ABSTRACT


Chelsey Trendle
University of Guelph, 2016

Advisor: Dr. Karen Landman

Ecological design projects face many challenges in intensively modified landscapes that threaten the long-term integrity of natural systems. Intensification of surrounding land uses and increasing recreational pressures present numerous obstacles for conservation land managers. This research investigates the existing land management strategies of public and private agencies in Southern Ontario. The goal is to determine how adaptive management and ecological design principles contribute to the long-term success of conservation and habitat enhancement projects in intensively modified landscapes. Six case studies form the basis of this investigation; a review of existing management plans and semi-structured interviews inform a comparative analysis of current land management regimes. Results are used to determine how metrics for land management, informed by ecological design goals, contribute to the adaptive management process and the ability of landscape architects to achieve long-term success in their ecological design projects.

Keywords: adaptive management, ecological design, ecological landscapes, land management, conservation
Acknowledgements

First and foremost I would like to thank my advisor, Dr. Karen Landman, for her guidance, patience, and dedication throughout this process. This thesis would not have been possible without her unwavering support and encouragement. I cannot thank you enough.

I would also like to express my gratitude to my committee member, Dr. Stephen Murphy, and to my key informants for their valued contributions to this research.

Finally, a special thank you to my friends and family for always believing in me. Your love and encouragement has helped me get to where I am today, and continues to motivate me to pursue my passions.
### Table of Contents

Abstract ................................................................................................................................. iii

Acknowledgements ........................................................................................................... iii

List of Figures ...................................................................................................................... vi

List of Tables ....................................................................................................................... vi

Chapter 1  Introduction ........................................................................................................ 1
  Purpose ............................................................................................................................... 3
  Thesis Structure .................................................................................................................. 4

Chapter 2  Literature Review .............................................................................................. 5
  A Conservation Ethic ......................................................................................................... 5
  Modern Landscapes: The Case of Urban and Novel Ecosystems ........................................... 6
  Ecosystem Restoration, Health, and Integrity ....................................................................... 8
  Enhancing Environmental Resilience through Land Management ....................................... 9
    Integrated Land Management ......................................................................................... 11
  Socio-Ecological Systems ................................................................................................. 12
    Policy Framework .......................................................................................................... 14
  Ecological Design: Restoring ecological function and encouraging resilience ..................... 15
    Integrating Science and Design ..................................................................................... 17
  Embracing Uncertainty: An Adaptive Approach to Project Management ......................... 18
    The Process ..................................................................................................................... 20
    Types of Adaptive Management ..................................................................................... 21
    Understanding the Context .............................................................................................. 23
    Benefits ............................................................................................................................ 23
    Implementing an Adaptive Management Approach .......................................................... 24
    Challenges and Barriers .................................................................................................... 24
    Defining Success ............................................................................................................. 25

Chapter 3  Methods .............................................................................................................. 27

  Research Process .............................................................................................................. 28
  Comparative Case Studies ................................................................................................. 31
    Case Study Identification ................................................................................................. 32
    Case Study Selection Criteria ......................................................................................... 32
Document Review ................................................................................................................................. 34
Semi-Structured Questionnaire Development ......................................................................................... 34
Key Informant Interviews....................................................................................................................... 35
Data Analysis ....................................................................................................................................... 36
Recommendations ................................................................................................................................. 37
Chapter 4 Results and Analysis ............................................................................................................ 38
Comparative Case Study Analysis ......................................................................................................... 39
Private Land Holding 1: Rare Charitable Research Reserve, Indian Woods ........................................ 40
Private Land Holding 2: Ignatius Jesuit Centre, Old Growth Forest Project ........................................ 48
Municipality 1: City of London, Westminster Ponds/Pond Mills ESA ............................................... 53
Municipality 2: City of Kitchener, Huron Natural Area ........................................................................ 62
Conservation Authority 1: Toronto and Region Conservation Authority, Tommy Thompson Park ... 70
Conservation Authorities: Credit Valley Conservation, Island Lake Conservation Area ................... 77
Summary .................................................................................................................................................. 85
Chapter 5 Discussion ............................................................................................................................ 86
Lessons from the Case Studies .............................................................................................................. 90
Existing Management Strategies ........................................................................................................... 91
Public involvement ............................................................................................................................... 92
Policy Context ....................................................................................................................................... 93
Defining Ecological Success in Modified Landscapes ........................................................................ 94
Reflection on the Literature Review ..................................................................................................... 95
Reflection on Methods ........................................................................................................................... 95
Chapter 6 Conclusions .......................................................................................................................... 97
Limitations ........................................................................................................................................... 97
Implications for Landscape Architecture ............................................................................................. 98
Recommendations for Future Research ............................................................................................... 98
References ............................................................................................................................................... 100
Appendices ............................................................................................................................................ 107
Appendix I. Key Informant Participation Request Script Email ............................................................ 107
Appendix II. Key Informant Interview Questions .................................................................................. 109
List of Figures

Figure 1. Conceptual Framework for Long-Term Investigation of Socio-Ecological Systems .................................. 13
Figure 2. Analysis of Socio-Ecological Systems ........................................................................................................ 14
Figure 3. Ecological Design Framework and Project Structure .................................................................................... 17
Figure 4. The Adaptive Management Process ............................................................................................................ 21
Figure 5. Research Process ............................................................................................................................................... 31
Figure 6. Case Study Locations ...................................................................................................................................... 34

List of Tables

Table 1. Key Informant Professions ............................................................................................................................ 38
Table 2. Key Considerations Identified ....................................................................................................................... 85
Chapter 1 Introduction

Ecological design and associated land management practices face numerous challenges in an increasingly urbanized world, particularly in terms of their ability to create and/or maintain healthy ecological systems that are capable of withstanding the pressures of human-dominated landscapes, while meeting the needs of both human and wildlife communities over time. Interdisciplinary collaboration among natural and social science professionals is required to address such multi-faceted issues of the landscape. Despite traditional differences, the critical link between the realms of landscape architecture and ecology in the development and maintenance of sustainable landscapes, including advancement of conservation and habitat enhancement projects, has been increasingly recognized among researchers and within professional organizations (Green, 2013).

Urbanization and the ever-increasing prevalence of human influence has resulted in the conversion of natural landscapes into intensively modified ones: a process which has had profound influence on the structure and function of remaining natural systems (Alberti, 2005; Vitousek, Mooney, Lubchenco, & Melillo, 1997). Fragmentation, habitat loss, and reduced connectivity are associated with declining health of natural systems as a result of development in human-dominated landscapes. Thus, integration of effective conservation and habitat enhancement strategies are important to incorporate in any landscape design project and corresponding management regime. Areas in and adjacent to urban landscapes are particularly challenging in terms of effective design and management because they tend to have experienced significant modifications in the past, and long-term landscape conditions and influences may be uncertain. Improper management of existing natural areas within these complex landscapes, combined with degradation and increasing pressures for development, can ultimately threaten the long-term success of conservation and habitat enhancement initiatives. As such, the design and management of ecological projects must be approached through interdisciplinary collaboration to develop objectives that are clearly defined, sensitive to the individual context of each site, and supported by ongoing management and monitoring practices. Management strategies must also consider the unpredictable nature of the
environment, complement the conservation approaches of other authorities, and be able to adapt to the conditions of the landscape as well as the various jurisdictional and policy contexts of larger governing bodies.

