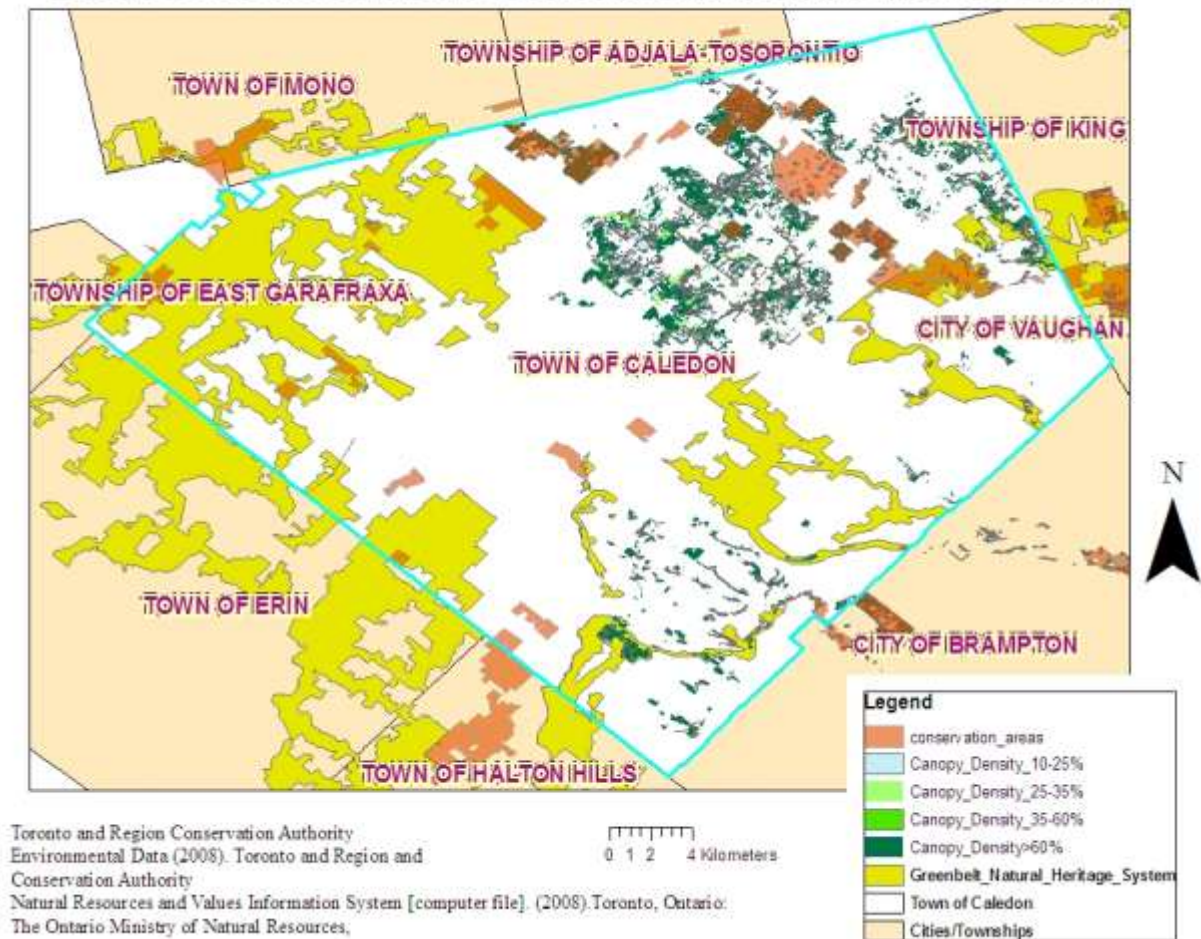
Map 6).

Municipality	Forest Cover in each Municipality ha (%)	Contribution to Regional Forest Cover (%)	No. of Forest Patches	Mean Patch Size
Peel	25,867; (20.6%)	100%	1,127*	23.0
Caledon	21,954, (31.5%)	84.9%	624	35.2
Brampton	1,972, (7.3%)	7.6%	251	7.7
Mississauga	1,940, (6.7%)	7.5%	263	7.4

Table 6 Percentage distribution of forest cover in Caledon, Brampton and Mississauga

(Source: North-South Environmental Inc., *et al.*, 2008: vi).

Forest, Conservation Areas and Greenbelt Natural Heritage System in Caledon



Map 6 Forest, conservation and Greenbelt areas in Caledon

(Created by author with GIS in July, 2010)

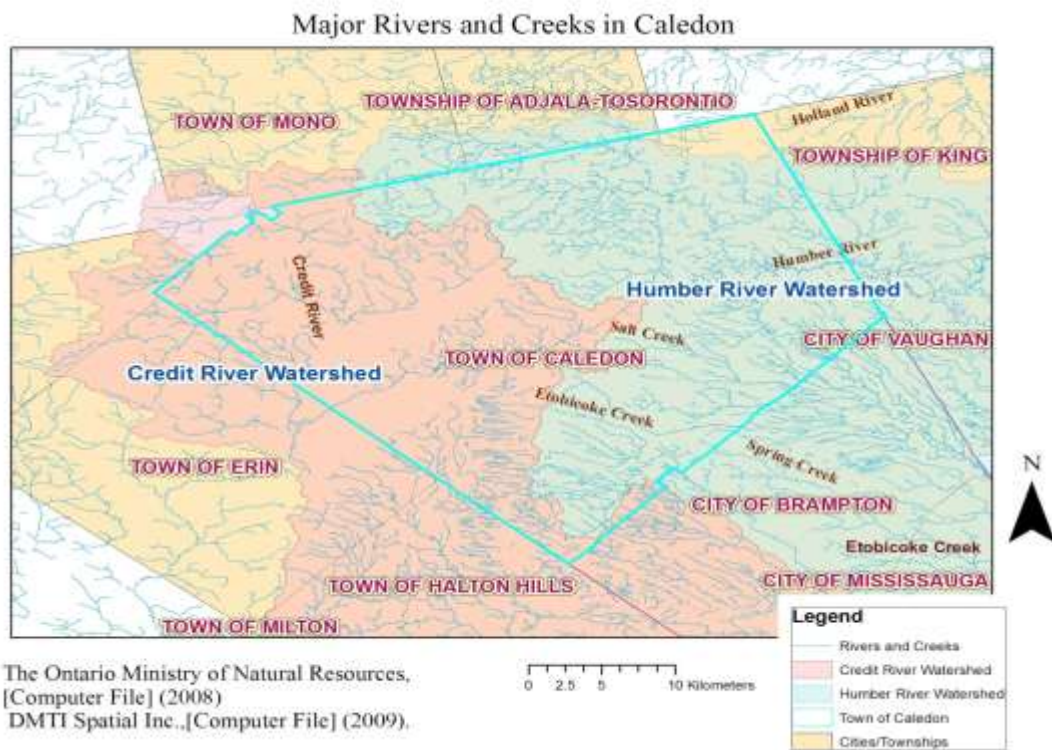
It is recognized that the protection of urban forests within Peel Region will benefit storm water management, air quality and climate change adaptations (Peel & Caledon, 2008). The urban tree canopy reduces the heat island effect in urban areas, improves air quality and intercepts rainfall before it becomes storm water runoff (Peel & Caledon, 2008). In other words, forest cover contributes to the resilience of a system to withstand the impacts of flood, air pollution and heat island effects.

Box 8 Local forests and watersheds– potential resilience asset

Asset 9. Healthy ecosystems help withstand shocks:

Healthy forests and watersheds provide Caledon with the capacity to withstand various shocks including soil erosion, flooding, heat island effects and associated health costs. Hence, maintaining the health of forests and watersheds can reduce substantial costs of ecological restoration and healthcare for the Town of Caledon.

Credit River and Humber River Watersheds in Caledon



Map 7 Credit River and Humber River Watersheds in Caledon

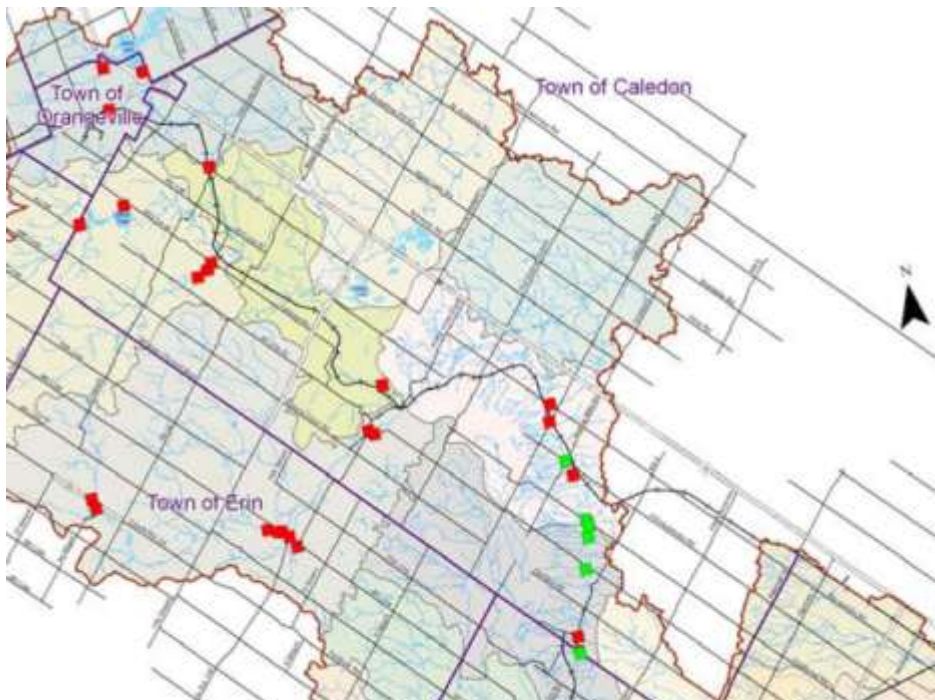
(Created by author with GIS, July 2010)

It should be noted that regulatory oversight for water is closely related to legislation³ introduced earlier in section 5.1. Water quality is generally fair or good because forests and wetlands cover in the Credit River and Humber River watersheds (Map 7) assimilate runoff, improve water quality, and reduce the likelihood of flooding (CVC, 2007; TRCA, 2008b).

The CVC and TRCA recognize that urbanization poses a great threat to the health of the watersheds and possibly, public health (CVC, 2007; TRCA, 2008a). The watersheds provide the Town of Caledon with clean drinking water and diverse habitats that support air quality, tourism and recreation (CVC, 2007; TRCA, 2008a). Thus, the watersheds contribute to the resilience of Caledon because they help the system withstand future health cost associated with poor water and air quality.

Watersheds also contribute to flood control. Along the Humber River, the risk of flooding remains an issue in Bolton, Caledon, where intensification takes place (TRCA, 2008b). Credit Valley Conservation Authority has identified 'Flood Damage Centres' (Map 8), locations prone to flooding along the Credit River, and TRCA has identified areas vulnerable to floods along the Humber River (Map 9).

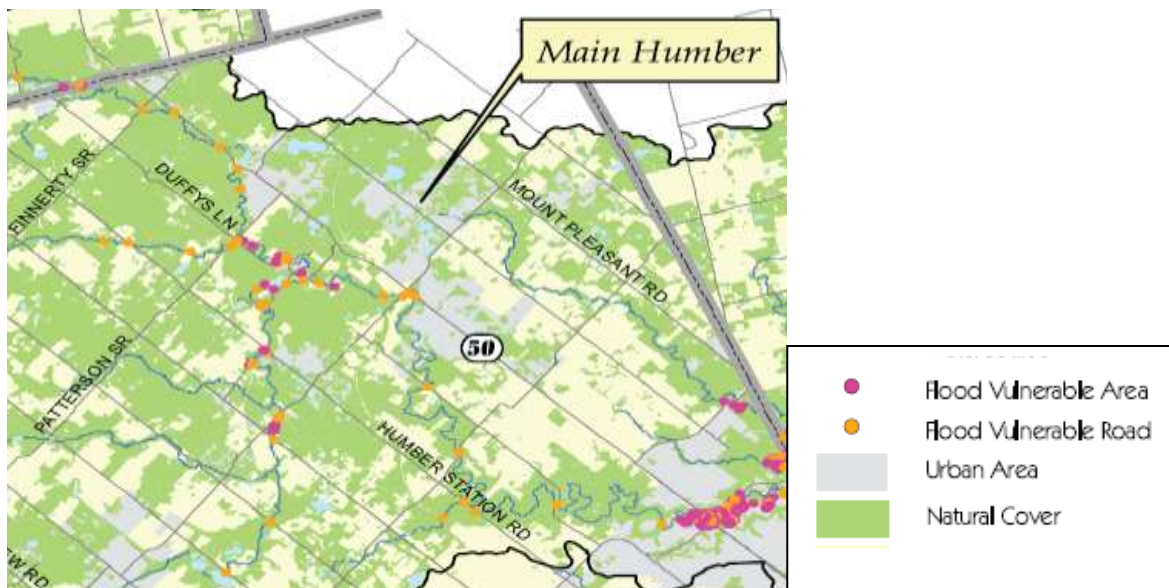
³ Other major legislation include the Ontario Water Resources Act, Environmental Protection Act and Conservation Authorities Act (CVC, 2007).



Map 8 Flood damage centres in Caledon along the Credit River

■ Flood damage centres along the Credit Valley River
 — Municipal Boundary

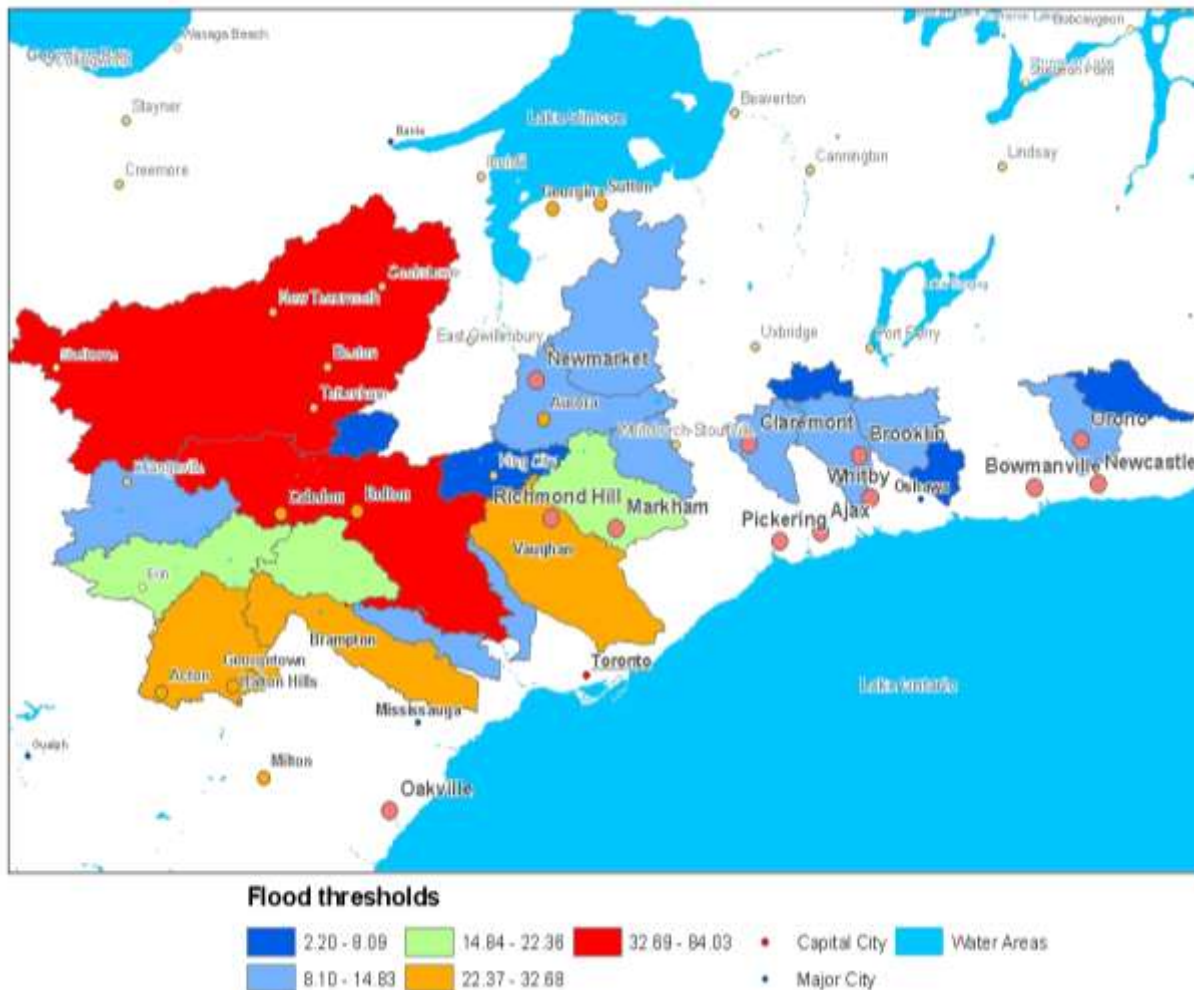
(Adapted from CVC (2007:85))



Map 9 Flood vulnerable areas in Caledon along the Humber River

(Adapted from TRCA (2008a: 47))

Flood thresholds in the ORM area



Map 10 Flood thresholds in towns and cities in the Oak Ridges Moraine area

(Source: Lei (2009:100))

Based on Lei's (2009) flood threshold map, Caledon is one of the municipalities that has the highest flood threshold on the Moraine (Map 10). This implies that Caledon has a higher flood threshold because watersheds absorb rainfall and runoff. TRCA plans to "develop an adaptive management program that will use feedback from monitoring activities to make adjustments to policies, plans and programs" (TRCA, 2008b: 160). The CVC also plans to adopt adaptive environmental management to manage the Credit River Watershed (CVC, 2007). CVC

(2007) has found that the continual improvement of policy implementation through learning and experimentation suited watershed management (CVC, 2007). These features of adaptive environmental management underscore the principles of resilience thinking (Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006) (also Section 2.4).

Box 9 Watershed management– potential resilience assets and threats

Asset 10 Plans to adopt adaptive watershed management nurtures flexibility and learning

Both the Credit River Conservation Authorities and TRCA intend to adopt adaptive environmental management to manage the watersheds (CVC, 2007; TRCA, 2008b). Adaptive environmental management has the potential to allow Conservation Authorities to learn and adapt to social, economic and ecological changes. Adjusting institutional policies and practices to social-ecological conditions is a key resilience feature (Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006) (also Section 2.4)

5.3 Resilience to What and with What – Potential Resilience Threats and Assets based on a Cross-scalar Study of Caledon in the Economic Domain

This part of the analysis follows sections 1 and 3 of the Resilience Assessment Workbook (RA, 2007). The Workbook guides researchers to “describe the key features of scales above and below your focal scale that are critical for understanding the economic context of your issue or challenge” (RA, 2007: 19). This section focuses on economic activities driven by the provincial growth management policy, also known as Smart Growth (Johnson, 2007; EPA, 2010). Major policies associated with Smart Growth and Caledon’s Official Plan are discussed in areas including intensification, aggregates, housing, economic development and agriculture.