In addition to challenges at a local scale, a growing consensus among scientists and researchers suggests that the world is in a time of dramatic environmental change brought about by an unprecedented rate of human intensification (Millennium Ecosystem Assessment, 2005). The population of Southern Ontario is expected to increase by 3.7 million between 2001 and 2031 (Neptis Foundation, 2014). The importance of this is increasing as the integrity of wildlife habitats and natural open spaces continue to face challenges associated with human activity. Challenges present in intensively modified landscapes, including fragmentation and habitat loss as well as the uncertainties associated with managing dynamic natural systems under such pressures, can exacerbate the potential of our landscapes and natural systems to exceed thresholds for withstanding disturbance, which can ultimately lead to environmental crises.

However, history has shown that creative solutions to complex problems are often born out of responses to such crises (Dramstad, Olson, & Foreman, 1996). Although it is easy for our perspective to be short-sighted in terms of truly understanding ecological issues and their long-term impacts on society and the state of the natural world, through scientific inquiry, as well as connection and observation of trends and patterns, it is difficult to deny the looming crises. Landscape architects are in a position to respond to these crises because of their ability to identify and synthesize social and ecological aspects that are inherently entwined in the design process. Landscape architects are trained to approach these issues from a landscape perspective, understand the various socio-ecological connections involved, and respond to landscape and ecological challenges from a place of creativity and ingenuity (Dramstad et al., 1996).

The purpose of this study is to investigate whether a trans-disciplinary adaptive management (AM) approach can assist practitioners in the establishment and maintenance of productive ecological communities in intensively modified landscapes. As the conditions of the landscape continue to evolve in response to local and global environmental challenges, landscape
architects, ecologists, and land managers have the opportunity to work together towards the
development of innovative solutions to improve the current state and long-term success of
ecological systems through effective design, conservation, and management practices. In a time
of uncertainty and looming environmental crises, it is important for landscape architects and
land managers to learn from the successes and failures of previous projects in order to establish
a precedent and improve the effectiveness of ecological design now and into the future. This
study investigates how landscape architects can learn from existing AM practices, in order to
ensure the long-term success of conservation and habitat enhancement projects beyond the
design and implementation phases, to protect and restore biodiversity in today's intensively
modified landscapes. Conservation issues and habitat enhancement initiatives have created a
greater opportunity for partnerships between the realms of landscape architecture,
conservation science, and ecology. Effective design is a fundamental component of productive
conservation and habitat enhancement projects. This notion is perhaps most commonly
reflected in the design, management, and maintenance of floristic diversity projects that
encourage the success of native species and the removal of aggressive or otherwise
unfavorable exotic species to improve habitat quality. However, the management and
restoration of habitat has had a less rigorous association with design professionals (Beardsley &
Felson, 2010). Therefore, this research seeks to determine what opportunities exist for
landscape architects to learn from the AM process, and contribute to conservation measures at
various scales. The research question for this study is how does adaptive management
contribute to the long-term success of ecological design projects in Southern Ontario?

Purpose

Provincial statutes and regulatory agencies outline objectives for land-use planning and
conservation on a landscape scale, which guide land management practices within Ontario.
However, interpretation of these objectives may vary between local land management agencies
in the pursuit of individual goals for conservation and habitat enhancement projects. This study
investigates the land management practices of six public and private agencies in Southern
Ontario and seeks to determine whether land management techniques are cohesive across
jurisdictional boundaries and how an AM approach challenges or contributes to the success of
ecological design projects on both site and landscape scales. Through an AM perspective, I explore how each agency understands and applies management techniques to their conservation and habitat enhancement projects, as well as ways in which an AM perspective is used to evaluate long-term successes and failures of such projects. Through a comparative analysis of metrics for management and monitoring employed at the case study sites, results are used to determine if an AM approach can contribute to the success of ecological design projects for conservation and habitat enhancement in intensively modified landscapes.

**Thesis Structure**

Chapter 2 focuses on the presentation of literature associated with conservation, ecological design, and AM practices. It briefly introduces the notion of a conservation ethic and the challenges associated with conservation and natural areas management in intensively modified landscapes. Principles of ecological design are discussed for their relevance to restoring healthy ecological function, and ability to integrate science and design in a landscape context. Chapter 2 also provides an overview of AM approaches to conservation and land management practice, which informs the basis of the investigations conducted herein. Chapter 3 provides a description of the research design, as well as explanation and justification of methods used: case study development, document review, and key informant interviews. Chapter 4 discusses the results and analysis of this research. Results of key-informant interviews are included, summarized and coded according to key themes and sub-themes that arose from discussions with each key-informant. Chapter 5 presents a discussion of the outcomes associated with the findings of this study in a broader context, and reflects on the methods employed and the key findings followed by recommendations to inform future ecological design projects and improve cohesiveness of local land management strategies. Finally, Chapter 6 reiterates the goals of this research and discusses the limitations of this study, the implications for landscape architecture, and well as recommendations for further research in terms of planning, design, and long-term management of conservation and habitat enhancement projects in intensively modified landscapes.
Chapter 2  Literature Review

This literature review investigates the theoretical background and evolution of conservation and land management practices, with a focus on ecological design and AM approaches as they pertain to the development and maintenance of successful conservation and habitat enhancement projects in intensively modified landscapes. The notions of ecological design and AM are products of a systems-thinking ecological approach to land management, and are in many ways complementary components of a successful conservation and habitat enhancement project. They are also necessary tools in the development of planning and management regimes aimed at fostering healthy, sustainable landscapes, and improving the state of modified lands for the long-term well being of humans, plants, and animals alike. Through this literature review, the relevance and current application of these concepts are explored in terms of public and private land management regimes in Southern Ontario. Key concepts, guidelines, and frameworks relevant to effective ecological design and AM are discussed, as well as their integration and application into local conservation and habitat enhancement projects. Opportunities and limitations to the implementation of effective AM strategies for conservation and habitat enhancement projects are also discussed, as well as strategies necessary to maximize the functional role and long-term success of natural spaces in modified landscapes. The concept of AM and associated application variances for the purposes of managing environmental conservation and habitat enhancement projects in challenging landscapes is of particular interest to this research.