Elaborations on the different scales focus only on the larger, large and focal scales. Specific areas that can potentially enhance or threaten resilience of the Caledon in the context of urban growth are presented in boxes. Table 7 below illustrates key elements of the smaller, small, focal, large and larger scales in the economic domain.

Scale	Describe the Scale
Larger	Provincial Smart Growth, Intensification plans, Aggregate policies
Large	Regional Intensification Targets, Employment Land Targets
Focal	Caledon intensification targets, tri-nodal development plan in Mayfield West, Bolton and Caledon East Municipal aggregate policies Rural service centres development
Small	Developments in communities such as Terra Cotta, Albion and Caledon East
Smaller	Individual home businesses and entrepreneurs

Table 7 Scales in the economic domain of Caledon in the context of urban growth

5.3.1 Resilience to what and with what- on the economic domain's larger scale: provincial level

Intensification and Growth Management

The concept of Smart Growth originated in the United States, and is adopted by the Province of Ontario as a main strategy for economic growth (Johnson, 2007; EPA, 2010; Ministry of Public Infrastructure Renewal, 2006). The Province intends to implement Smart Growth in the Greater Golden Horseshoe area, and later in Northern Ontario (Johnson, 2007). This Smart Growth strategy aims to create clusters of residential and industrial areas to make Ontario economy productive, diverse and competitive (Johnson, 2007). The key provincial legislation is the Places to Grow Act (also Sections 2.7 and 5.1.1).

Aggregates Industry

In the context of urban growth, the Town of Caledon is positioned as a vital source of aggregates resource for the constructions of buildings and highways (Markvart, 2009; Chamber & Sandberg, 2007; Johnson, 2006). Aggregate resources are non-renewable, including sand, gravel, clay, limestone, marble, and granite (Markvart, 2009). The Province has consistently regarded aggregates as a provincial resource, and hence, strives to consolidate control over aggregates extraction (Markvart, 2009). In 1979 and the early 1980s, the Ministry of Natural

Resources issued the Mineral Aggregate Policy to direct municipalities not to allocate significant aggregate deposit lands to any other land use (Chambers & Sandberg, 2007). Aggregates extractions have permanently altered the landscape, causing damages to surface and groundwater; and loss of habitats as well as agricultural lands (C4SE, 2009; Markvart, 2009).

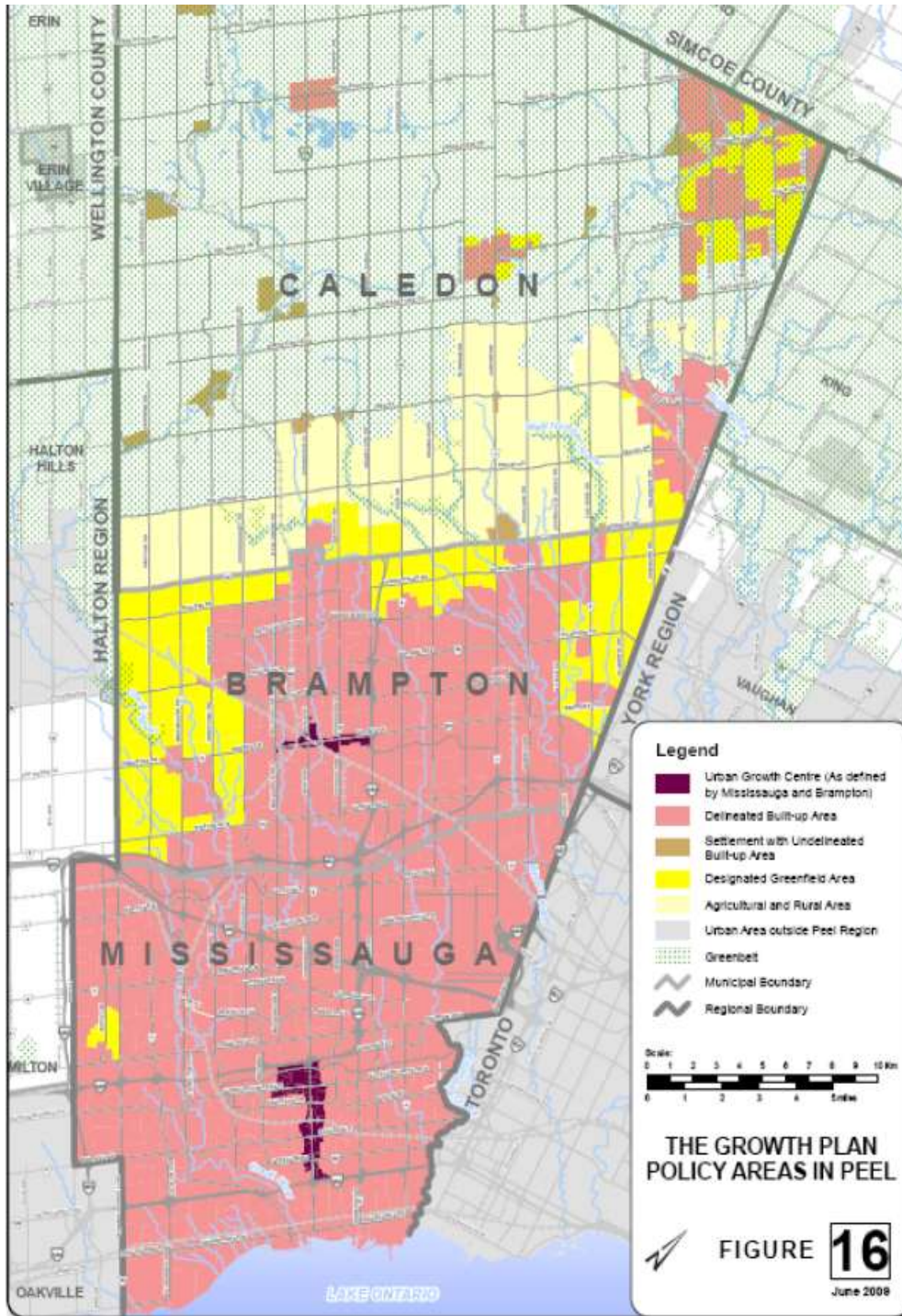
Box 10 Aggregate extractions – potential resilience threat

Threat 5 Aggregates cause stress to the environment and society

Aggregates extractions have caused social and environmental stresses in Caledon. Aggregates operations have caused damages to vegetation, habitats and watersheds (C4SE, 2009; Markvart, 2009). They have also caused heavy truck traffic and noises (Markvart, 2009). Aggregates operations, therefore, are likely to cause future disturbances to Caledon’s environment and communities. Accumulative effects of aggregates operations may move Caledon into an undesirable state (e.g. drinkable watershed into undrinkable watershed; habitats into open pits.) As a result, aggregates operations can reduce the resilience of Caledon.

5.3.2 Resilience to what and with what- on the economic domain’s large scale: regional level
Intensification Targets

The Region of Peel implements the Places to Grow Plan through its Regional Official Plan (ROP). The ROP identifies built-up and agricultural areas (Region of Peel, 2008) (Map 11).



Map 11 Designation of built-up and Greenfield areas in Caledon, Brampton and Mississauga

- Delineated Built-up Area
- Designated Greenfield Area
- Agricultural and Rural Areas

Source: Town of Caledon, 2009h.

Box 11 Intensification– potential resilience assets and threats

Asset 11. Prevention of urban sprawl reduces future shocks

Intensification can prevent urban sprawl and reduce associated environmental, economic and health costs (Ministry of Public Infrastructure Renewal, 2006; MMAH; 2005). Thus, it can nurture the system’s resilience by reducing the potential shocks it will experience in the future as population grows in Caledon (also Box 1, p.69).

Threat 6. A lack of foresight of trade-offs

A lack of foresight of trade-offs can lead to conflicts and disturbances. Intensification aims to encourage more diverse, compact and competitive economy in the Greater Horseshoe Areas (Ministry of Public Infrastructure Renewal, 2006; MOEI, 2010). Nevertheless, the province has assumed that economic interests and other ecological and social interests are compatible. In Places to Grow and Peel’s Official Plan, they do not foresee potential conflicts among these interests, nor do they suggest any possible ways to handle trade-offs among social, economic and ecological interests. A central principle of resilience thinking is that people need to learn and anticipate disturbances. Conflicting interests are potential disturbances that the governments should take into account when implementing intensification policies on the provincial and regional levels.

5.3.3. Resilience to what and with what- on the economic domain’s focal scale: municipal level

Caledon Intensification Targets

Rural Service Centres, Bolton, Mayfield West and Tullamore are the focus of the majority of new residential and employment growth (Table 8) (Town of Caledon, 2008f; Town of Caledon, 2009g). This is known as the tri-nodal strategy (Town of Caledon, 2009 i). The strategy aims to maximize the existing and future labour pool; transportation linkages; servicing systems; and proximity to markets (Caledon 2008 f).

Settlement Category	2011 Population With the approval of OPA 226	2021 Population With the approval of OPA 226	2031 Population With the approval of OPA 226
Rural Service Centres (Bolton, Caledon East, Mayfield West)	45,724	55,016	75,106
Villages (Alton, Caledon, Cheltenham, Mono Mills, Palgrave, Inglewood)	6,592	8,242	10,753
Hamlet	1,452	1,666	1,662
Industrial/Commercial Centres	178	175	175
Palgrave Estate Residential Area	3,909	4,636	5,756
Rural	17,146	17,264	17,549
Total	75,000	84,444	111,000

Table 8 Caledon intensification targets

(Source: Town of Caledon (2009d:9))

Box 12 Caledon intensification– potential resilience assets and threats

Asset 12 Caledon tri-nodal strategy preserves ecosystems and reduces Caledon’s vulnerability

Intensification through settlement areas and tri-nodal development in Caledon facilitates employment and business growth while preserving agricultural lands and ecosystems such as wetlands and watersheds (Town of Caledon, 2008f; Town of Caledon, 2009g; Town of Caledon, 2009i). These ecological features nurture the focal ecological system (North-South Environmental Inc. *et al.*, 2008; CVC, 2007; TRCA, 2008a) (also Box 7, p.81). Construction of infrastructure in Rural Service Centres can also reduce Caledon’s vulnerability to high financial and environmental costs of urban sprawl.

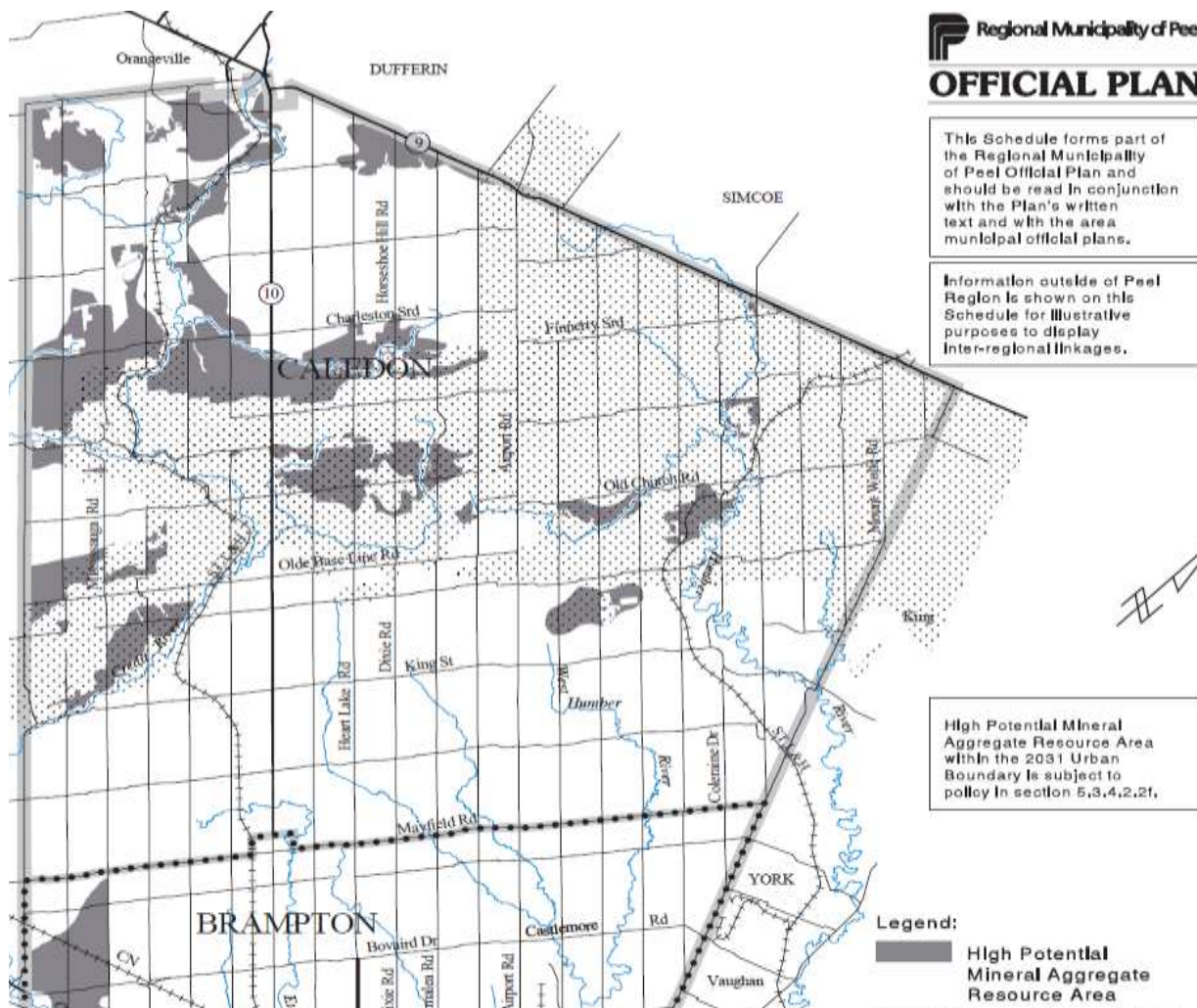
Caledon Aggregates Industry

Provincial support for prioritized aggregates land use positions Caledon as an essential public source of aggregates (Chamber & Sandberg, 2007; Markvart, 2009; Johnson, 2006). In the

early 1980s, Caledon Town Council was pressured by the Ministry of Natural Resources to adopt an aggregate resources area map in its Official Plan to designate parts of the Town for extraction.

In 1996, the Town initiated a Community Advisory Group to address aggregates land use conflicts, and to “negotiate a transition to a local institutional system that would help avoid costly Ontario Municipal Board hearings” (Markvart, 2009:89). As a result of the Caledon Community Resource Study, in 2000, the Town adopted the Official Plan Amendment (OPA) 161 (Markvart, 2009).

The OPA 161 refines the Regional High Potential Mineral Aggregate Resource Area (HPMARA) (Map 12), and gives the Town power to implement the first aggregate extraction prioritization policy in Ontario (Markvart, 2009). The prioritization policy categorizes ten resource areas into ‘Resource Area’ and ‘Reserve Area’ (Markvart, 2009). Reserve Area is subject to higher standard of approval, whereas Resource Area is encouraged for aggregate extraction (Markvart, 2009; Town of Caledon, 2008f).



Map 12 High potential mineral aggregate resource area in Caledon

Source: (Region of Peel (2008: Schedule C))

Box 13 Caledon Aggregates Policy – potential resilience asset

Asset 13 Aggregates prioritization strategy keeps option open for Caledon

Since Caledon possesses most aggregates sites in Peel Region. The use of a prioritization strategy can lessen rigidity of the institutional framework that approves aggregates extraction in Caledon. This gives the Town flexibility in deciding what type of aggregates operations is compatible with both ecological and economic interests (Markvart, 2009; Town of Caledon, 2008f). Flexible decision-making is a key resilience feature (Holling, 2001) (also Section 2.4).

Caledon Housing & Transportation

There is a lack of affordable housing and transit in Caledon (Greenwood *et al.*, 2010). In 2009, Caledon was ranked highest in its housing prices among surrounding communities, making it inaccessible to general labourers and young people (Greenwood *et al.*, 2010:23). Caledon housing policy direction is to “promote and encourage diverse housing types, densities and tenure as a means to support sustainable, compact, equitable, and accessible housing for the current and future needs of residents” (Town of Caledon, 2009 i). Caledon’s Official Plan states that it aims to “promote and foster the availability of housing for all income groups, including those with special needs” (Planning and development, 2009: 26). A primary direction of Caledon Official Plan is to expand public transit such as GO Bus/Rail and smart commute (Town of Caledon, 2008f).

Box 14 Caledon housing and transportation – potential resilience threats and assets

Threat 7 A lack of affordable housing and public transit

The lack of affordable housing and public transit makes Caledon inaccessible to the general labour force and young people who are just starting their careers (Greenwood *et al.*, 2010). This hinders development of diverse industries and young entrepreneurship, which is identified a key to economic resilience of Caledon (Greenwood *et al.*, 2010).

Caledon local commercial and industrial development

Caledon’s Official Plan identifies key areas of competitive advantages: tourism, recreation, small business, agricultural related business and knowledge-based industries (Town of Caledon, 2008d). The Town has carried out a number of initiatives to promote local businesses. The ‘Discover Caledon’ program allows consumers to buy a card at a cost of \$20, of which \$5 would go to local charities (Discover Caledon, 2010). The consumer can enjoy

discounts with local participating businesses (Discover Caledon, 2010). This program enhances the circulation and accumulation of financial capital as well as investment, thereby strengthening Caledon to withstand regional market fluctuations (Discover Caledon, 2010). Helping the local economy withstand external market fluctuations can increase the resilience of Caledon (Greenwood *et al.*, 2010). Another local initiative is called the ‘Green Development Program’ (Town of Caledon, 2010), which encourages local investment and employment by giving development charges discounts to businesses that adopt environmental designs and technologies in their buildings and operations (Town of Caledon, 2010).

Box 15 Caledon economic development – potential resilience asset

Asset 14 Local economic development reduces vulnerability to market fluctuations

Caledon carries out initiatives such as Discover Caledon and Green Development program to promote local investments and employment while encouraging efficient use of energy and resources (Town of Caledon, 2010; Discover Caledon, 2010) This can reduce Caledon’s vulnerability to external market fluctuations in the long run. Helping the local economy withstand external market fluctuations increases the resilience of Caledon (Greenwood *et al.*, 2010).