A Conservation Ethic

The concept of wildlife management and conservation was developed through the game management practices of early North American settlers, when wildlife and other natural resources were perceived as abundant and common; owned by all people and managed by none (Adams & Lindsey, 2010; Adams, 1994, 2005). Inevitably, pressures of over-hunting and habitat loss lead to the extinctions of countless species, and severely declining populations of others (Adams & Lindsey, 2010). In subsequent years, this human-centered, utilitarian perception of natural resources and the focus on consumption and game management slowly gave way to a more forward-thinking approach, and the term conservation experienced a
rebirth. A growing sense of concern for the state of the environment and appreciation for the intrinsic value of the natural world arose, which called attention to the notions of preservation, management, and conservation of the environment, and ultimately lead to the development of a conservation ethic across Europe and North America (Adams, 2005). Attitudes, values, and perceptions of nature became more holistic and the ideas of ecosystem planning, conservation and wildlife ecology, and sustainable use were introduced into land management practices (Adams, 2005; Clayton & Myers, 2009). These shifting perceptions of the human-nature dynamic introduced a systems thinking approach to the realms of environmental conservation, land management, and landscape architecture through the works of historical luminaries including Aldo Leopold, Ian McHarg, Frederick Law Olmsted, and Jens Jensen. The notion of ecological design was developed and introduced into landscape planning practices in an effort to improve the human-nature connection and create healthier landscapes through the integration of science, design, and planning (Adams, 2005; Rottle & Yocom, 2010).

**Modern Landscapes: The Case of Urban and Novel Ecosystems**

Human-dominated landscapes have replaced or modified the vast majority of the world's natural ecosystems (Millennium Ecosystem Assessment, 2005). The influence of human activity and development continues to affect the health of the natural world at an unprecedented rate, resulting in significant direct and indirect impacts on ecosystems at multiple scales (Kowarik, 2013; Millennium Ecosystem Assessment, 2005). Ecological degradation, habitat loss and fragmentation, reduced number and size of natural areas, species exchange, and accelerated changes in hydrologic and soil conditions are among issues commonly associated with the human influence on the landscape (Alberti, 2005; Kowarik, 2005, 2011; Marsh, 2010). Over 50% of the global population now resides in urban areas, with further increases expected over the next several years. Urban areas have been identified as a primary driver of large-scale environmental change, causing significant alterations to landscape and climatic conditions, and placing increasing pressures on natural biological and hydrological systems (Grimm et al., 2008). The process of urbanization significantly alters the form and function of natural landscapes to better suit human communities, often at the expense of species diversity and natural processes of native ecosystems (Adams & Lindsey, 2010). Remnant or re-established natural areas and
open spaces comprise the green space systems of urban landscapes. These spaces and the connections between them provide an important ecological service for human and wildlife communities in terms of providing habitat, facilitating species flow, and providing recreational services and opportunities for people to interact with nature (Adams and Lindsey, 2010). Adams and Lindsey (2010) refer to these altered natural landscapes as urban ecosystems, shaped and influenced by human attitudes, behaviours, and socio-political processes.

Physical or ecological barriers that challenge the long-term health of urban ecosystems in intensively modified landscapes may result in the emergence of ecological processes and communities that differ fundamentally from historical systems (Kowarik, 2011). These communities are referred to in the literature as novel ecosystems or emerging ecosystems and are often attributed to direct or indirect impacts of human action. Novel ecosystems evolve from biotic responses to modification or degradation of natural areas, or abandonment of intensively managed systems, and are characterized by new combinations of species that occur in an area where they previously did not (Hobbs et al., 2006; Milton, 2003). Novel ecosystems include the notion of embracing uncertainty (Keith et al., 2011).

The impacts of urban growth amplify existing socio-ecological pressures and challenges for natural spaces within and adjacent to urban areas, which can further influence the integrity of natural systems. At the landscape scale, conversion of productive natural lands leads to habitat loss and reduced species diversity as a result of fragmentation, limited connectivity between patches, increased vulnerability of sensitive species, and reduced function of natural processes (McWilliam, Brown, Eagles, & Seasons, 2014; Millennium Ecosystem Assessment, 2005). Population growth and intensification of adjacent land uses also results in a number of local impacts to urban ecosystems and abutting natural areas. Density of urban areas and proximity of residential developments has been shown to have a number of detrimental impacts on urban ecosystems and natural spaces (McWilliam et al., 2014). Population growth results in increased demands for recreational use, which carries the associated pressures of litter, waste dumping, vandalism, ad hoc or informal trail networks not reflective of ecological design principles, and other unauthorized uses of natural spaces. Property encroachment, soil
degradation, vegetation trampling, wildlife disturbances, altered groundwater regimes, and proliferation of invasive or exotic vegetation from residential plantings are among the challenges of natural areas within human-dominated systems that must be considered and addressed by landscape planners, designers, and conservation land managers (Adams & Lindsey, 2010; McWilliam et al., 2014; McWilliam, Eagles, Seasons, & Brown, 2010).

As the dynamics of urban areas continue to intensify the complexities of the landscape, land managers must establish adaptive and cohesive strategies for conservation and habitat enhancement initiatives, recognizing humans as a primary driver of environmental change, in order to design and manage for the long-term well-being of natural systems in intensively modified landscapes.

**Ecosystem Restoration, Health, and Integrity**

Ecological health and integrity are fundamental components of conservation and restoration policy and practice (Higgs, 2003). Canada's National Parks Act defines ecological integrity as "a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes" (Government of Canada, 2017).

In the discussion of land management practices, it is important to identify the distinction between ecological health and ecological integrity, and to understand the application of each to design and management projects in intensively modified landscapes. Both ecological health and ecological integrity carry connotations of nature in an ideal state. As a result, they are often used interchangeably, but are not necessarily mutually inclusive. In *Restoring Nature's Place*, Daigle and Havinga (1996) describe a significant distinction between ecological health and ecological integrity, which ultimately states that health can exist without integrity, but integrity cannot exist without health:

Ecological integrity refers to an ecosystem's 'wholeness'. Integrity implies that all the essential elements of biodiversity, from the gene and species to the community and landscape are present, intact, and functioning as an interconnected, naturally
Evolving whole with the underlying abiotic environment. Ecological health, on the other hand, is a subset and fundamental requisite of integrity, along with resilience and the ability to continue evolving and developing naturally. Health refers to an ecosystem’s ability to thrive even in the absence of some of its parts by maintaining a measure of its optimal functioning and inherent ecological processes (Daigle & Havinga, 1996, p.31).

Although health is a somewhat objective term that may be subject to change as criteria for defining healthy ecosystems evolves over time, integrity implies an association with an original state (Higgs, 2003). Urbanization causes significant alternations to both health and integrity of natural systems. As such, this distinction is particularly relevant to conservation and restoration practices and ecological design projects in degraded or modified landscapes because it clearly expresses restoration of ecological integrity as a difficult and long-term endeavour. However, by employing informed ecological design and management practices at the site level, practitioners can contribute to higher levels of both ecological health and integrity at the landscape scale (Daigle & Havinga, 1996).