Caledon’s Agricultural and Rural Policy (OPA 179) and Initiatives

Caledon introduced a new Agricultural and Rural Policy known as the Official Plan Amendment 179 (OPA 179) in 2003. Under OPA 179, Caledon commits to supporting businesses that have distinct relationships to farming operations including wineries, farm markets, carpentry and bed and breakfasts (Town of Caledon, 2009f). Caledon’s vision for its Prime Agricultural Area is to produce healthy food and value-added products for local and regional markets.

The OPA 179 states that Caledon will promote a viable agricultural industry by “giving first priority to agriculture and its needs within the Prime Agricultural Area, promoting value-

added agriculture, farm intensification and diversification” (Mackenzie, 2008:78). Moreover, Caledon adopted ROPA 21B (Regional Official Plan Amendment 21B) in 2010 to increase certainty for the agricultural sector through protection of prime agricultural lands and support for agriculture-related uses (Region of Peel, 2010b).

In 2007, the Caledon Town Council passed a motion that expressed its interest in an Alternative Land Use System (ALUS). The ALUS approach is a distinct farm support program that provides financial compensation to farmers for their ecological goods and services to preserve agricultural lands (Mackenzie, 2008). Ecological goods and services includes water filtration, flood attenuation, biodiversity and carbon sequestration

Box 16 Caledon Agricultural Policy --- potential resilience assets and threats

Asset 15 Preservation of agriculture enhances ecosystem diversity

Caledon has policy in place to preserve its prime agricultural land. Agricultural lands are generally more effective than built-up areas in preserving the natural heritage system and natural corridors (TRCA, 2008). They enhance functional and response diversity in local ecosystems, which is critical to the resilience of a social-ecological system (Folke *et al.*, 2002; Walker *et al.*, 2006) (also Section 2.4).

Threat 8 The loss of farmland in the White Belt in Caledon

Several non-government organizations are concerned that the Greenbelt Plan fails to protect significant agricultural lands in the White Belt in Caledon (Mackenzie, 2008). The White Belt anticipates urban developments, and represents about 70% of Caledon’s prime agricultural land (Mackenzie, 2008: 79). Moreover, there are big financial gains for farmers in the White Belt to sell their lands to developers (Stew & Watkins, 20008).

5.4 Summary of Potential Resilience Assets and Threats Based on a Cross-Scalar Study of Caledon in the Context of Growth Management

Based on a cross-scalar study of Caledon, sections 5.1- 5.3 answer the questions of ‘resilience to what?’ and ‘resilience with what?’ by identifying potential resilience threats and assets.

Domains	Scale that influences the focal scale	Potential Resilience Assets	Potential Resilience Threats
Social	Larger Scale – Provincial Level	<ul style="list-style-type: none"> • Growth plans reduce impacts of future shocks of urban sprawl (Box 1, p.69) • Growth plan review mechanism nurtures continual learning (Box 1, p.69) 	<ul style="list-style-type: none"> • Downloading of Growth plan implementation onto municipality reduces people’s motivations and flexibility (Box 1, p.69)
	Large Scale – Regional Level	<ul style="list-style-type: none"> • Growth plans reduce impacts of future shocks of urban sprawl (Box 1, p.69) • Civil groups act as monitoring and different knowledge systems, which nurtures learning and adjustments (Box 3, p.72) 	
	Focal Scale – Municipal Level	<ul style="list-style-type: none"> • Official Plan contains development approval mechanism that keeps options open (Box 4, p.75) • Official Plan intends to adopt adaptive management that nurtures continual learning and experimentation (Box 5, p.76) • Civil society groups nurtures continual learning and self-organization (Box 7, p.81) 	<ul style="list-style-type: none"> • The lack of indicators hinders continual monitoring and adjustments (Box 5, p.76) • Official Plan lacks a vision of a desirable and sustainable future (Box 5, p.76) • NIMBY (Not in my Backyard) (Box 7, p.81)
Ecological	Large Scale– Moraine Level	<ul style="list-style-type: none"> • Legislated conservation of natural corridors facilitates renewals after disturbances 	<ul style="list-style-type: none"> • A lack of vigorous research in landscape connectivity hinders

		(Box 7, p.81)	ecosystem diversity (Box 7, p.81)
	Focal Scale– Ecosystems in Caledon	<ul style="list-style-type: none"> • Healthy ecosystems help withstand shocks (Box 8, p.84) • Intention to adopt adaptive watershed management nurtures flexibility and learning (Box 9, p.88) 	<ul style="list-style-type: none"> • Aggregates operations cause stress to the environment and society (Box 10, p.90)
Economic	Larger Scale – Provincial Level	<ul style="list-style-type: none"> • Growth Plans prevents urban sprawl and reduces future shocks (Box 1, p.69) 	<ul style="list-style-type: none"> • Aggregate operations cause stress to the environment and society (Box 10, p.90)
	Large Scale– Regional Level	<ul style="list-style-type: none"> • Growth Plans prevents urban sprawl and reduces future shocks (Box 11, p.92) 	<ul style="list-style-type: none"> • A lack of foresight of trade-offs among economic, social and environmental objectives can lead to conflicts and disturbances (Box 11, p.92)
	Focal Scale– Municipal Level	<ul style="list-style-type: none"> • Caledon tri-nodal strategy preserves ecosystems and reduces Caledon’s vulnerability (Box 12, p.93) • Aggregates prioritization strategy keeps option open for Caledon (Box 13, p.95) • Local economic development reduces vulnerability to market fluctuations (Box 15, p.97) • Preservation of agriculture enhances ecosystem diversity (Box 16, p.98) 	<ul style="list-style-type: none"> • A lack of affordable housing and public transit increase inequities (Box 14, p.96) • The loss of farmland in the White Belt (Box 16, p.98)

Table 9 A summary of potential assets and threats based on a cross-scalar study of Caledon

Table 9 above presents a summary of potential resilience threats and assets identified through the cross-scalar study of Caledon. The following discussion focuses only the focal scale (i.e. the Town of Caledon).

Potential Resilience Assets and Threats in the Social Domain

In the social domain, Caledon's Official Plan is identified as a potential resilience because the Official Plan intends to adopt adaptive management and integrate sustainability into its overall planning (Box 5, p.76). Also, the Official Plan gives the Town flexibility to determine if future development proposals benefit its overall sustainability objectives. Keeping options open and decision-making process flexible is important for nurturing resilience (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006) (Box 4, p.75).

Another potential resilience asset identified in the social domain is active civil society groups because they have pushed the focal system to adjust and change their policies to anticipate future disturbances brought by development such as quarry and pesticide use (Box 6, p.78).

In the social domain, a potential threat to Caledon's resilience is the lack of indicators audit Caledon's progress in sustainability (Purell, 2009; CEAC, 2006). Indicators allow monitoring and continual adjustment of policy; and therefore, are key feature of the resilience of a socio-ecological system (Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006) (Box 5, p.76).

In the social domain, civic groups' NIMBY (Not In My Backyard) strategy is identified as a potential threat to resilience (Box 6, p.78) (Chamber & Sandberg, 2007; Johnson; 2006; Macaraig & Sandberg, 2007). This strategy has been successful in blocking environmentally destructive activities such as landfills and the Rockfort Quarry in Caledon (Baxter *et al.*, 1999; Ontario Municipal Board, 2010). Nevertheless, NIMBY may move local environmental impacts to other places, reducing options for other municipalities and towns (Box 6, p.78).

Potential Resilience Assets and Threats in the Ecological Domain

In the ecological domain, local ecosystems are identified as potential resilience assets (Box 8, p.84). Local systems including forests and watersheds help Caledon withstand disturbances caused by urban growth such as heat island effects, air and water pollution (Peel & Caledon, 2008, CVC, 007; TRCA, 2008a).

Another potential resilience asset identified in the ecological domain is the Conservation Authorities' plans to adopt adaptive watershed management (Box 9, p.88). Adaptive environmental management is identified a key resilience feature because it allows institutional policies and practices to be adjusted to social-ecological conditions (Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006).

In the ecological domain, the local aggregates industry is identified as a threat to Caledon's resilience (Box 10, p.90). Aggregate extractions have caused social and environmental stresses in Caledon. They also caused damages to vegetation, habitats and watersheds (C4SE, 2009; Markvart, 2009). The cumulative effects of aggregates operations can move part of Caledon into an undesirable state (e.g. drinkable watershed into undrinkable watershed; habitats into open pits.) As a result, more aggregates operations can reduce the resilience of Caledon.

Potential Resilience Assets and Threats in the Economic Domain

In the economic domain, Caledon's tri-nodal development strategy and local economic development is identified as potential resilience assets (Box 12, p.93; Box 15, p.97). Caledon's tri-nodal development will concentrate urban development in Rural Service Centres (Town of Caledon, 2008f; Town of Caledon, 2009g). This helps preserve agricultural lands and ecosystems such as wetlands and watersheds (Town of Caledon, 2008f; Town of Caledon, 2009g;

Town of Caledon, 2009i). These ecological features can nurture the resilience of local ecological systems (North-South Environmental Inc. *et al.*, 2008; CVC, 2007; TRCA, 2008a).

In the economic domain, Caledon's aggregates prioritization strategy is identified as a potential resilience asset because it keeps options open for Caledon (Box 13, p.95). Flexible decision-making is identified a key resilience feature (Holling, 2001; Walker & Salt, 2006; Anderies *et al.*, 2006) (also Section 2.4). Furthermore, local economic development and preservation of agriculture are identified as potential resilience assets (Box 15, p.97; Box 16, p.98).

In the economic domain, the lack of affordable housing and public transit is identified as a potential threat to Caledon's resilience (Box 14, p.96). This hinders development of diverse industries and young entrepreneurship, which is key to economic resilience of Caledon, especially Caledon has an aging population (Greenwood *et al.*, 2010).

5.5 Conclusion on the Research Results of 'Resilience to What' and 'Resilience with What' Based on a Cross-Scalar Study of Caledon

Sections 5.1- 5.4 have answered the question of 'resilience to what?' and 'resilience with what?' through a cross-scalar study of Caledon. The findings will be verified with interviews results in chapter six. Before moving to chapter six, five emerging themes of resilience of Caledon are identified based on the cross-scalar study.

Emerging Theme 1: Continual learning is a key resilience feature

The cross-scalar study of Caledon shows that civil groups have played a significant role in promoting learning and adjustment between institutional practices and social-ecological conditions (Planning and development, 2009; Planning and development, 2010; Purell; 2009; Macaraig & Sandberg, 2007; Baxter *et al.*, 1999) (also Box 6, p.78). An example is the

Caledon's tri-nodal development strategy. The tri-nodal strategy was developed by citizens and planners to concentrate urban development in Rural Service Centres - Bolton, Mayfield West and Tullamore (Town of Caledon, 2008f; Town of Caledon, 2009g). Construction of infrastructure in Rural Service Centres can reduce Caledon's vulnerability to high financial and environmental costs of urban sprawl.

Emerging Theme 2: Nurturing diversity in agriculture is a key resilience feature

The loss of farmland is identified as a potential threat to resilience because of the subsequent loss of ecosystems and employment opportunities (Box 16, p.98). Caledon's Official Plan aims to diversify local agriculture to address this threat (TRCA, 2008a; Mackenzie, 2008; Region of Peel, 2010b) (Box 16, p.98). A diverse local agriculture is also important to the resilience of Caledon because it supports an 'eat local' rural economy to withstand external market fluctuations (Greenwood *et al.*, 2010). Supporting local agriculture can increase Caledon's resilience because it helps reduce Caledon's vulnerabilities to environmental damages and social costs associated with urban sprawl.

Emerging Theme 3: Adaptive and flexible decision-making is a key resilience feature

Adaptive and flexible decision-making is an important resilience feature (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006). This is illustrated in Caledon's aggregates and land use policies. Caledon's aggregates prioritization policy gives the municipality some flexibility in determining the location and pace of aggregate operations in Caledon (Box 13, p.95).

Also, the Official Plan contains land use policy that gives the municipality power to request special Environmental Impact Studies (EIS) for new development (Caledon, 2008b). This allows the Town to determine if future development proposals promise contributions to its overall sustainability objectives (Caledon, 2008b) (Box 4, p.75). Furthermore, the Town of Caledon and the Credit Valley Conservation Authority intend to adopt adaptive management (Planning and development, 2010; CVC, 2007) (Box 9, p.88). This adaptive approach coincides with resilience thinking's emphasis on continual learning and experimentation to maintain resilience of a system (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006).

Emerging Theme 4: A resilience asset can also be a threat to resilience

On the focal scale, civil groups help promote continual learning and self-organization, nurturing resilience to negative impacts of urban growth (Baxter *et al.*, 1999; Johnson, 2006; Markvart, 2009; Macaraig & Sandberg, 2007) (Box 5, p.76). However, these civil society groups can also reduce resilience of other municipalities by pushing the problems to elsewhere because of their NIMBY strategy (Chamber & Sandberg, 2007 Johnson, 2006; Macaraig & Sandberg, 2007) (Box 5, p.76). This problem is known as general resilience versus specific resilience, and will be addressed (Chapter 7 and Section 8.1.4).

Emerging Theme 5: Resilience of a focal system is influenced by other scales

The cross-scalar study in sections 5.1-5.3 reveal that the resilience of the focal system is influenced by other scales. For example, provincial Smart Growth designates growth numbers to Caledon, preventing disturbances caused by uncontrolled urban sprawl (Ministry of Public Infrastructure Renewal, 2006; MOEI, 2010) (Box 1, p.69). At the same time, the province

downloads many new responsibilities onto municipal staff, thereby reducing institutional flexibility (Dougan & Associates, 2002; Hanna *et al.*, 2007) (Box 1, p.69).

Another example is aggregate extractions. The Provincial Mineral Aggregate Resources Policy Statement directs Caledon not to allocate significant aggregate deposits to any other land use (Markvart, 2009; Chamber & Sandberg, 2007). Aggregates extractions have brought negative social and environmental impacts on Caledon, which is likely to reduce its resilience (Box 10, p.90).

Chapter 6 Research Results: ‘Resilience of What, Resilience to What, Resilience With What’ – Potential Resilience Threats and Assets Based on Interviews with Community Members in Caledon

Chapter five has answered the question of ‘Resilience of what?’ and ‘resilience with what?’ through a cross-scalar study of Caledon that relies mainly on literature review, secondary research and government documents. Hence, the resilience assets and threats identified are mostly associated with government policies and legislation such as the Places to Grow Act (2005) and the Oak Ridges Moraine Conservation Act (2001). This raises two questions. How do people in Caledon view their abilities to respond to changes and disturbances caused by urban growth? Is the concept of resilience relevant to their concerns? This research attempts to answer these questions through the analysis of empirical data, collected through twenty-six interviews with relevant community members identified through purposive and snowball sampling (also Section 3.3).

To verify and complement the findings about Caledon resilience assets and threats presented in chapter five, twenty-six interviews have been conducted. In addition, the interviews have been used to investigate desirable characteristics of Caledon to enrich the findings about ‘resilience of what’ (also Section 3.3). This part of the research has been guided partially guided by sections 1 and 4 of the Resilience Assessment Workbook (RA, 2007).

Interviewees were not asked about resilience per se in order to avoid the use of academic jargon. Instead, interviewees were asked to describe what they appreciated most about Caledon, and this was interpreted as a desirable Caledon from the community members’ perspectives. This information is important because it sheds light on a desirable state of social-ecological system (Section 6.1). The Workbook states that one major strategy of interventions for resilience aim at

“enhancing system resilience in order to maintain a desirable regime” (RA, 2007: 70). Interviewees were also asked to describe the assets for and threats to things that they appreciated most, which were interpreted as assets for and threats to a desirable Caledon respectively (Sections 6.2 and 6.3).

Chapter Structure

All the subchapters use interview results to answer the questions of ‘resilience of what?’, ‘resilience to what?’ and ‘resilience with what?’ Section 3.3 and Appendix D present interview methods and interview questions respectively. Charts and tables are used for illustrations. Section 6.1 presents interview results about what constituted a desirable Caledon (i.e. ‘Resilience of What?’). Section 6.2 presents interview results about threats to a desirable Caledon (i.e. ‘Resilience to What?’). Section 6.3 presents interview results about assets for a desirable Caledon (i.e. Resilience with What?’). Sections 6.4 analyzes the interview results through the lens of resilience thinking, and identify emerging themes of resilience based on sections 6.1-6.3. Lastly, Section 6.5 compares the emerging themes of resilience based on interview results with that of the cross-scalar study (Section 5.5).

6.1 A Desirable Caledon Based on Interview Results

Twenty-six interviewees from purposive and snowball sampling participated in this research (Table 10).

Sectors	Subsectors	Codes of Interviewees' Subsectors	Number of Interviewees	Additional information about interviewees
Governmental (11)	Municipal Staff (5 Local, 1 Regional)	MS	6	Four are not Caledon residents
	Politicians (4 Local, 1 Regional)	PL	5	Three Town Councillors are also farmers. One is Caledon's Mayor, and one is a regional politician.
Non-Governmental (13)	Environmental Groups' Leaders	EG	6	All are Caledon residents. One interviewee is also a member of the Chamber of Commerce
	Individuals	IN	6	All individuals are residents of Caledon who have lived in Caledon for more than 10 years. They have knowledge about development and growth of Caledon. One of them is a former Town staff, while another is a former Town Councillor. Four interviewees have been involved in environmental initiatives.
	Social Services Representative	SS	1	Caledon Community Services
Private (2)	Aggregates Industry	AI	1	Caledon Resident
	Local Property Developer	LPD	1	Caledon Resident
			Total Number of Interviewees: 26	

Table 10 Interviewees' information by sectors

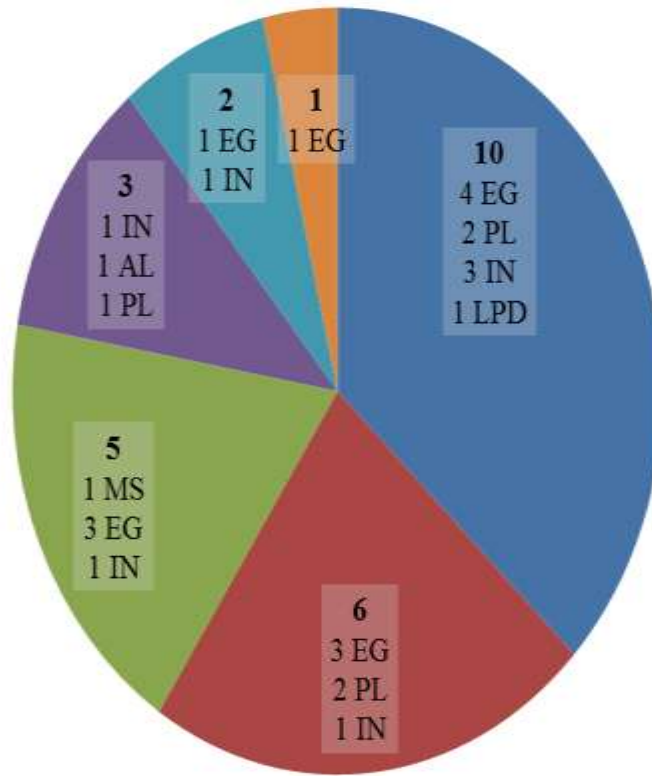
The Resilience Assessment Workbook does not address the question ‘resilience for what’. In other words, the Workbook does not explicitly look into the final goals of enhancing resilience (also Section 2.6). To shed light on the final goals of enhancing resilience, this research investigates desirable characteristics of Caledon through interviews with community members.