Enhancing Environmental Resilience through Land Management

The vulnerabilities of natural systems to impacts of human activity present a range of challenges towards developing landscapes that are capable of balancing the needs of both people and the environment, as well as facilitating the long-term success of conservation and habitat enhancement projects. Several approaches exist in landscape planning and management practices to mitigate the impacts of anthropogenic pressures on natural systems and enhance ecological productivity, resilience, and overall landscape quality. Understanding the spatial parameters and influences of socio-cultural processes on the landscape can facilitate increased connectivity and enhanced ecosystem health through effective design and management of natural and open spaces (Marsh, 2010). Public and stakeholder support is also a critical element of success; with the support and involvement of local communities, practitioners and land managers have the opportunity to design and manage the landscape in a way that fosters meaningful connections between citizens and nature, while also improving conservation measures for wildlife (Miller, 2005). Thus, with the necessary principles and conditions considered throughout the design and management of natural spaces in intensively
modified landscapes, these systems maintain the potential to support ecological productivity, encourage resilience, and provide a range of social and psychological benefits for people (Kowarik, 2011, 2013). In order to ensure the long-term viability of conservation initiatives, land management strategies must be well informed, integrated, and adaptable to the dynamic natural and anthropogenic conditions of the landscape.

Berkes (2004) identifies three important conceptual shifts in the evolution of landscape ecological thinking: "...a shift from reductionism to a systems view of the world, a shift to include humans in the ecosystem, and a shift from an expert-based approach to participatory conservation and management" (p.622). These fundamental shifts remain central to conservation land management today, and are reflected in the literature through the introduction of conservation management concepts including socio-ecological systems, ecosystem-based management, and integrated land management strategies (Berkes, 2004, 2012; Marsh, 2010; Olsson, Folke, & Berkes, 2004).

Landscape modification is among the most profound human influence on the natural world, yet ecological impacts were not always a priority in traditional land management decisions (Dale et al., 2000). Traditional land use regimes often inhibited natural biological processes, leading to significant landscape degradation and a number of ecological challenges including habitat loss, reduced species richness, and fewer patches of productive natural land (Kowarik, 2005; Marsh, 2010). Linear thinking, centralized governance, and a general perception of nature as a simple system often directed conventional land management practices. As such, broader consideration of external impacts on natural spaces and proper management of ecological systems for long term health were not typically incorporated into traditional land management regimes (Berkes, 2004; Dale et al., 2000). Management focused instead on maintaining control and increasing the predictability and productivity of natural systems through practices that encouraged suppression of natural variation, which we now know is quite detrimental to ecosystem process and function. The broad range of external influences and the dynamic nature of ecological systems that we recognize and understand today would have been beyond the scope of a traditional land management regime (Berkes, 2004). Practitioners eventually recognized that
environmental management issues were often too extensive to be adequately resolved through conventional management practices. This realization prompted a paradigm shift in which nature was recognized as a complex system involving the interaction of various elements and exhibiting characteristics of uncertainty, non-linearity, and self-organization. Integrative ecosystem-based management practices were emphasized and external influences on system function and resilience were acknowledged and incorporated into management practice (Berkes, 2012; Berkes, Colding, & Folke, 2003). Ecosystem-based management was introduced as a holistic approach that challenged conventional land management practices and placed significant emphasis on conservation and protection of natural systems through a process of multi-level governance and collaborative learning. This approach acknowledged the importance of considering elements such as scale and natural response times in landscape planning and management. It also emphasized broad scale systems thinking, extending beyond the realm of ecology, to consider all levels of external influence on natural processes (Berkes, 2012).

A sense of urgency is often associated with modern conservation and landscape management issues. Integration of ecological design and AM principles offers land managers the opportunity to address complex ecological issues and contribute to the development and maintenance of productive natural spaces within highly altered landscapes. Enhanced awareness of socio-cultural influences and communication of empirical knowledge among conservation land managers is a key component of effective long-term management strategies.

**Integrated Land Management**

Ecological issues are highly complex and often involve both social and natural factors. Therefore, an interdisciplinary approach that combines knowledge of both social and natural systems is necessary to establish effective AM strategies. Olsson et al. (2004) state that effective land management requires the active pursuit and integration of knowledge and understanding of dynamic ecosystem processes into management actions, as well as the flexibility to support adaptive processes and evolve with changing organizational and institutional conditions. Marsh (2010) also discusses the notion of integrated landscape management as a collaborative approach to conservation, in which all members of society are actively involved in the pursuit of ecological objectives throughout the management process.
Complexity exists not only in terms of dynamic natural processes themselves, but also in the interactions of human communities with these processes. Considering the current state of world and the degree of human impact on natural systems, it is not feasible to consider social and ecological aspects as separate entities. Successful land management must therefore consider humans as more than just external elements of natural systems, but actively incorporate these dynamic interactions into the management regime (Berkes, 2004).

**Socio-Ecological Systems**
The literature refers to the linkages and interactions between natural and human dynamics as the *socio-ecological system*; that is, the influence of ecological and human-associated drivers on ecosystem dynamics. Socio-ecological systems theory is a trans-disciplinary approach that seeks to integrate knowledge of the social and natural sciences through a multi-dimensional collaborative network of experts, institutions, and local users; it seeks to improve long-term ecosystem management through the integration of socio-political processes and various tiers of knowledge related to ecological function (Berkes, 2004; Redman, Grove, Kuby, & Kubyl, 2004).

The traditional approach to long-term ecological research recognized two classifications of variables as having distinct influence on ecosystem dynamics; ecological drivers and drivers associated with human activity. Ecological drivers include factors such as geological location, climatic variation, and hydrological process. Human-associated drivers are those directly related to human activity and include factors such as land use change and introduction of exotic species: factors known to have significant influence on ecosystem dynamics. Researchers have argued that while this traditional approach recognized the influence of both ecological and social processes, it did not accurately reflect the complexities of ongoing and variable interactions between natural and social systems. Thus, a more integrated framework was developed to unite these variables and better reflect the elements, interactions, and associated influences on long-term ecosystem dynamics as a single complex system; pictured in Figure 1 (Redman et al., 2004).
Studies presented in the literature reflect the contributions of a socio-ecological approach to improvements in long-term ecological health and conservation land management practices (Berkes, 2004; Olsson & Folke, 2001; Olsson et al., 2004). However, the degree of resilience present in socio-ecological systems determines their ability to effectively respond and adapt to ecological change. Berkes et al. (2003) describe resilience as the degree to which ecological systems can maintain stability and adapt to external conditions; a concept previously used by Holling (1973) to aid in explanations of the dynamics of complex systems. In *Navigating Socio-Ecological Systems: Building Resilience for Complexity and Change*, Berkes et al. (2003) emphasize the importance of building resilience in complex systems in order to maintain stability and enhance the overall capacity of a system to withstand dramatic or sudden change. Berkes et al. (2003) also explain that the dynamic interrelationships between disturbance, diversity, knowledge, and self-organization influence the resilience and adaptive capacity of
socio-ecological systems. These elements of change and resilience can be incorporated into the design and implementation of long-term land management strategies in order to increase system resilience to changing conditions of the landscape (Berkes et al., 2003). The linkages and complexities of dynamic socio-ecological systems are illustrated in Figure 2, a conceptual framework developed by Berkes et al. (2003).

**Figure 2. Analysis of Socio-Ecological Systems (Berkes et al. 2003, p.22)**

**Policy Framework**
A hierarchy of policies and statutes from different jurisdictional levels provide a structural framework to govern land management practices in Ontario. Policies enacted at federal, provincial, regional, and municipal levels provide guidelines for modern land management strategies. Protection of threatened or endangered species is a primary objective for local conservation and habitat enhancement initiatives, and is facilitated on both the federal and provincial levels through the Species at Risk Act (SARA) as well as the Ontario Ministry of Natural Resources legislation for the protection of at risk species. Provincial governance also includes acts and guidelines to direct land use and development, including the Conservation Authorities Act, the Planning Act, the Places to Grow Act, the Environmental Assessment Act, and Official Plans that guide the growth and development of municipalities. A number of official designations provide additional protection for ecologically sensitive or significant areas, important habitat, and conservation lands. At the local level, management activities are
influenced by municipal Official Plans as well as policies and legislation, which guide planning and development practice and protect local ecological systems.

**Ecological Design: Restoring ecological function and encouraging resilience**

The notion of ecological design has become more prominent in design and planning professions as a result of increased awareness and concern for the state of the environment. Ecological design seeks to integrate the needs of both human and non-human communities into the natural and built environment; it has contributed to the understanding and ability to address issues associated with human activity and declining ecosystem health (Rottle & Yocom, 2010). Van Der Ryn and Cowan (1996) define ecological design as:

> Any form of design that minimizes environmentally destructive impacts by integrating itself with living processes. [It] implies that the design respects species diversity, minimizes resource depletion, preserves nutrient and water cycles, maintains habitat quality, and attends to all the other preconditions of human and ecosystem health (Van Der Ryn & Cowan, 1996, p.18).

Ecological design promotes conservation, regeneration, and stewardship, and is an integral part of a responsible land management regime (Van Der Ryn & Cowan, 1996). It considers human and environmental health as mutually inclusive, and is founded on the notion of integrating the human and the natural world to create sustainable, dynamic landscapes in which all species can thrive (Rottle & Yocom, 2010; Van Der Ryn & Cowan, 1996). Although ecological design is not a new concept, it has demonstrated a strong historical presence in responsible landscape design practices, and remains an influential aspect of effective land management strategies (McHarg, 1969; Van Der Ryn & Cowan, 1996).

The ecological design concept emerges from the realm of landscape ecology, which can be defined as the study of ecological interactions and spatial patterns at a landscape scale (Dramstad et al., 1996). Landscape ecology seeks to improve the overall understanding of ecological form and function in order to enhance environmental connectivity and foster the development of resilient landscapes (Marsh, 2010). Landscape ecology sets the context for ecological systems thinking at the site scale, with principles reflected in ecological design concepts for responsible land management, including consideration of patches, edges,
corridors, and mosaics in landscape planning processes (Dramstad et al., 1996). A systems thinking approach combined with an understanding of the structure and function of natural processes and the evolution of landscape dynamics are fundamental to successful ecological design, as they influence the ability of a design to adapt to changing environmental conditions.

Ecological design draws inspiration from nature to guide development and inform solutions to complex problems. It demands a thorough understanding of the structure and function of natural systems as well as the landscape dynamics that influence the success of a project over time. The practice of ecological design extends beyond conservation and seeks to regenerate and restore the lost and degraded elements of the natural world. A multi-disciplinary, collaborative approach to land planning is used to carefully integrate complex natural processes into the built landscape. Ultimately, ecological design strives to create healthy, sustainable landscapes through integration of the environmental and cultural contexts of a landscape and seeks to enhance, rather than inhibit, natural landscape processes (Van Der Ryn & Cowan, 1996).

Figure 3 provides a framework developed by Susan Buis and Linda Krippner, included in Basics Landscape Architecture 02: Ecological Design by Rottle and Yocom (2010), which illustrates the adaptive nature of ecological design, the sequence of activities required to see a project through from its initial phases to final completion, and the iterative relationships that exist between each phase. An AM approach enhances the ecological design process by allowing landscape architects the opportunity to learn from project failures and successes in order to guide the development of future projects, and inform subsequent management processes (Rottle & Yocom, 2010).
Integrating Science and Design

Ecological design often informs interdisciplinary projects that are intended to create productive, dynamic landscapes capable of fulfilling human necessity while supporting long-term ecological health and resilience. Many foundational principles of landscape architecture are based on integrating scientific environmental knowledge with design to create spaces that support human use while also encouraging natural processes and increasing ecological integrity.

Through the integration of science and design in both theory and practice, ecological design provides practitioners with an interdisciplinary approach to understand, integrate and encourage important natural processes within the built environment, improve ecological health, and foster a greater relationship between humans and the natural world (Rottle & Yocom, 2010). Ultimately, ecological design presents an opportunity for practitioners to develop dynamic solutions to complex environmental challenges in a collaborative, informed, and multidisciplinary way (Rottle & Yocom, 2010; Van Der Ryn & Cowan, 1996).
Embracing Uncertainty: An Adaptive Approach to Project Management

Any successful design project requires a thorough management regime to ensure it remains productive and true to its original intent following implementation. Management and long-term monitoring allow practitioners the opportunity to learn from previous decisions, thereby improving overall understanding of system functions and reducing future uncertainty (Canessa et al., 2016). AM offers the opportunity to learn thorough management, with the flexibility to adjust the process over time as understanding of natural system function improves, and uncertainty is reduced. The ability to proceed with management action despite some degree of uncertainty is particularly useful within landscapes experiencing a significant rate of change as land managers often face social and political pressures to take action, in addition to sensitive ecological conditions that may require rapid response without a thorough knowledge base (Williams & Brown, 2016).