The analysis of transcribed interviews in this research has been informed by grounded theory. Grounded theory intends to “identify categories and concepts that emerge from text and link these concepts into substantive and formal theories” (Ryan & Bernard, 2000: 783). The “interpretations of data shape his or her [the researcher] emergent codes in grounded theory” instead of making data “fit into preconceived standardized codes” (Charmaz, 2000: 515). I have read through all the transcriptions and responses to particular questions several times before interpreting the data.

In the process of data interpretation, I have established subcategories under ‘A Desirable Caledon’. Subcategories were established based on repetitions of similar ideas by interviewees. For instance, when asked about what they appreciated most, many interviewees mentioned trees, trails and the moraine. These responses have been categorized as ‘Natural & Cultural Heritage’.

According to interviewees, a desirable Caledon comprises natural landscape and heritage (10); engaged citizens (6); rural character with urban benefits (5); family roots (3), small town character (2) and a caring municipality (1). The results confirm that Caledon community members value the natural landscape (Macaraig & Sandberg, 2007; Ross, 1999) (also Section 4.2). Detailed results are summarized in Chart 2.

A Desirable Caledon Expressed by Community Members



- Natural Landscape & Heritage
- Engaged Citizens in Caledon
- Rural with urban benefits
- Family Roots
- Small Town Character
- Caring Municipal Government

Chart 2 A desirable Caledon by themes and interviewees' backgrounds

AI=Aggregate Industry; EG=Environmental Groups' Leaders; LPD=Local Property Developer; MS=Municipal Staff; PL=Politicians; IN=Individuals; SS=Social Services

Natural Landscape & Heritage (10)

Ten interviewees expressed that they appreciated the natural landscape and heritage of Caledon. Environmental group leader (EG) 1 said that, “I love the variability of the terrain, the hills, and the creeks, the ponds and the bushes, Maple bushes, and trees.” EG 2 expressed that, “What I also appreciate about Caledon is the fact that can be surrounded by trees, and hills, and water, and coyotes are virtually in the next fields.” An individual (IN) 1, who has lived in Caledon for more than 40 years responded that, “fresh air, its [Caledon] history, its prehistory, particularly, it’s quite stunning.” Politician (PL) 2 appreciated the terrain, the Bruce trails and the Trans-Canada trails.

Engaged Citizens (6)

Individual (IN) 1, who has lived in Caledon for 40 years, pointed out that, “One of the good things about Caledon is that people are very naturally environmentally conscious. So you have a lot of people who support Council, support initiatives to conserve the Escarpment, the Moraine.” Environmental group leader (EG) 1 added, “I appreciate that there are so many organizations that deal with environmental issues.” EG 3 mentioned, “I feel that a lot of people in the community really care about it, and are actively trying to make it a good community.”

Politician (PL) 1 observed that, “the people are well-informed and they know about what’s going on. They are very knowledgeable and for the most part, very interesting and interested in what’s going on.” PL 2 emphasized that,

from a community standpoint, I really love the people of Caledon. They are engaged, well informed, and involved in their Town. They don’t sit quietly in the back

row; you hear from them. They tell you what they think. They are right in there. I love that. I really do like that. They put a lot of pressure on all levels of government and that's good.

Rural setting with urban benefits (5)

Six interviewees pointed out that many people wanted to have a rural environment, but they also wanted to enjoy the urban benefits such as 24-hour grocery and diverse cuisines. Municipal staff (MS) 1 mentioned “I think, well, probably, you actually have country here. But you have a fair amount of urban benefits. Some of the things I enjoy – golf, food, stuff like that...” Individual (IN) 3 said, “I could be Mr. Business Man in downtown Toronto in my suit, and then come home and put on my old clothes and jump on my tractor.”

Environmental group leader (EG) 5 added, “I must say I love the trail ways... I have a nice shop, grocery centre, supermarket in Caledon East. And this is a 24-hour one. That is a good thing.” But EG 5 also recognized that many residents wanted a rural lifestyle and urban benefits, and that could be conflicting.

Family Roots, Small Town Character & Caring Municipality (3, 2, 1)

Three interviewees expressed that they value family roots and the small town character of Caledon. Politician (PL) 1 said, “And it’s always the community and the families that bring what I would call the life to earth, the life within our community and our country here.” An aggregates industry representative (AI) said, “So I have a lot of family connections. My grandparents lived in Alton during World War Two. So I appreciate my personal family history.”

Two interviewees expressed that they appreciated the small town character of Caledon. Individual (IN) 2 said, “I like the feeling of small community, and all the people I know who are well involved in the community. And I went for a bike ride once down at the rail trail, and I would say I met seventeen different groups of people. All of them we knew.” Environmental group leader (EG) 2 said, “And I appreciate the fact there is a scale-down sense of, like shopping. So there is a vibrant kind of shopping area, but it’s all scale-down.” EG 2 added, “And I appreciate the fact that we do have a very open and caring municipal government, both whether it’s politicians or staff. That staff truly reflect a certain flavour of Caledon. And that comes out of the Official Plan.” These desirable characters will be discussed in relation to resilience of Caledon in section 6.4.

6.2 Threats to a Desirable Caledon Based on Interview Results

Research results about threats to a desirable Caledon are part of the answer to the question of ‘resilience to what?’ The Resilience Assessment Workbook points out that researchers need to “develop a list of disturbances that are potentially threatening” in order to enhance resilience of a system (RA, 2007: 27). Interviewees were asked to describe threats to things they appreciated most, and this was interpreted as threats to a desirable Caledon.

Six subcategories were established based on repetitions of similar ideas expressed by interviewees. For instance, sixteen interviewees expressed similar ideas about the threats of urban growth in terms such as ‘population growth’, ‘urban expansion’, ‘industrial development’ and ‘density’ (Table 11, p. 121). These terms were grouped under the subcategory of ‘Urbanization and Population Growth’. The six subcategories include urbanization (16); disconnect between provincial legislation and people’s livelihoods (7); sharp decline in

agriculture (5); aggregates extractions (5); fiscal challenges (3) and a lack of affordable housing (3). Elaborations on threats are presented in Chart 3 and Table 11.

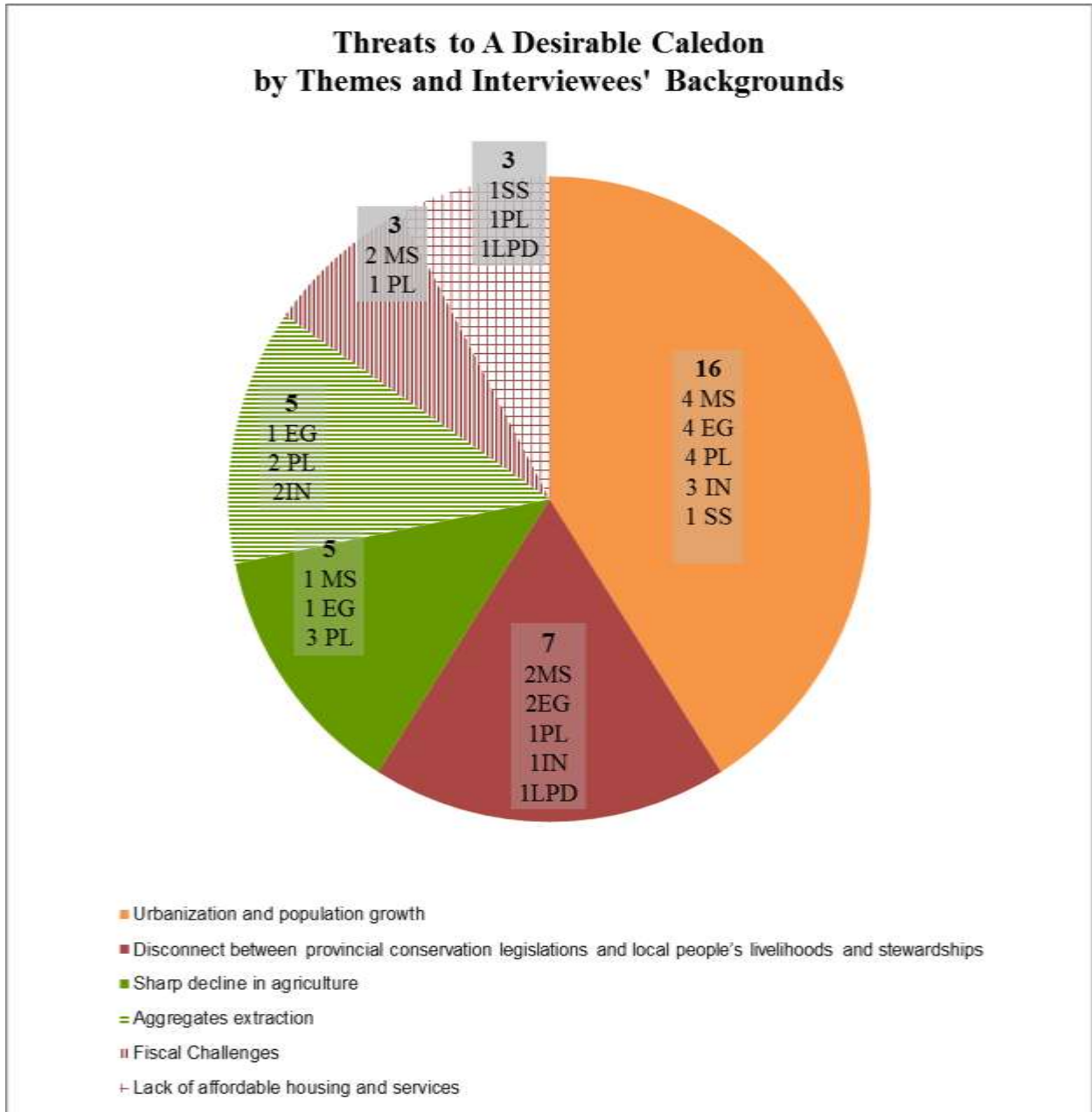


Chart 3 Threats to a desirable Caledon by themes and interviewees' backgrounds

AI=Aggregate Industry; EG=Environmental Groups' Leaders; LPD=Local Property Developer; MS= Municipal Staff; PL=Politicians; IN=Individuals; SS=Social Services

Urbanization & Population Growth (16)

Sixteen interviewees expressed concerns about urbanization causing the losses of natural heritage, rural and small-town character as well as agriculture in Caledon. More descriptions and interviews' quotes are presented in Table 11. A municipal staff (MS) 2 mentioned that,

the white belt that has been established by the provincial government will certainly be bringing a lot more industrial development through the southern, through at least the community. So that is a threat because I think that will certainly change a big chunk of the town, and bring with it huge transportation system along with that.

A politician (PL) 4 observed that,

we continue to urbanize all the good agricultural land, we continue to green up the non-agricultural land as a compensator for urbanization, but we don't do anything about agriculture. We continue, as society, to rely on more marginal lands' ability to produce more food. And in doing that, we are relying on more and more fertilizers, fairly dangerous methodology.

An environmental group leader (EG) 2 emphasized, "What I alluded to is Vaughan-based developer has come in. And his [developer], trying to impose his desires which is to develop and make a lot of money, trying to impose that upon us."

Disconnect between Provincial Conservation Legislation and Local People's Livelihoods and Stewardship (7)

Seven interviewees expressed that some provincial legislation threatened a desirable Caledon because it lacked flexibility to allow for environmental innovations, diversification of agriculture and value-added processing in areas protected by conservation legislation. Politician

(PL) 2 pointed out that, “Provincial restrictions are ridiculous. There are too many hurdles to helping the agricultural sector...” An environmental group (EG) 2 wanted to build an education centre there, but was unable to do so because of conservation restrictions. Municipal staff (MS) 3 wanted to, but could not preserve a heritage building in a conservation area due to regulations.

Sharp Decline in Agriculture (5)

Five interviewees expressed that agricultural decline was a threat to a desirable Caledon. Urbanization is taking place in the White Belt in Caledon, where most agricultural lands are (CEAC, 2006). An individual (IN) 1 mentioned that, “In Caledon, we have the top-grade farmland, but we have the only farmland left. It is getting huge development pressure...” Politician (PL) 2 mentioned that, “Agriculture is suffering. It used to be our main industry in Caledon.” Another politician (PL) 4 observed that, “So it’s not only agriculture getting threatened, it’s all the support industries, employment towards agriculture.”

Aggregates Extractions (5)

Five interviewees expressed that aggregates extractions posed threats to a desirable Caledon. An individual (IN) 6, who has lived in Caledon for more than 60 years, observed that the aggregates industry did not rehabilitate the mine pits after extractions. An environmental group leader (EG) 5 said that, “and of course they are a threat to our water supply. And all the other things that came with that, the dust, many issues.” A politician (PL) 4 pointed out that “... the urbanization demands of Ontario make the aggregates very attractive. So the laws of Ontario favour the gravel companies. The municipalities and the people who live within the area, and their municipal governments are always pitted against the gravel.”

Fiscal Challenges (3)

Three interviewees pointed out that fiscal challenges posed threats to a desirable Caledon. A politician (PL) 2 said that, “When you get a developer who said I want to go right now, I am putting another 27,000 people in. Oh no, you are not. Because the 60,000 people over the next 10 years cannot afford to pay \$86 million [for infrastructure and services].” PL 5 pointed out that, “And then the next thing is to find the water, to find the water and the sewage capacity to serve that new growth. And build that infrastructure and the money to do that, and keep taxes at a reasonable rate.”

Lack of Affordable Services and Housing (3)

Three interviewees identified a lack of affordable housing and services as a threat to a desirable Caledon. A politician (PL) 3 found that, “It’s growing. Homelessness...maybe we haven’t been aware of it, but it’s more prevalent than you can imagine.” A social services representative (SS) observed that, “Probably the lack of mental health and health services, [that are] affordable. Again, affordable housing, affordable mental [health services]...” A local property developer (LPD) found that, “One thing Caledon does not have is affordable housing....Not enough creativity to create concepts of housing...There should be concessions for development charges for people to build affordable housing.”

The section above describes threats to a desirable Caledon based on interviews. Table 11 below presents more interviewees’ quotes related to threats to a desirable Caledon.

Threats to a Desirable Caledon	Sample Interviewees’ Quotes
Urbanization and Population Growth <ul style="list-style-type: none">• A takeover by developers can turn Caledon into another Brampton, causing it to lose its small-town character and rural heritage• Increased population makes it harder for	MS 1 “But probably the threats are more to what we may call heritage vistas. That’s what I think with development, right? You go to some places and you can see for miles, and it’s beautiful, right? You change that into a couple square mile of housing. It doesn’t look as interesting anymore.”

<p>people to live within the carrying capacity of the land</p> <ul style="list-style-type: none"> • Urban growth and newcomers’ urban lifestyles can reduce population’s time and interests in local environmental issues • Urbanization pressures cause the loss of agriculture, family traditions and the market for local food production • Developers and Town’s Councillors challenge the Official Plan at the Ontario Municipal Board 	<p>MS 2 “The white belt that has been established by the provincial government will certainly be bringing a lot more industrial development through the southern, through at least the community. So that its’ a threat because I think that will certainly change a big chunk of the town, and bring with it huge transportation system along with that.”</p> <p>MS 3 “The Greenfield density target is kind of, the problem with it is top-down planning, and it’s planning with numbers... the Province’s requirement that it’s a combined target between residential and employment. It can force the residential density way, way up to 60,70 or even 100 persons per hectare, just to compensate for some of the employment land.”</p> <p>PL4 “We continue to urbanize all the good agricultural land, we continue to green up the non-agricultural land as a compensator for urbanization, but we don’t do anything about agriculture. We continue, as society, to rely on more marginal lands’ ability to produce more food. And in doing that, we are relying on more and more fertilizers, fairly dangerous methodology.”</p> <p>PL 5 ”And the sadness I think that I see is generations will suffer from is the amount of, of urban pressure that you have that takes away those family lifestyles. To urban growth and growth of the country.”</p> <p>IN 1 “I do not believe it’s appropriate for developers to take us on the OMB, the Ontario Municipal Board, or Councillors to undermine something [Caledon’s Official Plan] which the rest of Council has made a decision on... You know my tax money, my time, my effort went to, hundreds of people like me, went towards creating a good Official Plan and area plans.”</p>
<p>Disconnect Between Provincial Conservation Legislation and Local People’s Livelihoods and Stewardship</p> <ul style="list-style-type: none"> • Provincial legislation lacks flexibility to allow environmental innovations, diversification of agriculture (e.g. value-added processing) • Conservation legislation is imposed by upstairs government that lack practical 	<p>MS 3 “Their lack of flexibility in the Oak Ridges Moraine Act prevented it, and within two years, the barn had burned down, and they had knocked down the farmhouse.”</p> <p>EG2 “I mean so much of the Moraine in Caledon is in the natural linkage. Really, you can’t do anything there. There’s no institutional use... I have always wanted to convert our family farm into a centre for learning. [inaudible] But in order to run that through,</p>