AM is a systematic approach to decision-making that encourages knowledge integration and a cycle of continual learning to improve ecological resilience based on incremental change and response of natural systems to management action (Holling, 1978). Formerly known as Adaptive Environmental Assessment and Management (AEAM), AM was developed by C.S. Holling and C.J. Walters as a structured process of informed decision-making to reduce the degree of ecological uncertainty over time through knowledge integration, monitoring, and informed adjustments to ongoing management practices (Williams & Brown, 2016; Rist, Felton, Samuelsson, Sandstrom, & Rosvall, 2013). Holling and Walters proposed the concept of AM as a way to improve conservation management practices and enhance the effectiveness of long-term decision-making processes through short-term learning (Burgman, 2005). AM is an iterative process that requires interdisciplinary research and communication among scientists, practitioners, and community stakeholders (Rist et al., 2013). Integration of management and monitoring techniques as well as community involvement is imperative to the AM process in order to reduce ecological uncertainty and improve conservation management practices over time (Canessa et al., 2016; Runge, 2011).
The AM approach was originally developed to address the challenges of fisheries management in the 1970s. Since then, it has been integrated into various facets of environmental and natural resources management (Runge, Converse, & Lyons, 2011; Walters, 1986). AM has been recognized in recent years for its relevance in addressing complex natural resource and conservation management issues, and is commonly integrated into the decision-making processes and objectives for projects on both public and private lands (Canessa et al., 2016; Ruhl, 2016). Natural resource management can be a difficult realm to navigate due to the variability inherent in ecological systems. However, the flexibility of an AM strategy provides practitioners with the ability to improve the management of dynamic natural resource systems in the long term. AM is particularly ideal if landscape conditions require structured decision-making to take place despite potentially significant uncertainties associated with management action (Runge et al., 2011; Williams, Szaro, & Shapiro, 2009).

Due to the inherent complexities of natural systems, our knowledge regarding the intricacies of system process and function remains incomplete, making accurate predictions on the long-term outcomes of management actions nearly impossible without engaging in experimental management. Therefore, uncertainty is a difficult but inherent element in any management regime associated with the maintenance, conservation, or enhancement of the natural environment (Runge et al., 2011). Uncertainty can be considered a threat to effective management due to the tension that it can elicit among stakeholders throughout the decision-making process. Tensions developed early on can be problematic for the development of management objectives as well as the ability to retain stakeholder support, and can ultimately compromise the outcome and long-term success of a management strategy. However, uncertainty is also a key component of AM, and an extremely important factor to acknowledge throughout the entire management process (Williams et al., 2009). Of particular importance to a successful AM strategy, and perhaps the greatest challenge, is the ability to identify the most important uncertainties to address in the management process. Uncertainties addressed in an AM regime must be directly relevant to predefined management objectives and must be possible to reduce over time. It is also important to consider the degree to which uncertainty reduction is possible given the resources available for implementation, monitoring, and ongoing
support (Runge et al., 2011). An AM approach forces practitioners and stakeholders to acknowledge uncertainties prior to and throughout the management process. It provides a framework to guide effective decision-making in the face of uncertainty and ultimately improves long-term outcomes of management strategies. Committed and ongoing support, patience, and flexibility of practitioners and stakeholders is required throughout the lifetime of a project in order to ensure the best possible performance of an AM management strategy (Williams et al., 2009). Furthermore, the effectiveness of an AM approach is directly influenced by the ability of decision-makers to respond quickly and efficiently to observed changes in system behaviour and, as such, may be most appropriate for addressing ecological issues at a local level.

The Process
AM is a learning cycle comprised of six stages, as illustrated in Figure 4. The cycle begins with (1) problem definition and development of specific management objectives, followed by (2) an assessment of current knowledge based on existing information and predictive models, (3) identification of uncertainty and development of hypotheses for potential management outcomes, and (4) selection and implementation of a management action. The final stages of the AM process include (5) monitoring system responses, and (6) evaluation of outcomes and management revisions based on knowledge gained. Participation of the broader social structure is central to this process and is encouraged throughout each stage of the learning cycle, including identification of uncertainties, establishment of primary management objectives, evaluation of alternative actions, as well as ongoing monitoring and decision-making throughout the lifespan of the project (Rist et al., 2013; Williams, 2011). Ongoing stakeholder involvement can manage and reduce conflict and uncertainty, encourage an atmosphere of collaborative learning, and ultimately foster a greater support for AM approaches to natural resource management issues (Rist et al., 2013).
Types of Adaptive Management

AM was founded on the notion that learning through a structured but flexible management approach can result in the reduction of uncertainty over time (Walters, 1986). An AM strategy promotes decision-making based on the pursuit of uncertainty reduction through management actions. The collaborative, social learning process and multi-dimensional decision-making approach is what distinguishes AM from traditional management approaches (Williams & Brown, 2016; Williams et al., 2009). Not only does AM encourage continual adjustments to new knowledge and outcomes of management actions, it also provides a framework to assist practitioners in identification of relevant uncertainties to address, definition of associated management objectives, and evaluation of alternative actions and resource restrictions prior to program implementation (Canessa et al., 2016; Rist et al., 2013; Williams & Brown, 2016). An AM approach is comprised of three major components: (1) a management policy to guide actions, (2) a monitoring plan to record system responses, and (3) a management system to put a plan into action (McCarthy & Possingham, 2007; Parma, 1996). Depending on context and site
objectives, an AM strategy can take on an *active* or *passive* role in land management. Both active and passive variations are based on adaptive learning, but each takes a slightly different approach to the reduction of uncertainty over time (Williams, 2011).

*Passive Adaptive Management*
An effective passive AM strategy emphasizes communication, reflection, and willingness to incorporate learning into the management regime. Implementation of specific resource objectives through traditional best management practices is the primary driver of a passive AM approach (Allan & Curtis, 2005). Learning through management action and reducing uncertainty are beneficial consequences of the decision-making process; however, this is not the primary focus of passive AM. Thus, the evolution of learning via passive AM is a gradual process and although knowledge gained from system responses is recognized and integrated into the management plan, important opportunities to accelerate learning and improve future management strategies may be overlooked (McCarthy & Possingham, 2007; Parma, 1996; Williams, 2011).

*Active Adaptive Management*
In complex disciplines such as ecological conservation and associated land management issues, immediate action is often required despite some degree of uncertainty. Active AM provides the framework necessary to address this type of urgency by embracing the complexity of natural systems, and promoting holistic thinking and collaboration in the active pursuit of learning to improve existing conditions (Allan & Curtis, 2005; McCarthy & Possingham, 2007). Active AM encourages a dynamic, interdisciplinary approach to management for the long-term. It actively seeks to reduce uncertainty through management objectives and short-term learning, anticipates potential system responses, and encourages intervention and adjustment based on observed outcomes of management actions (Canessa et al., 2016; Parma, 1996; Williams, 2011). In an active AM strategy, alternative actions to address management objectives are identified early on and may be assessed for effectiveness using conceptual models. Impacts of the broader social, environmental, and economic context are also considered in an active AM process (Burgman, 2005). Essentially, its active pursuit of learning is what differentiates an active approach to AM from a passive one. Active AM seeks to understand and evaluate the
effectiveness of a management strategy through regular performance monitoring and informed adjustments to observed system responses (McCarthy & Possingham, 2007; Walters, 1986). It builds on what is learned in order to reduce structural and epistemic uncertainty in the long term, and continually works to improve the knowledge of a system in order to improve future management practices (Runge et al., 2011). Active AM also includes the additional challenge of balancing effective management of present systems with the pursuit of learning to improve future conditions (McCarthy & Possingham, 2007).