<p>knowledge about the land</p> <ul style="list-style-type: none"> • Bureaucracy makes approval process for local development very difficult 	<p>a charitable organization and formalize it, one would need to have it zoned institutional.”</p> <p>PL2 “And they [bureaucrats] keep bringing down regulations after regulations after regulations about environmental ones as well as others on what you can do and what you can’t do. And it appears to me to be a group of bureaucrats sitting down at Queen’s Park who have never been out in the countryside in their lives. And they don’t really know what’s going on. And therefore, they are making it much more difficult for these people [farmers] to make a living. They are selling. They are selling [the farmland].”</p> <p>PL3 “And they come up with regulations. The big thing is that they think because they are looking at textbook, they can think better. Why don’t they ask people for their input?”</p>
<p>Sharp Decline in Agriculture</p> <ul style="list-style-type: none"> • Urbanization takes place on the prime agricultural land in Southern Ontario • Society relies more and more on marginal lands to produce food, increasing the use of fertilizers and pesticides • Employment (e.g. machinery) associated with agriculture is lost 	<p>IN 1 “In Caledon, we have the top-grade farmland, but we have the only farmland left. It is getting huge development pressure from the east and from the south.”</p> <p>PL 2 “Agriculture is suffering, it used to be our main industry in Caledon. With provincial policies and planning regulations like Places to Grow, the Oak Ridges Moraine Act and the Greenbelt Act, it makes it very difficult for farmers to expand their operations or adapt to changing markets.”</p> <p>PL4 “So it’s not only agriculture getting threatened, it’s all the support industries, employment towards agriculture get equally threatened. So the impact on our economy is much, much larger than it seems simply because a farmer is not farming.”</p> <p>PL5 “And that agriculture is probably one that suffers most and lost from all of the industries that we have.”</p>
<p>Aggregates Extractions</p> <ul style="list-style-type: none"> • Provincial policy favours aggregates extraction • Municipalities have no control over licensing and operation of aggregates • A lack of provincial policy to protect watersheds against aggregates • Aggregates industry does not rehabilitate the land after extraction finished 	<p>EG 5 “And of course they are a threat to our water supply. And all the other things that came with that, the dust, many issues.”</p> <p>PL4 “So the urbanization demands of Ontario makes the aggregates very attractive. So the laws of Ontario favour the gravel companies. The municipalities and the people who live within the area, and their municipal governments are always pitted against the gravel”</p> <p>IN3 “Obviously, the gravel industry is definitely a</p>

	<p>threat. You think you are living on a quiet country road, and you may end up having a large volume of gravel trucks goes by. There could be noise, dust.”</p> <p>IN6 “...aggregates company is buying out gravel...I can show you gravel pits down there that has trees, big, growing in the middle of them. How long did a tree to grow that big? People don’t understand that very question. Why didn’t they rehabilitate?”</p>
<p>Fiscal Challenges</p> <ul style="list-style-type: none"> • Rapid development requires great infrastructure cost • Caledon’s tax base relies heavily on residential assessment • Industrial development can expand the municipal tax base, but it depends on the type of development (e.g. outdoor warehousing does not pay much property taxes while costing municipal services) 	<p>MS3 “One thing that is an issue is that the Town’s assessment base is very heavily residential as opposed to partial industrial. And people think that it’s fiscally beneficial to have a better balance between residential and industrial, and not residential assessment. Our Fiscal Impacts Study communicated that it’s not necessarily that simple because there’s some industrial uses, low industrial uses, that don’t pay for themselves.”</p> <p>PL2 “So when you get a developer who said I want to go right now, I am putting another 27,000 people in. Oh no, you are not. Because the 60,000 people over the next 10 years cannot afford to pay 86 million.”</p> <p>PL5 “And then the next thing is to find the water, to find the water and the sewage capacity to serve that new growth. And build that infrastructure and the money to do that, and keep taxes at a reasonable rate.”</p>
<p>Lack of Affordable Services and Housing</p> <ul style="list-style-type: none"> • There is a lack of mental health and health services • A lack of affordable housing led to homelessness 	<p>PL3 “It’s growing. Homelessness, we didn’t, maybe we didn’t have the technology, maybe we haven’t been aware of it, but it’s more prevalent than you can imagine.”</p> <p>SS “Probably the lack of mental health and health services, [that are] affordable. Again, affordable housing, affordable mental [health services] ...”</p> <p>LPD “One thing Caledon does not have is affordable housing....Not enough creativity to create concepts of housing...There should be concessions for development charges for people to build affordable housing.”</p>

Table 11 Threats to a desirable Caledon and interviewees’ quotes

6.3 Assets for a Desirable Caledon Based on Interview Results

Research results about assets for a desirable Caledon are part of the answer to the question of ‘resilience with what?’ In order to enhance Caledon’s resilience, it is important to identify its assets from the perspectives of community members.

Interviewees were asked to describe assets that could maintain what they appreciated most, and this was interpreted as assets for a desirable Caledon. Seven subcategories were established under the category of ‘Assets for a Desirable Caledon’. These categories were established based on repetitions of similar ideas by interviewees. For instance, a number of interviewees mentioned advocacy groups and active citizens as an asset for a desirable Caledon. Positive comments about citizens’ initiative and volunteer work were categorized as ‘Civic Engagement & Effective Volunteerism’.

According to interviewees, assets for a desirable Caledon comprise strong local civic engagement and volunteerism (15); participatory planning and solid citizen-municipality relationship (8); low-impact development (8); diverse agriculture (5); provincial conservation policies (5); municipal environmental leadership (5); and urbanization as an opportunity (3). Elaborations on these assets are presented in Chart 4 and Table 12.

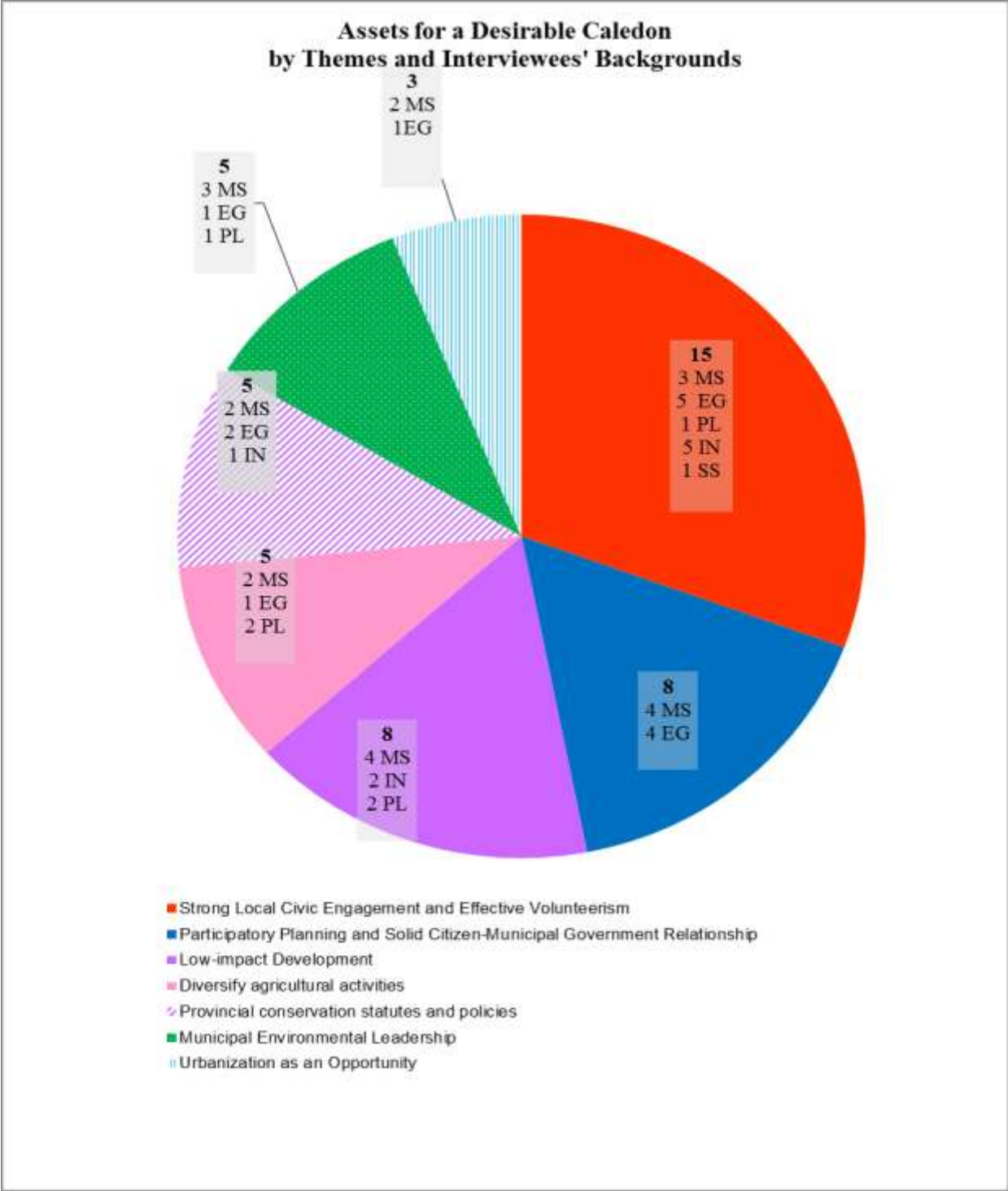


Chart 4 Assets for a desirable Caledon by themes and interviewees' backgrounds

AI=Aggregate Industry; EG=Environmental Groups' Leaders; LPD=Local Property Developer; MS=Municipal Staff; PL=Politicians; IN=Individuals; SS=Social Services

Strong Local Civic Engagement and Effective Volunteerism (15)

Fifteen interviewees expressed that active civil society groups and volunteers were an asset for a desirable Caledon. A municipal staff (MS) 5 said, “if you do something wrong, they [citizens] are certainly there to correct us. I guess the best example of it, we do have a committee, the CEAC [Caledon Environmental Advisory Committee].” An environmental group leader (EG) 1 observed that “the strengths are again all those organizations that bring all the people together, and help them to have a stronger voice about what’s going on.” EG 2 mentioned that, “So the volunteerism is one of its strongest assets. And a lot of that comes from the rural community.” A social service (SS) representative said that, “There are a lot of advocacy, groups, environmental groups, people passionate about the community. So I think the community itself is a main strength, the people.” Explanations and other interviews’ quotes about assets for a desirable Caledon are presented in Table 12.

Participatory Planning and Solid Citizen-Municipal Government Relationship (8)

Eight interviewees mentioned that participatory planning and solid relationship between citizens and the municipality was an asset for a desirable Caledon. A municipal staff (MS) 3 observed that “they [residents] get very involved in growth planning. And pushing Council to control growth, the amount of growth. Well there is Bolton Residents’ Association; there is a Caledon Village Residents’ Association.” Environmental group leader (EG) 4 pointed out that, “the whole tri-nodal process, the whole Master planning process, that all came out of CEAC [Caledon Environmental Advisory Committee].”

EG 2 expressed that,

I think that one of the strengths is the fact the relationship between the municipal government, whether it’s politicians or staff, and citizenry. It’s a pretty solid relationship.

There is a degree of openness, and accountability, and again, grounded in that know-your-neighbour.

Low-impact Development (8)

Eight interviewees pointed out that the low-impact development with innovative environmental features in residential and employment land use was a strength for a desirable Caledon. A municipal staff (MS) 1 pointed out that, “I used the word ‘low-impact’ in the sense that because people say you can’t do anything, you know, and I think we need to get beyond that.” MS 5 said that, “to make Caledon resilient and sustainable is to protect our natural landscapes through sustainable rural/agricultural uses and balanced urban growth centres based on low impact design principles”. A politician (PL) 3 believed that “low-impact development is the way we have to start thinking... we can bring the population in. Let’s think about how it fits into the nature around it...”

Diversify Agricultural Activities (5)

Five interviewees said that diversifying agriculture was an important asset for a desirable Caledon. Diversification of agriculture is about supporting value-added activities on farms such as cheese-making, welding and eco-tourism. An environmental group leader (EG) 2 emphasized that,

they [Caledon residents] have really big, big plans to really make this a multi-purpose venture where they grow vegetables, they will have a CSA [Community Support Agriculture] but they really see it as a way to try work for youth to teach about the connections and environmental issues and local food security. So that’s a really cool thing. That’s a huge asset to have those kind of people who are so motivated and self-directed.

A municipal staff (MS) 1 mentioned that, “but you know, allowing more value-added on the farm, right? Looking at, you know, other areas where recreation can be supported with additional facilities.” A politician (PL) 4 referred to a farm as an asset, and said, “And they [Downey Farm] also sell fresh turkeys, as you can see there, fresh turkeys, ducks in the winter time. The other thing they did in the last few years. There is a building in the back where they [Downey Farm] make their own wine, fruit wines which they sell...”

Provincial conservation statutes and policies (5)

Five interviewees referred to provincial conservation policies such as the Oak Ridges Moraine Conservation Act (2001) and the Greenbelt Act (2005) as an asset because they protected the environment in Caledon against urban sprawl. Individual (IN) 3 mentioned that, “an asset is defined legislation that is environment-focused, lifestyle-focused, which I think the Oak Ridges Moraine, Niagara Escarpment Commission and Greenbelt Plan.” An environmental group leader (EG) 4 pointed out that, “and they [the municipality of Caledon] got the Niagara Escarpment Plan, the Oak Ridges Moraine Plan, and we got the Greenbelt Plan. So there is a large swap of Caledon that is pretty well protected.”

Municipal Environmental Leadership (5)

Five interviewees pointed out that municipal environmental leadership was an asset because the government had been investing time and resources in developing and implementing plans such as the tri-nodal strategy to promote sustainability. A municipal staff (MS) 3 mentioned that, “council sees fit to maintain a fairly large Planning Department here for the size of the municipality. And so, they put a lot of resource into growth management.” MS 4 emphasized that, “engaged citizens and environmental leadership, I see them as assets.” A

politician (PL) 2 said that, “we have some pretty stringent environmental policies and we have taken major steps forward. We have an Environmental Progress Officer who monitors and reports on our successes.”

Urbanization as an Opportunity (3)

Three interviewees identified urbanization as an asset for a desirable Caledon because it gave Caledon opportunities to build more compact and sustainable communities in Rural Service Centres. A municipal staff (MS) 3 mentioned that,

I think one of the great opportunities is that we are starting from scratch. We have the opportunity to do things right, not to have repeat mistakes...I think we have the opportunity to create a community that is based on good foundation of sustainability in growth management practices.

An environmental group leader (EG) 2 said that, “Urban development versus preservation. So I think the threat can be turned into an amazing strength and asset, which is the need for more and more communication.” An individual (IN) 3 observed that,

Across Caledon south, it's going to be quite a large population someday now. Bolton may not be the big one. It may be Mayfield or some of the other ones along that strip. That will change the dynamic. But it may be helpful. It may mean those people are happy. There will be a community down there.

The section above has presented assets for a desirable Caledon based on interviews. Table 12 below presents more interviewees' quotes related to assets for a desirable Caledon.

Assets for a Desirable Caledon	Sample Interviewees' Quotes
<p>Strong Local Civic Engagement and Effective Volunteerism</p> <ul style="list-style-type: none"> • Citizens' groups bring people and resources together to address social and environmental issues (e.g. Concerned Citizens for Caledon, Countryside Alliance) • Local food movement supports local agriculture and employment (e.g. Eat Local Caledon, Eco Village) • Pro-slow and sustainable growth model groups' leaders won municipal election in 2010 (e.g. Patti Foley, Rob Mezzapelli) • The use of new media such as electronic networking and Caledon Radio allows people to self-organize and solve problems associated with development • An increasing level of environmental consciousness and willingness to bring positive changes 	<p>MS 5 "If you do something wrong, they are certainly there to correct us. I guess the best example of it, we do have a committee, the Caledon Environment CEAC [Caledon Environmental Advisory Committee]. So they've, basically, in every project that the Town, Caledon is taking, they will review it, and they will provide comments, support us or correct us. We have also been partnering with the Countryside Alliance on different initiatives."</p> <p>IN 1 "Life would not be so great here if we didn't have this huge core of volunteers that supported Council and staff on doing things, you know whether it's looking after parks, picking up garbage... That ability to get things done with volunteers, I haven't encountered anywhere else."</p> <p>IN 3 "The strengths are a lot of people, a lot of like-minded people are here."</p> <p>EG 1 "The strengths are again all those organizations that bring all the people together, and help them to have a stronger voice about what's going on."</p> <p>EG 2 "So the volunteerism is one of its strongest assets. And a lot of that come from the rural community who volunteer for fire fighters services, meals on wheels. But there is also, over the last 20 years, a group of people are there to protect and volunteer to preserve its ecological and environmental assets."</p> <p>SS "Probably, there are a lot of advocacy, groups, environmental groups, people passionate about the community. So I think the community itself is a main strength, the people."</p> <p>PL4 "Since 1970, greater awareness in society causes legislation, which is all part of awareness, has made us pay more attention to the balance between nature and people."</p>
<p>Participatory Planning and Solid Citizen-Municipal Government Relationship</p> <ul style="list-style-type: none"> • The public is involved through village associations, and Town's Councils working groups • The Caledon Environmental Advisory 	<p>MS3 "Well, they [residents] get very involved in growth planning. And pushing Council to control growth, the amount of growth. Well there is Bolton Residents' Association, there is a Caledon Village Residents' Association."</p>

<p>Committee (CEAC) made up of citizens has influenced numerous Council’s decisions</p> <ul style="list-style-type: none"> • Work is done in a ‘know-your-neighbour’ environment in which many people know Councillors and the Mayor personally 	<p>EG 2 “I think that one of the strengths is the fact the relationship between the municipal government, whether it’s politicians or staff, and citizenry. It’s a pretty solid relationship. There is a degree of openness, and accountability, and again, grounded in that know-your-neighbour.”</p> <p>EG 4 “The whole tri-nodal process, the whole Master planning process, that all came out of CEAC [Caledon Environmental Advisory Committee].”</p> <p>EG5 “He [Councillor] just won the election. I must say they are willing to working with community, to a large extent. That’s my experience. That’s all I can say. I found them reasonable responsive, and willing to work with groups.”</p>
<p>Low-impact Development</p> <ul style="list-style-type: none"> • Low-impact development with innovative environmental features in residential and employment land use (e.g. Green Development Program) • Mixed land use 	<p>MS 1 “I used the word ‘low-impact’ in the sense that because people say you can’t do anything, you know, and I think we need to get beyond that.”</p> <p>MS 3 “So we have a lot of areas protected, we have a lot of requirements for developers doing development. Where we need to sort of take the next step is low-impact development.”</p> <p>MS 5 “To make Caledon resilient and sustainable is to protect our natural landscapes through sustainable rural/agricultural uses and balanced urban growth centres based on low impact design principles”</p> <p>PL 3 “Low-impact development is the way we have to start thinking... You know what, we can bring the population in. Let’s think about how it fits into the nature around it, make it fit for what we need.”</p> <p>PL5 “I think, the strength in society, is that if you can have people to work and live within a ten and fifteen-minute range from home is a very strong, strong thing in our society today where people enjoy where they live and work. So I think again planning, planning has to do with a big part of that.”</p> <p>IN 2 “It’s almost a battle between long-time residents and developers. And I don’t think it has to be that way... Maybe the European models or other models where they managed to get some growth without destroying</p>

	things.
<p>Diversified Agricultural Activities</p> <ul style="list-style-type: none"> • Support value-added activities on farms such as cheese-making, welding and eco-tourism • Citizens initiated local food movement such as the Albion Community Supported Farm 	<p>MS1 “But you know, allowing more value-added on the farm, right? Looking at, you know, other areas where recreation can be supported with additional facilities.”</p> <p>PL2 “There is going to be different types of animals being raised. Some farmers have begun raising pigeons because there is a growing demand for it. There are some goat farms starting up too, I think we can expect to see a growing diversity in livestock.”</p> <p>PL 4 “And they [Downy farm] also sell fresh turkeys, as you can see there, fresh turkeys, ducks in the winter time. The other thing they did in the last few years. There is a building in the back where they [Downy Farm] make their own wine, fruit wines which they sell at where the Open sign is.”</p> <p>EG2 “They [several Caledon residents] have really big, big plans to really make this a multi-purpose venture where they grow vegetables, they will have a CSA [Community Support Agriculture] but they really see it as a way to try work for youth to teach about the connections and environmental issues and local food security. So that’s a really cool thing. That’s a huge asset to have those kind of people who are so motivated and self-directed”</p>
<p>Provincial conservation statutes and policies</p> <ul style="list-style-type: none"> • Oak Ridges Moraine Conservation Act, the Greenbelt Act and the Niagara Escarpment Plan protect much of the environment in Caledon against urban sprawl 	<p>IN 3 “An asset is defined legislation that is environment-focused, lifestyle-focused, which I think the Oak Ridges Moraine, Niagara Escarpment Commission and Greenbelt Plan.”</p> <p>EG 4 “And they got the Niagara Escarpment Plan, the Oak Ridges Moraine Plan, and we got the Greenbelt Plan. So there is a large swap of Caledon that is pretty well protected.”</p> <p>PL5 “I think really if the policies of the government and the Official Plans uphold their policies, then I think that then the ability of maintaining farming lifestyle can live in Caledon.”</p>
<p>Municipal Environmental Leadership</p> <ul style="list-style-type: none"> • Municipality invests time and resources in developing Official Plan and Secondary Plans with community members 	<p>MS 3 “Council sees fit to maintain a fairly large Planning Department here for the size of the municipality. And so, they put a lot of resource into growth management.”</p> <p>PL2 “We have some pretty stringent environmental</p>