Understanding the Context
Successful application of an AM strategy begins with an understanding of the proper context for implementation, including evaluation of the appropriateness and feasibility of an AM approach to address desired objectives (Rist et al., 2013). In order for AM to be an appropriate tool for managing a given situation, conservation and reduction of ecological uncertainty must be a primary objective; situations motivated by other factors such as the reduction of social, institutional, or political management obstacles would not be appropriate contexts for an AM strategy. It must also be plausible to reduce identified uncertainty through experimental learning. If AM is deemed an appropriate management alternative, practitioners must evaluate the feasibility of successful implementation given the social, institutional, and political context of the situation, as well as any financial or temporal challenges and resource constraints that may result in an unsuccessful outcome. Stakeholder engagement can be particularly helpful in the development of a thorough understanding of the project context at this stage of assessment. Only after these requirements are met and an AM strategy has been implemented can practitioners begin to assess performance and likelihood of long term success (Rist et al., 2013; Williams et al., 2009).

Benefits
The collaborative learning-based framework and flexible management style promoted by an AM regime is beneficial to natural resource-based projects because it encourages the continual pursuit of knowledge to enhance overall understanding of natural systems and improve future decision-making processes (Williams et al., 2009). The sense of urgency commonly associated with natural resource and conservation issues, particularly in intensively modified landscapes,
often requires immediate attention despite incomplete knowledge of system processes and response (McCarthy & Possingham, 2007). AM fosters the development of management strategies based on collaboration and communication among stakeholders and researchers. This social learning process encourages long-term stakeholder support and ultimately provides the foundation for articulating existing information to develop specific objectives, guide the decision-making process, and inform optimal management actions. The flexible nature of AM allows practitioners to evaluate the effectiveness of management actions and resource expenditures, and ultimately encourages the ongoing evolution and improvement of a management strategy (Williams et al., 2009).

Implementing an Adaptive Management Approach
Successful implementation of an AM framework requires practitioners to approach management issues from a scientific perspective, while considering the larger socio-cultural context as well as external influences that may affect system process and function. The political context of land management, constraints of available resources, and the capacity to involve and engage stakeholders throughout the management process are important considerations when implementing an AM approach (West, Schultz, & Bekessy, 2016). The following is a series of steps frequently discussed in the literature to guide AM implementation. These steps can be broken down into a two-phase learning process, the set up phase and the iterative phase, which carry a project through from planning to implementation. The set up phase involves identification and assessment of key components to facilitate the design, development, and support of an ideal management plan for a given situation. The iterative stage then incorporates structural elements and puts the plan into action. It also requires long term commitment to monitoring and ongoing adjustments to management actions as required, based on observed system responses (Canessa et al., 2016; Williams et al., 2009).

Challenges and Barriers
AM remains a well-cited concept since its introduction into the realm of natural systems management nearly four decades ago. It is frequently touted as an ideal strategy for addressing natural resource challenges in the face of ecological uncertainty. Yet the literature reveals some confusion among managers in terms of the proper context and application of AM, as well as the
true extent of success. Although AM may not be the most ideal strategy for all situations, many of the questions regarding its effectiveness can be attributed to general management issues, and are not necessarily reflective of the AM process itself (Canessa et al., 2016; Rist et al., 2013). Risk aversion, stakeholder conflict, degree of institutional stability, and lenient and unfocused attitudes among managers are examples of general management issues that could negatively influence an AM regime (Canessa et al., 2016; Rist et al., 2013; Runge et al., 2011).

AM emphasizes learning, reflection, and improvement through experimental management strategies that embrace the complexity and variability of natural systems, which can be too risk-laden and contentious for practitioners and stakeholders accustomed to more traditional, goal-oriented land management practices (Allan & Curtis, 2005). As a result, challenges to effective AM are typically associated with overcoming underlying cultural ideologies and reluctance to change, as well as inefficiencies and a lack of long-term support for ongoing maintenance and monitoring. Other impediments for effective AM can arise from conflicting land use regimes, unfocused monitoring, and inefficient data collection (Allan & Curtis, 2005; Allen & Gunderson, 2011; Moir & Block, 2001; Rist et al., 2013; Ruhl, 2016; Williams et al., 2009). The delay between action and outcome inherently associated with holistic experimentation and natural systems can be problematic in terms of resource availability and maintaining continuity as project responsibilities shift among individual decision-makers (Williams et al., 2009). The literature also suggests that the majority of AM programs are relatively short sighted and do not accurately account for the appropriate scale, long-term responses, or extent of complexities that can be associated with slower ecosystem processes (Moir & Block, 2001). Thus, the most significant challenges reflected in the literature in terms of conservation are associated with program scale, resource constraints, and inadequacies of long-term monitoring programs (Canessa et al., 2016; Moir & Block, 2001; Rist et al., 2013).

**Defining Success**

Success of an AM strategy is defined by an ability to achieve management objectives through an integrated learning-based framework and decision-making process. Williams et al. (2009) suggests that success of an AM strategy is dependent on the presence of four fundamental aspects throughout the lifespan of a project: (1) compliance with applicable legislation, (2)
ongoing and committed involvement of stakeholders, (3) ability to accomplish management objectives, and (4) collection and integration of knowledge gained to improve future management decisions. The development of strong feedback systems supported by diligent monitoring regimes, appropriately scaled programs, and consideration of long-term system responses is also important to the overall success of an AM strategy and the development of healthier landscapes (Moir & Block, 2001).

An AM approach requires stakeholders and land managers to make thoughtful, guided choices about human interaction with nature, to take responsibility for impacts, and to continue to seek ways to restore function and connectivity to highly impacted sites in order to improve the overall health of the landscape. Management protocols allow landscape architects and land managers to evaluate the success of stewardship plans and design intent through assessment of management actions over time. AM is an ideal approach to natural resource management issues related to conservation and habitat enhancement projects in intensively modified landscapes, given the challenges and uncertainties typically associated with these settings. AM is a dynamic, adaptable, guided process that forces land managers to actively improve current understandings of complex natural processes in order to reduce ecological uncertainty. AM also requires managers to acknowledge impacts and responsibility for improving conditions of the environment, as well as the state of conservation and environmental health and integrity in highly altered landscapes (Parma, 1996; Rottle & Yocom, 2011).
Chapter 3  Methods

The current landscape of Southern Ontario is an intensively modified mix of urban and agricultural land uses and irregular, fragmented patches of remnant natural land: a drastic departure from the original landscape, which once comprised roughly 90% forest cover. Rapid deforestation and urbanization transformed the land into the Southern Ontario known today as one of the most intensively modified landscapes in North America (Schmitt & Suffling, 2006). Designers and land managers for conservation and habitat enhancement projects in such intensively modified landscapes need to actively plan, manage, and adjust to challenges presented by the continued interaction of social and ecological systems. Effective planning and management of natural spaces in urban areas is continually evolving, requiring ongoing interaction and communication among scientists, land managers, landscape architects, and members of the public. The profession of landscape architecture is flexible in that practitioners may or may not be involved with both the design and management of a given site. Yet, knowledge of the anticipated management practices are a key component of effective ecological design. This led to the development of the research question: How does adaptive management contribute to the long-term success of ecological design projects in Southern Ontario? The following objectives were developed to guide the research process:

1. Determine how local agencies are applying an adaptive approach in current management and monitoring practices, and how those metrics are used to evaluate and respond to successes and/or failures;

2. Determine the methods and extent of public and professional involvement in current management processes;

3. Determine the challenges and barriers to achieving long term success for ecological design projects in intensively modified landscapes; and,

4. Establish best practices to inform design and management of ecological projects in intensively modified landscapes from an adaptive management perspective.
This chapter outlines the research strategy, including the methods of data collection selected to address the research question and guiding objectives, and provides a description of the analysis process.