<ul style="list-style-type: none"> • Caledon Official Plan sets the foundation for well-planned development, and the municipality is willing to defend the Official Plan at Ontario Municipal Board • The municipality created the Environmental Progress Office, and adopted the Environmental Action Plan and Green Development Program. 	<p>policies and we have taken major steps forward. We have an Environmental Progress Officer who monitors and reports on our successes.”</p> <p>MS 4 “Engaged citizens and environmental leadership, I see them as assets. In the [Environmental Progress Action Plan], there is a whole section in the first part of the Plan on community’s achievements and Town’s achievements”.</p>
<p>Urbanization As an Opportunity</p> <ul style="list-style-type: none"> • Urban pressures pull people together to contribute ideas to community development • Caledon has an opportunity to implement sustainable development • Intensification builds a sense of community 	<p>MS 3 “I think one of the great opportunities is that we are starting from scratch. We have the opportunity to do things right, not to have repeat mistakes... Given the amount of technology that exists now, and the amount of attention paid to the environment, I think we have the opportunity to create a community that is based on good foundation of sustainability in growth management practices.”</p> <p>EG 2 “I think that in response to the Vaughan-based threat, it has really, really pulled people together... This external pressure to take over this land, is going to be constant... Sometimes I get a little bit weak thinking about how much efforts, every four years, every effort... Urban development versus preservation. So I think the threat can be turned into an amazing strength and asset, which is the need for more and more communication.”</p> <p>IN 3 “across Caledon south, it’s going to be quite a large population someday now. Bolton may not be the big one. It may be Mayfield or some of the other ones along that strip. That will change the dynamic. But it may be helpful. It may mean those people are happy. There will be a community down there. That will be tax resource.”</p>

Table 12 Assets for a desirable Caledon and interviewees’ quotes

6.4 Emerging Themes of Resilience Based on Interview Results

Table 13 below summarizes assets of and threats to a desirable Caledon based on interview results. Emerging themes of resilience based on interview results are elaborated in section 6.5. These emerging themes of resilience will then be compared to those presented earlier in section 5.5.

Assets for a Desirable Caledon	Emerging Themes of Resilience	Threats to a Desirable Caledon
<ul style="list-style-type: none"> • Participatory Planning and Solid Citizen-Municipal Government Relationship 	<ul style="list-style-type: none"> • Adaptive Governance & Continual Learning 	<ul style="list-style-type: none"> • Disconnect between provincial conservation statutes and policies and local livelihoods and stewardship • Lack of affordable housing and transit • Urbanization and population growth
<ul style="list-style-type: none"> • Low-impact Development • Urbanization as an Opportunity • Municipal Environmental Leadership • Provincial conservation statutes and policies 	<ul style="list-style-type: none"> • Adaptive Governance & Continual Learning • Disturbance as an Opportunity 	<ul style="list-style-type: none"> • Urbanization and population growth
<ul style="list-style-type: none"> • Diversified agricultural activities 	<ul style="list-style-type: none"> • Diversification in Agriculture 	<ul style="list-style-type: none"> • Sharp decline in agriculture
<ul style="list-style-type: none"> • Strong local civic engagement and effective volunteerism 	<ul style="list-style-type: none"> • Adaptive Governance & Continual Learning 	<ul style="list-style-type: none"> • Urbanization and population growth • Aggregates extraction

Table 13 Summary of assets, threats and emerging themes of resilience based on interview results

The first column of Table 13 presents assets for a desirable Caledon identified through the interviews (also Table 12). The second column presents an emerging theme of resilience based on the assets in the first column. These emerging themes of resilience describe features of a resilient Caledon. Where the threats can potentially be addressed by particular assets, the relevant assets are presented in the same row (Table 13). The emerging themes of resilience are adaptive governance and continual learning; diversity in agriculture; and disturbance as an

opportunity. These themes of resilience are derived from key attributes of resilience identified through the Resilience Assessment Workbook and literature review (also Section 2.4).

Adaptive Governance and Continual Learning

Interviewees, except one environmental group leader, did not name resilience directly. Most of them talked about resilience indirectly in different terms. Interview results reaffirm the importance of continual learning and adaptive governance advocated by resilience thinking (RA, 2007; Wesley, 1995; Armitage, 2005; Walker & Salt, 2006; Anderies *et al.*, 2006).

“Adaptive governance can add to adaptability of social-ecological systems. It does so by integrating different types of understanding with adaptive forms of resource management through formal and informal institutions to learn and respond” (RA, 2007: 65). Adaptive governance is conducive to increasing people’s adaptive capacity (Section 2.5), and thus, resilience (Wesley, 1995; Armitage, 2005; Walker & Salt, 2006; Anderies *et al.*, 2006).

Governance includes laws, regulations, discursive debates, protests and other decision-making processes (Lebel *et al.*, 2006). Governance includes the public, private and civil sectors (Lebel, *et al.*, 2006). Adaptive governance allows continual interactions among stakeholders facilitate social learning, and mobilize people to self-organize to innovate and solve problems (Lebel *et al.*, 2006). Hence, public participation is key to adaptive governance.

In the case of Caledon, fifteen interviewees referred to strong civic engagement and effective volunteerism as a key asset in Caledon (Chart 4). Interviewees pointed out that Caledon’s community members were willing to invest time and resources to voice their concerns and get involved in decision-making. This asset is important for adaptive governance because advocacy groups can mobilize people to self-organize and solve problems, and promote learning

among citizens and municipal staff. This is illustrated in the Rockfort Quarry case, tri-nodal strategy and other advocacy initiatives (Johnson, 2006; Markvart, 2009; Baxter *et al.*, 1999; Macaraig & Sandberg, 2007) (also Section 5.1.3). One environmental group leader (EG) 1 reflected on civic engagement and said, “An urban design factor, I think, for Caledon will build a huge degree of resilience because we will as citizens meet and self-organize ... I think resilience is a distributed informed citizen.”

This was also confirmed by municipal staff and politicians who witnessed active civic engagement in municipal planning and development (Table 12). It will require more research to find out if civic engagement tightens feedback loops between governance and social-ecological conditions. One thing certain is that active civil involvement has promoted learning across sectors and self-organization for problem-solving.

Nurturing Diversity in Agriculture

Diversity is a repeated theme in many scholarly publications on resilience thinking (Holling, 2001; Walker & Salt, 2006; Folke *et al.*, 2002). Generally, ecological resilience is enhanced by functional and response diversity (Folke *et al.*, 2002), whereas social resilience is enhanced by a diversity of institutions that help absorb disturbances, create novelty and re-organize following disturbances (Low *et al.* 2002).

Interview results indicate that agricultural diversification has enhanced social and ecological resilience in Caledon. Interviewees pointed out that some farms were able to withstand urban growth pressures by diversifying their operations to include winery, cidery and eco-tourism. Politician (PL) 4 said that,

So if you want to protect and keep agriculture going, you have to diversify. You have to become what is called near-urban agriculture. What that means is you are using the market power of the urban area to sell your products to. Therefore, people will come out to where you are, and they will pay a premium for what you produce. As long as you produce enough variety, like the winery here is.

PL4 took the author to see the Downey's farm that had switched from conventional cropping to wine-making, retail sale and recreation (Photograph 2, 3, 4 ,5).





(Photograph 2, 3, 4 ,5) Clockwise, from left to right: Downey’s farm produced its own wine; Downey’s farm winery and retail; Produce sold at Downey’s farm retail store; and Downey’s farm outdoor facilities for programs.

Municipal staff (MS) 5, environmental group leaders (EG) 3 and EG 1 used the Spirit Tree Estate Cidery as an example to illustrate that local farms preserved farmland by producing premium products such as apple cider and bakery. Diversification in agriculture has helped Caledon maintain a productive rural economy and withstand development pressures on rural landscapes. One particular challenge facing agricultural innovations is legislated restrictions (Table 11, p.121), and this will be further addressed in chapter seven.

Urbanization as an Opportunity

Resilience thinking regards disturbances as an integral part of a resilient system (Kay *et al.*, 1999; Gunderson & Holling, 2002). This is captured in the diagram of an adaptive cycle, a heuristic depiction of how a system evolves (Figure 4).

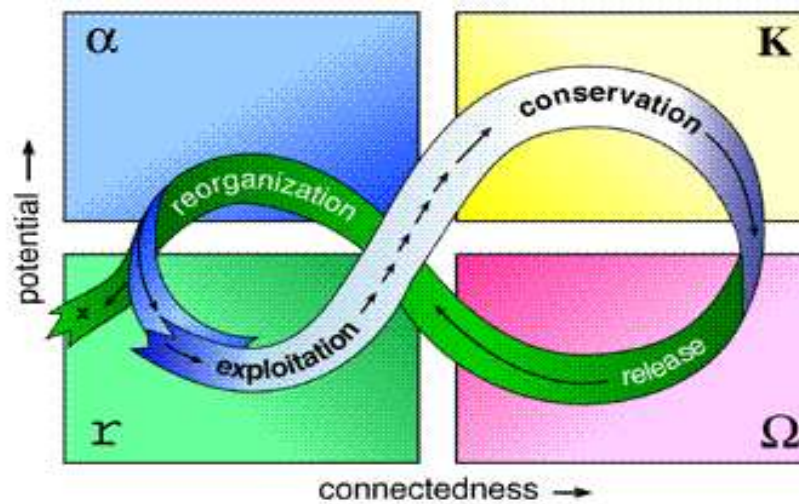


Figure 4 The four processes of an adaptive cycle of ecosystem

(Source: Gunderson & Holling, 1995: 21-22)

Resilience thinking embraces changes and disturbances to be part of a resilient system, which allow release and reorganization. Resilience thinking proposes that people should make good use of disturbances as ‘creative destruction’ to innovate and reorganize (Gunderson & Holling, 2002:45). In the case of Caledon, urban growth has been viewed by many as a negative disturbance (Stew *et al.*, 2008; Markvart, 2009; Oraclepoll, 2008). It is true that urban growth has caused many negative impacts such as the loss of farmland, water contamination and increased traffic. Nevertheless, three interviewees also saw urbanization as an opportunity. A municipal staff (MS) 3 pointed out that Caledon needed urban development to support its economy and employment. An environmental group leader (EG) 2 found that Caledon could turn threats caused by urban growth to an amazing strength when people could communicate with each other to address those threats. An individual (IN) 3 pointed out that the tri-nodal

development in Caledon could create compact and happy communities where people could live and work, and produce tax revenues for the municipality (also Table 12, p.131). These positive aspects of urban growth are opportunities for Caledon to renew and reorganize in face of changes caused by urban growth. Furthermore, eight interviewees expressed that low-impact development should be the next step that Caledon should take (Section 6.3).

6.5 An Overall Picture of Caledon Resilience

With the research results on ‘resilience of what?’ and ‘resilience to what’, the Resilience Assessment Workbook points out that researchers should use the results to “explore where and how to intervene in the system in order to enhance resilience” (RA, 2007: 70). Before recommending ways to enhance the resilience of Caledon in the context of urban growth, it is useful to analyze whether the findings about resilience based on literature review (Chapter 5) overlap with any findings based on the interviews (Chapter 6).

Themes of Resilience Based on Interview Results and a Cross-Scalar Study of Caledon

Section 5.5 has drawn five emerging themes of resilience based on a cross-scalar study of Caledon. These themes of resilience overlap with findings presented in the interview results (Section 6.4). These themes inform recommendations presented in chapter seven.

Theme 1: Continual learning is a key resilience feature

The cross-scalar study of Caledon and interview results affirm the importance of continual learning for enhancing the resilience of social-ecological systems (Lee 1993; Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006). The cross-scalar study identifies continual learning as a key resilience feature because it allows adjustment between institutional practices and social-ecological conditions (Planning and development, 2009; Planning and development,

2010; Purell; 2009; Macaraig & Sandberg, 2007; Baxter et al., 1999) (Section 5.5). This is illustrated in the tri-nodal strategy and the Rockfort quarry (also Box 6, p.78). The interview results show that promoting learning is a key asset. Fifteen interviewees raised that active civic engagement promoted continual learning about environmental and growth management issues among citizens and municipal staff in Caledon (Table 12). Eight interviewees pointed out that participatory planning promoted continual learning about planning issues between citizens and municipal staff (Table 12).

Continual learning among stakeholders is a key resilience feature (Lee 1993; Holling 2001; Walker & Salt, 2006; Anderies *et al.*, 2006). Social resilience can be enhanced through combining different knowledge systems and permitting different social actors to work in concert (Folke *et al.*, 2002; Kates *et al.*, 2001). According to interviewees, active civic engagement and participatory planning have mobilized people with knowledge and skills to solve problems (Table 12). For instance, participatory planning allows the Town of Caledon to develop the tri-nodal strategy to address urban growth pressures (Table 12).

Theme 2: Adaptive governance is a key resilience feature

The cross-scalar study and interview results affirm the importance of adaptive governance in strengthening the resilience of social-ecological systems (Armitage, 2005; Bunch, 2001; Fazey & Schultz; 2009; Folke, 2007). The cross-scalar study identifies adaptive and flexible decision-making as an important resilience feature (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006). This is illustrated in Caledon's aggregates and land use policies (Section 5.5). In the interview results, fifteen interviewees have referred to strong civic engagement and effective volunteerism as a key asset in Caledon (Chart 4). Adaptive decision-making and strong

civic engagement are the backbone of adaptive governance. This is illustrated in the Rockfort Quarry case, tri-nodal strategy and other advocacy initiatives (Johnson, 2006; Markvart, 2009; Baxter et al., 1999; Macaraig & Sandberg, 2007) (also Section 5.1.3). Public participation is crucial for adaptive government because it allows continual stakeholder interactions to facilitate social learning, as well as mobilize people to self-organize to innovate and solve problems (Lebel *et al.*, 2006).

Theme 3: Nurturing diversity in agriculture is a key resilience feature

In the cross-scalar study, nurturing diversity in agriculture is identified as a key resilience feature (also Section 5.5). Diversifying and supporting local agriculture is conducive to Caledon's resilience because it can reduce Caledon's vulnerabilities to environmental damages and social costs associated with urban sprawl (MOEI, 2010; Caledon, 2008b).

Interview results also indicate that diversifying agriculture helps Caledon absorb disturbances caused by urban growth. Eight interviewees mentioned that diversifying agriculture was an asset (Table 12). An environmental group leader (EG) 4 pointed out that a local organic farm initiative employed youth to preserve farmland, provide jobs and educate youth about environmental issues. Politician (PL) 4 used the Downey Farm as an example of agricultural diversification in Caledon. Eight interviewees stressed that diversifying agriculture was key to preserving farmland and supporting local employment under urban growth pressures.

Theme 4: A resilience asset can also be a threat to resilience

In the context of growth management, a resilience asset can also be seen as a threat to resilience. The implication of this finding is that Caledon needs to identify ways to work with resilience assets that can be regarded as threats (Chapter 7). For instance, based on the cross-

scalar study, civil groups help promote continual learning and self-organization, which address some negative impacts of urban growth (Baxter et al., 1999; Johnson, 2006; Markvart, 2009; Macaraig & Sandberg, 2007) (also Box 6, p.78). However, the actions of these civil groups in Caledon can also reduce resilience of other municipalities by pushing the problems elsewhere because of their NIMBY strategy (Chamber & Sandberg, 2007 Johnson, 2006; Macaraig & Sandberg, 2007) (also Box 6, p.78).

Furthermore, five interviewees indicated that conservation policies were an asset for Caledon, whereas seven interviewees saw them as an impediment to environmental innovations and agricultural diversification (Table 12). Thus, it is important for Caledon to identify how to work with assets that could also threaten resilience. This will be further elaborated in chapter seven.

Theme 5: Resilience of a focal system is influenced by other scales

The cross-scalar study shows that Caledon has been heavily influenced by policies on the larger scales. Regional and provincial policies affect the Town's planning, economic development, land use and aggregates extraction practices (also Section 5.1). In the interview results, thirteen interviewees referred to provincial policies as a major influence behind much municipal planning. A municipal staff (MS) 5 mentioned that, "that's the main controlling factor. The policies are from the provincial level. It's the Greenbelt Plan, Niagara Escarpment Plan, the Oak Ridges Moraine..." MS 2 pointed out that, "Well, the White Belt that has been established by the provincial government will certainly be bringing a lot more industrial development." The interviews also reveal that the loss of family farming has to do with provincial growth policies and the global economy. In a nutshell, resilience of Caledon is being influenced by policies on

larger scales. Recommendations for enhancing Caledon's resilience take into account such cross-scalar dynamics (Chapter 7).

Theme 6: Urbanization as an opportunity

The cross-scalar study and interview results confirm the importance of treating disturbances as opportunities for learning and renewals (Gunderson & Holling, 2002; Kay *et al.*, 1999). The cross-scalar study (Chapter 5) associates urban growth with threats to resilience. For instance, urbanization has been regarded as a threat to Caledon's resilience because it cause deteriorations of the watersheds (CVC, 2007; TRCA, 2008a) (Box 8, p.84). On the other hand, the interview results show that urbanization can also provide an opportunity for Caledon to renew and reorganize in face of disturbances caused by urban growth (Table 12).

Resilience thinking embraces changes and disturbance to be part of a resilient system, which allows release and reorganization. It proposes that people should make good use of disturbances as 'creative destruction' to innovate and reorganize (Gunderson & Holling, 2002:45). Three interviewees raised positive aspects of urban growth for Caledon to renew and reorganize its community in face of changes (Table 12).

Theme 7: A clash of values

Studying Caledon as a linked social-ecological system in the context of urban growth reveals that it is not a clear battle between 'bad urban pressures' and 'good rural municipality'. Urban growth involves multiple parties and levels of government. The debate around urban growth represents a clash of values and expectations of what a desirable community should be. It has been mentioned in section 4.2.2 that Caledon is characterized by conflicting interests among

different groups including Conservation Authorities, municipal staff, private developers, farmers and environmentalists. A number of interviewees named this clash of values in different ways.

An environmental group leader (EG) 5 said that, "...and that's a real, real problem for Caledon. We are stuck in the middle of really strong, conflicting interests and strong lobby groups." EG2 raised that, "I don't think people know why they think growth is bad. I really don't. Is it a fear of their value system being invalidated by another value system?" Politician (PL) 5 observed that, "They have a typical right wing conservative, entrepreneurial farmer, is going to have an ideology, he basically says get off my back. I own this and I know what's happening in here. You won't decide. Then you get the people who are sort on the left side who are very strongly pro-environment people."

A municipal staff (MS) 6 said that, "You know there are many people who resist growth in Caledon, just want Caledon to stay as small, rural municipality. And that's why they chose to live there. You know, there are people on the other side of that, who have the interest of seeing Caledon to grow for various reasons." Individual (IN) 6, who has lived in Caledon for more than 60 years, said, "... it's a just a question of takeover by the developers to make another Brampton with so many houses along the street. Should we do that? Or shouldn't we? Well, I think it's all according to what you like."

These statements reveal a clash of values in Caledon: whether to remain rural and sparsely populated, or to become more urbanized, or to embrace a mixture of both. It is not the aim of this research to answer this question. Rather, it aims to reveal values about a desirable Caledon (Section 6.1), which helps answer the questions of 'resilience of what?' (i.e. a desirable

focal system); ‘resilience to what?’ (i.e. threats to resilience) and ‘resilience with what?’ (i.e. assets for resilience).

By developing emerging themes of resilience based on the cross-scalar study of Caledon (Chapter 5) and community interviews (Chapter 6), recommendations for Caledon to enhance its long-term resilience in the context of urban growth are created (Chapter 7).

Chapter 7. Recommendations for Caledon

The following recommendations are guided by section 5 of the Resilience Assessment Workbook to develop “a list of high-priority interventions” (RA, 2007: 70). Recommendations are informed by the cross-scalar study of Caledon (Chapter 5) and interview results (Chapter 6). In addition, the interview results and themes of resilience have been emailed to interviewees for comments. The following comments are relevant to politicians, municipal staff, citizens groups and the general public.

Recommendation 1 – Promote Continual Learning in Caledon’s Official Plan Implementation

This recommendation corresponds to theme 1 presented in section 6.5. The cross-scalar study and interview results illustrate that continual learning among citizens and municipal staff in Caledon have played a significant role in adjusting institutional policies and practices to social-ecological conditions (Sections 5.5 and 6.5). This is illustrated in the tri-nodal strategy, the Rockfort Quarry case and Caledon planning (Section 5.1.3).

The goal of continual learning in Caledon, from a resilience perspective, should aim to tighten feedback loops between social-ecological conditions and institutional practice (Folke *et al.*, 2003; Walker & Salt, 2006; RA, 2007). In order to achieve this, Caledon can first launch a continuing learning project in areas where civic engagement has already took root. In the context of growth management, a priority area is the tri-nodal strategy outlined in the Official Plan (Table 12 and Section 5.1.3). The Caledon Environmental Advisory Committee (CEAC), a group made up of citizens, has participated in the development of the tri-nodal strategy (CEAC, 2004).

Continual learning projects can be applied in the implementation of Caledon's Official Plan policies related to stewardship of resources, land use, agriculture, aggregate operations and local economic development (Town of Caledon, 2008c). Continual learning projects need to involve municipal staff, CEAC, environmental groups, Conservation Authorities, landowners, residents, businesses representatives and farmers.

Specific working groups can be formed to run the continual learning projects. Working groups can create indicators to monitor specific areas of the Official Plan implementation and their effectiveness in moving Caledon to become desirable and resilient. Section 5.1 has presented community members' view of a desirable Caledon. Also, sections 5.4 and 5.5 have presented resilience features of Caledon. These research results can inform the continual learning project participants about what information should be collected and what indicators should be developed.

Based on research results about a desirable Caledon, information and indicators should be established for the quality and quantity of natural landscape and heritage; the degree of engaged citizenship; and Caledon's rural character with urban benefits (also Section 5.1). Based on research results about the resilience features of Caledon, there is also a need for indicators about the diversity of agriculture, in addition to the abilities of individuals to learn and re-evaluate the tri-nodal strategy (also Section 5.5).

Recommendation 2 – Adaptive Governance through an Accessible Communication Platform

This recommendation corresponds to theme 2 presented in section 6.5. Adaptive governance is a resilience feature of Caledon (also Sections 4.5 and 5.5.1) because it enhances

the capacity of social-ecological systems to adapt and renew in face of changes by pushing individuals and institutions to learn and respond (Wesley, 1995; Armitage, 2005; Walker & Salt, 2006; Anderies *et al.*, 2006; RA, 2007). This is illustrated in Caledon's aggregates prioritization policy, Rockfort Quarry case and tri-nodal strategy (Johnson, 2006; Markvart, 2009; Baxter *et al.*, 1999; Macaraig & Sandberg, 2007) (also Section 5.1.3).

The goal of adaptive governance, from a resilience perspective, should aim to promote continual learning and experimentation to maintain the resilience of a system (Holling 2001; Folke *et al.*, 2002; Walker & Salt, 2006). In order to achieve this, Caledon needs to develop an accessible communication platform that allows effective communication among the governmental, non-governmental and private sectors. Interviewees pointed out the problem of a lack of communication platform. A municipal staff (MS) 1 highlighted that,

civic engagement will always be strong when threats are real and apparent. The challenge is to create forums of engagement before threats appear. Official plan reviews need to be simplified to encourage broader engagement. Community based strategic planning needs to be an ongoing activity. Outreach needs to go beyond traditional engagement, discussion papers and public meetings. Social media should be used as an ongoing dialogue on civic design.

An environmental group leader (EG) 5 observed that, "Caledon will build a huge degree of resilience because we will as citizens meet and self-organize. And that's where you communicate..." EG 5 added that, "... electronic social networking system for Caledon I think is going to be really important... Because right now, the newspaper is the mechanism. And the newspaper are not doing, not good quality newspaper, people don't necessarily read them."

To address this lack of communication platform, it will be highly beneficial for the Town to develop a website for Caledon community members to be informed and get involved. This website can include regular electronic newsletters, online forums and government documents about Caledon long-term planning and growth management policy. This platform should also be an interactive tool that collects citizen's input on making Caledon more resilient and desirable. This website can start by focusing on launching and recruiting for the continual learning projects (also Recommendation 1), which will strengthen learning among stakeholders, and thus, adaptive governance.

Recommendation 3 – Nurture Diversity in Agriculture

This recommendation corresponds to themes 3 and 5 presented in chapter 6.5. In face of urban growth pressures, nurturing agricultural diversity is identified as a resilience feature of Caledon (Section 6.5.1). The cross-scalar study (Section 5.3.3) and interview results (Section 6.2) also indicate that a loss of farmland is a threat to resilience. A diverse agriculture can enhance Caledon's resilience because it preserves Caledon's rural farmland and economy (also Sections 6.4 and 6.5).

The goal of a diverse agriculture in Caledon, from a resilience perspective, should aim to enhance the abilities of ecosystems to deal with disturbances such as floods and water pollution caused by urban growth (Section 5.2.2), and also the abilities of communities to maintain livelihoods in a rural economy (Section 5.3.3). In order to achieve this, Caledon needs to implement its Official Plan policy to give “first priority to agriculture and its needs within the Prime Agricultural Area, promoting value-added agriculture, farm intensification and diversification” (Mackenzie, 2008:78; Region of Peel, 2010b) (Section 5.3.3).

In spite of the municipal policy, six interviewees pointed out that provincial conservation policies such as the Oak Ridges Moraine Conservation Act and the Greenbelt Act posed obstacles to agricultural expansion and diversification (Section 6.2). Thus, the Town of Caledon needs to work with the Region of Peel and the Province to increase flexibility in provincial policies to allow agricultural diversification. One opportunity for the Town of Caledon to introduce more flexibility into the provincial policies is through the 2015 review of the Oak Ridges Moraine Conservation Act and Greenbelt Act (also Section 2.7).

Recommendation 4 – Deliver Affordable Housing and Public Transit

This recommendation corresponds to the cross-scalar study of Caledon in section 5.4 and interview results in section 6.2. It is identified that a lack of affordable housing and public transit is a threat to resilience (Sections 5.4 and 6.2). The goal of affordable housing and public transit, from a resilience perspective, should aim to support a diversity of livelihoods, especially low-income families and young entrepreneurs (Greenwood *et al.*, 2010). This can help create a diverse local economy which could withstand market shocks more effectively (Greenwood *et al.*, 2010). Affordable housing and transit linked to employment locations can also help people work and live in Caledon, which is likely to reduce environmental impacts and infrastructure costs. Moreover, when people work and live in Caledon, their commuting time will be reduced.

Two environmental group leaders (EG) expressed that commuting was one of the causes for the lack of motivation to participate in community building. Therefore, providing affordable housing and transit can help people stay in-town with more time to participate in community building. This will be conducive to adaptive governance and continual learning, which in turn nurture resilience (also Section 6.5).

In order to achieve this, the Town of Caledon needs to allocate resources and funding ahead of time for affordable housing and transit. Development charges earned from projects like the Green Development Program (Box 15, p.97) and new development in the tri-nodal areas (Tullamore, Bolton and Mayfield) (Section 5.3.3) can be used in affordable housing and transit. Another way to raise funds for affordable housing, according to a local property developer (LPD), is to reduce development charges on affordable housing in Caledon (also Section 6.2).

Recommendation 5 – Implement Urbanization in the Form of Low-Impact Development

This recommendation corresponds to the theme of urbanization as an opportunity for community development (also Section 6.3). Eight interviewees pointed out that such a development should be the next step for Caledon to take in order to preserve environmental health while allowing urban intensification (Table 12). The Credit Valley Conservation Authority and the Toronto and Region Conservation Authority have adopted low-impact development plans in Caledon (CVC, 2009b). Low-impact development is conducive to ecological resilience because it aims to reduce the vulnerabilities of watersheds and other ecosystems to pollutions and habitat degradations (CVC, 2006; CVC, 2009a) (also Section 5.2.3). Maintenance of the health of watersheds is also critical to human health, which can reduce Caledon's vulnerability to health costs associated with the degradation of watersheds (CVC, 2006). Examples of low-impact development techniques include rainwater harvesting, green roofs, vegetation maintenance and permeable pavement for storm water source prevention and control (CVC, 2009a).

The Town of Caledon can use the tri-nodal development as an opportunity to implement low-impact development with the Conservation Authorities and estate developers. These low-

impact development techniques can be integrated into the Green Development Programs (CVC, 2009a; Town of Caledon, 2010), which give discounts on development charges to developers who adopt environmental technologies (Town of Caledon, 2010) (Box 15, p.97).

Recommendation 6– Develop Trade-offs Principles for a Resilient and Desirable Caledon

This recommendation corresponds to themes 4 and 7. The cross-scalar study and interview results showed that an asset for resilience can be viewed as a threat to resilience (Section 5.5 and 6.5). For example, while some saw urbanization as a threat to a rural lifestyle, others took it as an opportunity for Caledon to implement sustainability (Table 11, p.121; Table 12, p.131). While some people regarded provincial legislation as an impediment to environmental innovations and diversified agriculture, others regarded them as a safeguard of the natural landscapes (Table 11, p.121; Table 12, p.131). Thus, it is important for Caledon community members to envision the community they want to build, and to develop trade-off principles for maximum environmental, social or/and economic benefits.

These trade-off principles will be helpful in situations where Caledon has to balance the need for urban intensification and natural conservation, or the need for aggregates extraction and watersheds protection. Trade-off principles can also help resolve people’s conflicting views on the kind of development Caledon should pursue (also Section 6.5). Some trade-off rules are presented in Appendix C. Caledon can use an electronic communication platform (also Recommendation 2) to involve the public in developing trade-off rules for a resilient and desirable Caledon.

A municipal staff (MS) 1 pointed out that,

Trade-offs of urban versus preserving the natural landscape are achievable. Engaged citizens and strong participatory planning will be essential. Southern Ontario growth is characterized as endless subdivisions...Communities can be designed to feature the natural landscape. The community development should include a purpose for the community beyond housing more people. Agriculture should have more focus to serve/be part of new communities. Higher degree of integration of urban, rural and agriculture can be achieved. A strong community engagement is necessary to make it happen.

Recommendation 7 – Develop an Integrated Resilience Plan for a Desirable Caledon

This recommendation links the previous six recommendations. This integrated plan should strive to enhance adaptive governance by involving various stakeholders to define vision, goals, implement and assess results (Recommendation 1, 2). With a clear vision, Caledon will have a greater chance to implement and monitor an effective growth management policy (CEAC, 2006; Purell, 2009). Stakeholders include businesses representatives, municipal, regional and provincial staff, Conservation Authorities, citizens, landowners and farmers.

The integrated plan for resilience should focus on core resilience features such as continual learning; tightening feedback loops between social-ecological conditions and institutional practice; nurturing diversity in agriculture; promoting affordable housing and low-impact development (Recommendations 1-5). Trade-off principles should also be part of this integrated plan for resilience (Recommendation 6). Caledon can use sustainability principles (Gibson *et al.*, 2005; Folke *et al.*, 1998) as a guide to define the desirable resilience and ways to achieve it. Relevant principles of sustainability are listed in Appendix B.

The seven recommendations presented above intend to address the threats to resilience and strengthen the assets for resilience of Caledon as a linked social-ecological system in the context of urban growth. The following chapter will present research limitations and research implications on the Resilience Assessment Workbook and resilience thinking.

Chapter 8. Conclusion

8.1 Limitations and Reflections

8.1.1 Research limitations

This research has faced limitations in conducting interviews and the cross-scalar study of Caledon. The cross-scalar study identifies potential resilience assets and threats on multiple scales in the social, ecological and economic domains (Section 5.3). However, the final analysis focuses only on the focal scale of the Town of Caledon (Section 5.4). This was due to a lack of time and research materials that were required for a cross-scale analysis. The analysis can be broadened by incorporating research results of the scales above and below the focal scale.

Furthermore, this research has tried to present what assets may address particular threats in Table 13. Yet, this research did not analyze in-depth how assets can address particular threats. That would require more studies beyond the scope of this research.

This research has also faced limitations in conducting interviews. Interviews could not be arranged with the Conservation Authorities and the Chamber of Commerce (i.e. business representatives), who were likely to hold different opinions about urban growth in Caledon. This research could have benefited from their opinions about urban growth. Hence, the interview results do not present a balanced representation of interviewees (also Section 3.3). For example, ten interviewees (out of a total of twenty-six) were involved in environmental initiatives. They were likely to have biased views about urban growth issues in Caledon. This research could have addressed potential biases by conducting surveys through random sampling. Owing to time constraints, this research chose to conduct interviews through purposive and snowball sampling (Section 3.3).

Another limitation this research has faced was that there were only two interviewees who gave feedbacks for recommendations based on the interview results. One interviewee who did not give feedbacks expressed that she was too busy to give recommendations. This research could have gathered more opinions on recommendations for Caledon to enhance resilience if more interviewees were involved.

Overall, this research is exploratory work. There are no similar case studies that have utilized the Resilience Assessment Workbook to assess resilience of a place in the context of urban growth. A major limitation this research has faced was that it had to test ways to collect and synthesize the relevant information. For example, the identification of potential resilience assets and threats through a cross-scalar study was a new approach used in this research (Chapter 5). Another new method used was that interviews were also conducted to identify resilience features (Chapter 6). A considerable amount of time was taken to design these approaches to identify areas where Caledon could enhance resilience, since the Workbook did not provide sufficient guidance on ways to identify resilience features of a system.

8.1.2 Research contributions to resilience assessment

As exploratory work, this research takes a few innovative approaches in the resilience assessment. These innovative approaches can provide insights for future resilience assessments. Firstly, this research illustrates how to expand the use of a cross-scalar study to identify potential resilience threats and assets of a focal system (Chapter 5). This can help researchers develop recommendations for social-ecological systems.

Secondly, this research identifies assets for the resilience of the Town of Caledon. Whereas the Resilience Assessment Workbook looks into what constitute threats to the resilience

of a system, it does not explicitly investigate assets of a system that can enhance its resilience. This research can provide lessons for researchers to identify assets of a system in a resilience assessment.

Thirdly, this research incorporates an investigation of desirable characteristics of the focal system (i.e. the Town of Caledon) into the resilience assessment (Section 6.1). The purpose is to shed light on the question of ‘resilience for what?’ The Workbook lacks an elaboration on the ends of resilience (also Section 2.6). Information about a desirable Caledon helps reveal the ends of resilience by investigating what kind of a desirable social-ecological system people want to attain.

Furthermore, threats to and assets for a desirable Caledon have been analyzed in light of resilience thinking (Section 6.5). Hence, this research can provide other researchers an example of incorporating an investigation of a system’s desirable characteristics into a resilience assessment.

Fourthly, this research incorporates an identification of emerging themes of resilience into the resilience assessment of Caledon (Sections 5.5 and 6.5). The purpose is to synthesize findings based on literature review, the cross-scalar study of Caledon and interviews with community members (Chapters 4-6). It helps develop recommendations for Caledon to enrich resilience in face of urban growth pressures based on the emerging themes of resilience (Chapter 7). This research can provide other researchers an example of how to identify themes of resilience in a resilience assessment.

8.1.3 Reflections on the Resilience Assessment Workbook

Need to Address ‘Resilience with What’, ‘Resilience to What’ and ‘Resilience for What’

The Resilience Assessment Workbook is a useful tool for describing a system (i.e. resilience of what), and threats to the resilience of a system (i.e. resilience to what). The Workbook, however, does not address directly the question of ‘resilience with what?’ and ‘resilience for what?’ The Workbook should provide more guidance on identifying assets of a system that can build its resilience. It will be beneficial for the Workbook to guide researchers to investigate how assets of a system can address particular threats to the system’s resilience.

Furthermore, the Workbook lacks guidance on finding out what purposes should resilience serves. The Workbook should explicitly address normative qualities of a resilient system. Measures of normative qualities such as viable life support systems, sufficient livelihoods, accessible social services, diverse economics, democratic governance and a spirit of mutual assistance in communities (Gibson, 2006; University of Queensland & University of Southern Queensland, 2008; CRPT, 2006) can be included in the Resilience Assessment Workbook. The Workbook can integrate normative qualities of other resilience assessment tools (University of Queensland & University of Southern Queensland, 2008; CRPT, 2006; Walker *et al.*, 2010) into the Resilience Assessment Workbook.

Need to Accommodate Place-based Issues

One of the goals of the Resilience Assessment Workbook is to assist people to understand and manage a social-ecological system. In practice, it has been difficult to apply the Workbook to Caledon in a place-based manner. The case studies used in the Workbook such as Great Barrier Reef, Grand Canyon, and the Everglades revolve around a specific resource (RA, 2007). The case studies assess the resilience of systems in relation to the exploitation of a resource (RA,

2007). In contrast, this research aims to assess the resilience of Caledon in relation to multiple urban growth issues ranging from conservation, agriculture to land use. It will be beneficial if the Workbook gives some place-based examples that revolve around multiple issues regarding the resilience of a social-ecological system.

Resource-based case studies in the Workbook show that researchers are able to quantify a system's threshold and determine its desirable states (RA, 2007). But in this research, it has been difficult to determine the population density that represents a critical threshold. Instead of asking what density level might push Caledon beyond its current state, the question that arose was: 'How is this density going to be allocated so that the ecosystem and social system can remain in a desirable state?' The most meaningful aspect to this research has not been about finding out quantifiable thresholds, but rather diverse points of view on urban growth, its costs and benefits in light of resilience thinking.

Need to Synthesize Information about Social, Ecological and Economic Resilience

One major assessment component in the Resilience Assessment Workbook is the cross-scalar study. The Workbook guides researchers to assess resilience of the focal system across scales in its social, ecological and economic domains. However, it does not guide researchers to synthesize the information about social, ecological and economic resilience in the cross-scale study.

This research has faced a great challenge in connecting information about social, ecological and economic resilience based on the cross-scalar study (Chapter 5). For instance, how does continual learning promoted by civil groups in Caledon (i.e. social resilience) affect the prospect of adaptive environmental management (i.e. ecological resilience) (Sections 5.1.2

and 5.2.2)? How does local economic development (i.e. economic resilience) (Section 5.3.3) affect the resilience of Caledon's ecosystems (Section 5.2.3)? In particular, the Workbook lacks an elaboration on economic resilience, where researchers should learn to look for various aspects of an economy when conducting a resilience assessment. The Workbook should have outlined economic factors that a resilience assessment should take into consideration, such as employment rate, types of industries and income levels.

8.1.4 Reflections on resilience thinking

The role of Economic, Ecological and Social Resilience

Social resilience does not necessarily promote economic or ecological resilience, and vice versa. It is premature to assume that making social system more adaptive will automatically improve resilience of ecosystems (Folke, 2007). In the case of Caledon, it will require long-term integrated plan (i.e. Recommendation 7) to assess if an increase in human adaptive capacity improves resilience of ecosystems.

Furthermore, a number of studies have developed a fair amount of understanding of ecological resilience and social resilience (Gunderson *et al.*, 1995; Folke *et al.*, 2002; Folke *et al.*, 2003; Holling & Gunderson, 2002; Anderies *et al.*, 2006). But there remains a lack of theoretical understanding of the role of economic resilience in social-ecological systems. It will be highly beneficial if the field of resilience thinking develops on ideas of economic resilience from other academic fields. Studies on economic resilience such as *Building Resilience in Rural Communities* (University of Queensland & University of Southern Queensland, 2008), *Defining and measuring economic resilience to disasters* (Rose, 2004) and *Incorporating Resilience in the Assessment of Inclusive Wealth* (Walker *et al.*, 2010) (also Section 2.6) can provide information for economic analysis in the Resilience Assessment Workbook. These studies show that

economic information such as productivity, income levels, pricing of natural resources and the diversity of industries can be part of a resilience assessment (University of Queensland & University of Southern Queensland, 2008; Rose, 2004; Walker *et al.*, 2010).

In the case of Caledon, local economic development programs such as Discover Caledon and Green Development Program have played a role in Caledon's economic resilience (Section 5.3.3). One relevant study this research has used was *Economic Resiliency in Caledon: A Community Perspective* (Greenwood *et al.*, 2010). Other than this document, this research faced difficulty in selecting relevant literature to conduct an assessment of Caledon's resilience in its economic domain.

General Resilience versus Specific Resilience

The question of general resilience versus specific resilience needs to be addressed. This is illustrated in the case of NIMBY strategy employed by many civil groups on the focal scale (also Section 5.1.3). There are two questions here. First, how do we define and judge the kind of resilience (social/ecological/economic/social-ecological) to pursue? Second, how do we determine scale on which resilience should be pursued (one/multiple scales)?

Being aware of the scale of resilience is important because the enhancement of resilience of a focal system may reduce resilience of the system on another scale. Resilience practitioners should be aware that working on a focal system tends to optimize specific resilience of a focal system, and yet, it may reduce general resilience (Walker & Salt, 2006). The difference between specific resilience and general resilience is that the former refers to a system's ability to withstand predictable shocks, while the later refers to a system's capacity to withstand unforeseen disturbances (Walker & Salt, 2006).

Johnson (2006) and Macaraig & Sandberg (2007) have characterized local resistance in Caledon as NIMBY. This strategy has been successful in blocking environmentally destructive activities such as landfills and the Rockford Quarry (Baxter *et al.*, 1999; Ontario Municipal Board, 2010). Nevertheless, NIMBY may move local environmental impacts to other places, reducing options for other municipalities and towns.

Though NIMBY strategy tends not to focus on the broader issues (such as development policies, aggregates policies), one can argue based on resilience thinking, that revolts from small scales can trigger transformation of the bigger social-ecological system, moving it to a more desirable social-ecological state (also Section 2.3). For instance, local efforts in Caledon to restrict quarries may provide lessons for other municipalities to push for broader policy changes in aggregates mining.

The relationship between general and specific resilience needs more clarification, especially as to how they can be reconciled. How to increase specific resilience of the focal system, without losing general resilience of the bigger social-ecological system, continues to challenge resilience thinking practitioners. Resilience scholars have advised that it may be desirable to break constraints from the scale above and allow room for innovation and change from the scale below (RA, 2007). Being able to detect when the larger scale is over-imposing constraints on the focal system, or when the local will bring proper sources of novelty to the focal system, can be crucial to reconciling general and specific resilience.

8.2 Research Conclusion and Future Directions

The application of Resilience Assessment Workbook in the case study of Caledon has been an attempt to explore the questions of ‘resilience of what’, ‘resilience to what’ and

‘resilience with what’ for the Town of Caledon in the context of urban growth. The overall objective is to identify ways for Caledon to enhance its resilience as a social-ecological system in face of changes caused by urban growth. ‘Resilience of what’ describes Caledon as an integrated social-ecological system being shaped by its people, biophysical features, history, cross-scalar activities and dominant structuring variables (Chapter 4). In-depth descriptions of Caledon are also drawn from interview results which describe features of a desirable Caledon (Chapter 5). ‘Resilience to what’ describes negative changes caused to communities and the environment in Caledon by urban growth. These negative changes are presented as threats to Caledon’s resilience (Chapters 5 and 6). ‘Resilience with what’ describes the assets Caledon can build on to maintain and enhance its resilience when dealing with changes caused by urban growth (Chapters 5 and 6). This research has used a cross-scalar study and interviews with community members to identify resilience threats and assets of Caledon in the context of urban growth. The idea of a desirable Caledon has been integrated into the analysis threats and assets of Caledon’s resilience (Section 3.3 and Chapter 6).

Themes of resilience have been developed based on the cross-scalar study and interview results (Sections 5.5 and 6.5). An overall picture of Caledon’s resilience has been summarized based on these themes in section 6.5. It consists of seven themes that reaffirm the importance of continual learning, adaptive governance and diversity in enhancing resilience of a social-ecological system (Section 6.5). The themes also affirm the importance of understanding cross-scalar dynamics and treating disturbances as opportunities for renewals and re-organizations of social-ecological systems. Based on these themes, this research presented seven recommendations for Caledon (Chapter 7).

In response to continual learning as a key resilience feature, findings of this research recommend that Caledon launch pilot continual learning projects in the Official Plan implementation (i.e. Recommendation 1). The tri-nodal strategy can be an area for experimentation. The learning projects should aim at continual adjustment between institutional policies and practices to social-ecological conditions. In response to adaptive governance as a key resilience feature, findings of this research recommend that Caledon create an accessible electronic communication platform (i.e. Recommendation 2). This platform should allow stakeholders to participate in defining a vision of a resilient and desirable Caledon, as well as indicators that measure its progress.

In response to nurturing agricultural diversity, findings of this research recommend that Caledon implement its Official Plan policies to support value-added agricultural operations and increase certainty for the agricultural sector (i.e. Recommendation 3). Caledon should also influence policies on the broader scales to increase flexibility in provincial legislation, in order to support the diversification of agriculture. In response to a lack of affordable housing and transit, findings of this research recommend the delivery of affordable housing and transit (i.e. Recommendation 4). Options for achieving this include reducing development charges on affordable housing and diverting revenues from new local economic development to fund affordable housing. In response to the theme of ‘urbanization as an opportunity’, the findings of this research recommend low-impact development (i.e. Recommendation 5).

In response to the themes of ‘a resilience asset could also be a threat’ and ‘a clash of values’, the findings of this research recommend that Caledon develop trade-off principles (i.e. Recommendation 6). These trade-off principles should assist Caledon community members to

identify priority areas and rules to make decisions in difficult situations such as reconciling the needs for conservation and urban intensification. The goal should aim at maximizing social, economic and environmental benefits. To coordinate the implementation of recommendations 1-6, findings of this research propose the creation of an integrated plan for a resilient and desirable Caledon (i.e. Recommendation 7). The integrated plan should focus on core resilience features such as continual learning; tightening feedback loops between social-ecological conditions and institutional practice; nurturing diversity in agriculture; providing affordable housing and low-impact development (Recommendations 1-5). Trade-off principles should be part of this integrated plan for resilience (Recommendation 6). The development of trade-off principles may involve using principles of sustainability (Appendix C) and identifying desirable resilience features for Caledon. It is noteworthy that, based on resilience thinking, the capacity for learning, adaptation and self-organization is an essential sustainability feature (Berkes *et al.*, 2003). Caledon's ability to adapt to changes, innovate and use disturbances as opportunities will be crucial for it to avoid shocks caused by urban growth and remain in a desirable state.

In conclusion, this research provides a case study of resilience assessment of a municipality as a linked social-ecological system in the context of urban growth in southern Ontario. Future research direction for the Resilience Assessment Workbook and resilience thinking has been highlighted (Chapter 7). In regards to the Workbook, it can be enriched by providing methods and case studies of place-based resilience assessment that examine multiple issues. It can also be improved by giving guidance on how to synthesize information of the cross-scalar study (also Section 8.1.3). The Workbook can be improved by addressing the questions of 'resilience with what' and 'resilience for what'. In regards to resilience thinking, this research has shown two challenges for resilience thinking researchers. Firstly, researchers

need to develop ways to synthesize information about ecological, social and economic resilience. In particular, resilience thinking researchers need to explore the role of economic resilience in the resilience of social-ecological systems. One key question is how ecological, social and economic resilience can be enhanced simultaneously. Secondly, researchers have to clarify and reconcile general resilience and specific resilience (Section 8.1.3). In practice, researchers may need to develop trade-off principles between general resilience and specific resilience. Lastly, it will be beneficial for future resilience research to integrate sustainability principles into the development and implementation of resilience plans (see Appendix B). Sustainability principles can guide resilience practitioners to find out what kind of resilience is desirable, for whom and towards what purposes resilience is to be nurtured.

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Appendix A. Panarchy – A Heuristic Framework

The earlier view of nature and society as systems near equilibrium is being replaced by a view that emphasizes possibilities of multiple equilibriums, non-linear relations and cross-scale interactions in complex systems (Folke *et al.*, 2002; Gunderson & Holling, 2002). Complex systems are self-organizing. Panarchy is a heuristic tool that helps people see complex systems self-organize as nested adaptive cycles. Nested adaptive cycles are processes of growth, conservation, release and re-organization (Gunderson & Holling, 2002).

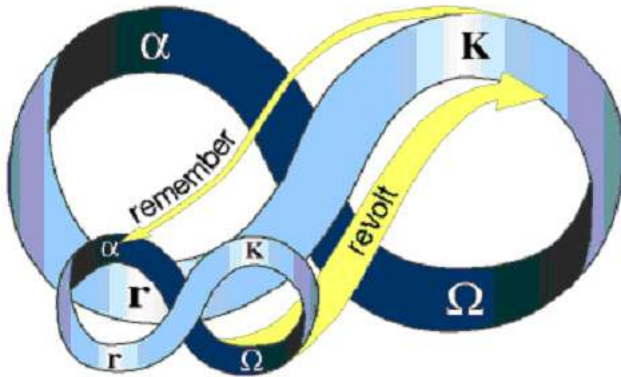


Diagram of adaptive cycles

Source: RA (2010).

For example, seedlings grow from trees into a patch from the process of exploitation to conservation. When a patch becomes mature, connectedness and stored energy increases. Thus, it is vulnerable to disturbances such as pest, storm and fire (Gunderson *et al.*, 1995). When there is a fire or pest outbreak, stored energy will be released back to the soil and the phase of reorganization will take place as different plant species take advantage of the space and released nutrients to grow.

In complex socio-ecological systems, the state of the systems are defined by interactions of nested adaptive cycles across temporal, spatial and organizational scales. On the larger scales (over a longer period of time/over a larger space/ in a larger organization), adaptive cycles generally maintain system stability by constraining the smaller and faster cycles, and conserving memory of past successful experiments (Gotts, N. M. 2007; Holling, 2001; RA, 2010). On the smaller scales, adaptive cycles generally provide novelty, especially during processes of release.

A significance of the heuristic framework of Panarchy is that policy-makers need not fear disturbances, and can treat them as creative destruction. Crises can provide opportunities for people to use new ways to reorganize social and ecological activities. Another significance of the heuristic framework of Panarchy is that it clarifies the meaning of sustainable development. Sustainability is the capacity to create, test and maintain adaptive capability, whereas

development is the process of creating, testing and maintaining opportunity in complex systems (RA ,2007).

Appendix B. Sustainability Principles Related to Social-Ecological Systems

Socio-ecological system integrity (Gibson, 2006)

- Build the integrity of social-ecological systems by maintaining the diversity, accountability required for adaptive adjustment
- Reduce human threats to system integrity and life support viability

Livelihood sufficiency and opportunity (Gibson, 2006)

- Ensure provision of key prerequisites for a decent life without compromising future generations' possibilities for sufficiency and opportunity

Intra-generational equity (Gibson, 2006)

- Reduce gaps between advantaged and disadvantaged groups

Inter-generational equity (Gibson, 2006)

- Favour actions that enhance the opportunities and capabilities of future generations to live sustainably.

Promote democratic governance (Gibson, 2006)

- Build the capacity and motivation for effective involvements of individuals and decision-making bodies in implementing sustainability through informed deliberations, reciprocal awareness and collective responsibility

Resource maintenance and efficiency (Gibson, 2006)

- Avoid waste and reduce overall material and energy use per unit of benefit

Manage ecological processes at multiple scales (Folke *et al.*, 1998)

- Detect changes in slow-changing structuring variables such as soil properties and hydrology
- Observe adaptive cycles and cross-scalar activities

Accumulate and transmit local ecological knowledge to guide management (Folke *et al.*, 1998)

- People such as farmers and fishermen possess on-the-ground knowledge about the subtle dynamics and variability in biotic and abiotic features and processes
- Use the on-the-ground knowledge to guide management

Promote self-organization and institutional learning (Folke *et al.*, 1998)

- Flexible institutions incorporate local ecological knowledge, anticipate surprises and respond to ecological changes.

Appendix C Trade-off Rules

1. Maximum net gains

Seek to attain mutually reinforcing, cumulative and lasting contributions that bring the most positive overall results in sustainability (including ecological, social and economic aspects)

2. Burden of argument on trade-off proponent

Burden of proof rests on the proponent of the trade-off who has to prove that the trade-off is unavoidable and acceptable

3. Avoidance of significant adverse effects

No trade-off that causes significant adverse effects on any sustainability areas (ecological, social, economic) can be justified unless the alternative is worse

4. Protection of the future

No displacement of a significant adverse effect on sustainability from the present to the future can be justified unless the alternative is displacement of an even more significant adverse effect

5. Open Process

Proposed trade-offs must be addressed through open involvement of all stakeholders, particularly those who will be affected by the trade-offs and proponents of sustainability.

The application of trade-off rules will differ in various circumstances and contexts. It is important to recognize the specific circumstances and priorities. In some cases, the greatest threat to sustainability is the exploitation of natural resources while in another case; a greater concern is corruption and poverty. Hence, application of sustainability “will not always lead to the same conclusions about what trade-offs should be accepted or rejected” (Gibson *et al.*, 2005: 138). For instance, it will be acceptable to allow job losses to reduce resource exploitation, but it will not be acceptable if the most poor will lose their jobs (Gibson *et al.*, 2005). Therefore, the application of sustainability and trade-offs rules must attune to local circumstances and contexts.

(Adapted from Gibson *et al.*, 2005: 122-141)

Appendix D Interview Questions

1. Are you a resident of Caledon? How long have you lived here?
2. How would you describe Caledon's physical environment and its people/community?
3. What do you appreciate most?
4. What are the threats to maintaining things you appreciate most in Caledon?
5. What are the strengths to maintaining things you appreciate most in Caledon?
6. What are the major changes you see over the years in the community and the environment of Caledon?
7. What are the major changes you see in Caledon's economy over the years?
8. How do people in Caledon respond to development pressures?
9. How do people in Caledon respond to conservation pressures?
10. What other sources (documents, people, etc.) should I enquire?