**Research Process**

A literature review was conducted to guide and inform a discussion on the opportunities and limitations of an AM strategy, in terms of its ability to encourage the long-term success of ecological design projects in intensively modified landscapes. Six case studies were identified, each managed by a different land authority. Each case study was selected based on a pre-determined list of criteria developed by the researcher. Following case study selection, relevant documents related to each project including corresponding mandates, management plans, and master plans were used to further inform the research and establish a greater understanding of the context of each site, as well as the questions used to structure the key-informant interviews. A small group of professionals involved in the management of each case study project were identified and contacted for their participation in semi-structured interviews to discuss how AM is integrated into their existing management regimes, as well as the goals, objectives, and challenges that exist at each case study site. Results from key-informant interviews and document reviews were used to comparatively analyze the case studies, in order to develop a greater understanding of current public and private land management strategies. Existing mandates, management plans, and master plans were compared with information gathered through key-informant interviews to support evidence of opportunities and barriers for AM application at each land authority. The role of the public and of landscape architects within the management process of each case study was also investigated. Overall, the comparative analysis of selected case studies was used to assess whether current management practices contribute to the establishment of cohesive management plans, and ultimately determine if AM is leading to successful ecological design projects. A greater understanding of existing management practices can increase awareness of opportunities and limitations that influence the long-term success of ecological design projects among landscape architects. This knowledge can then be incorporated into the initial development phases of ecological design.
projects in intensively modified landscapes to foster a greater likelihood of success. The following steps were used to guide the research process conducted herein:

1. Conduct a literature review to develop a greater understanding of AM in the context of conservation and habitat enhancement within intensively modified landscapes;
2. Develop criteria for case study selection and identify local agencies as well as reference sites for detailed analysis;
3. Identify and contact key informants from each agency; professionals directly involved with or knowledgeable of the design, implementation, management, and monitoring of selected projects;
4. Develop a set of questions for key informants based on information gathered in both the literature and document reviews;
5. Conduct semi-structured interviews with key informants;
6. Conduct a comparative and thematic analysis of interview results to identify similarities and differences in land management strategies; and,
7. Determine how an AM strategy has contributed to the long-term success of conservation and habitat enhancement projects in Southern Ontario.

Six case studies were chosen to represent public and private land managers in Southern Ontario, each of which claims ownership and responsibility of environmentally significant properties in intensively modified landscapes, managed for public use as well as conservation and habitat enhancement purposes. The Westminster Ponds/Pond Mills ESA, the Huron Natural Area (HNA), the Leslie Street Spit/Tommy Thompson Park (TTP), and the Island Lake Conservation Area (ILCA) were selected to represent public landscapes in the context of local municipalities and conservation authorities. The responsible agencies associated with selected sites are the City of London, the City of Kitchener, the Toronto and Region Conservation Authority (TRCA), and the Credit Valley Conservation Authority (CVC), respectively. The Indian Woods Project at the Rare Charitable Research Reserve in Cambridge and the Old Growth Forest Project at the Ignatius Jesuit Centre in Guelph were selected to represent private land holdings. Ongoing ecological and stewardship initiatives, presence of sensitive landscapes,
significant habitat, and high levels of biodiversity, as well as a general proximity to expanding urban areas create a similar context in terms of conditions and challenges experienced by these two private land managers.

Although these six locations are comprised of both man-made landscapes and pre-existing natural areas, they were deemed appropriate for the case study analysis portion of this study as each contains Environmentally Significant Areas (ESAs), has experienced extensive anthropogenic influence in the past, continues to face pressures associated with expanding urban populations, and can inform ecological design practices. The current density and projected growth of these regions, as well as the presence of ESAs, and the emphasis that has been placed on conservation and natural area enhancement within these regions in recent years were also contributing factors to the selection process. Furthermore, each of the six sites selected incorporates both public use and natural regeneration in their management plan and emphasizes long term monitoring practices to ensure success of conservation and habitat enhancement areas. In selecting these sites as the basis for case study development, the researcher anticipated that "although approaches, ecosystem types, and disciplinary expertise differ among sites, conceptual similarities override differences" (Redman et al., 2004, p.162).

Key themes addressed throughout this study include management and monitoring practices, public and professional involvement, as well as challenges and limitations in regards to long-term management and monitoring of natural areas and conservation lands. The research process that guided this study is shown in Figure 5. Case study development, document review, and semi-structured interviews were the primary methods of data collection. Method selection was informed by a review of qualitative research literature, including the works of Yin (2009), Creswell (2007), Francis (2001), and Deming and Swaffield (2011).
Figure 5. Research Process

Comparative Case Studies
Case study research is an established method of qualitative data collection used across various professions to explore, evaluate, and describe theories, phenomena, and complex relationships observed in real-world situations (Creswell, 2007; Francis, 2001; Yin, 2009). Case studies are commonly used in the social and natural sciences to inform research initiatives, reduce
knowledge gaps, and provide practical opportunities to learn from existing conditions as well as improve problem-solving abilities, evaluate project success, and predict future outcomes (Francis, 2001). Francis (2001) defines case studies as "...a well-documented and systematic examination of the process, decision-making, and outcomes of a project, which is undertaken for the purpose of informing future practice, policy, theory, and/or education" (p.16). Case study research is particularly useful in understanding difficult issues associated with a real world context, which also makes them exceedingly useful in the field of landscape architecture (Francis, 2001). Deming and Swafield (2011) discuss the ways in which cross-case study investigations and analysis can contribute to advancements in landscape architectural research. The case study investigations conducted herein are comparative in order to allow systematic exploration of general land management strategies for conservation and habitat enhancement projects across selected agencies.

Federal and provincial policies govern the overall management framework of natural and open space lands in Ontario. However, the application of objectives specified by provincial frameworks may be somewhat subject to interpretation by land managers at a local scale. At the outset of this study, the researcher anticipated that individual approaches and responses to contextual pressures would differ among local agencies, and ultimately influence the cohesiveness and long-term success of conservation and habitat enhancement projects at a landscape scale. As a result, a cross-case study approach was chosen as an appropriate method of primary data collection for this research.

Case Study Identification
An internet search was conducted to identify candidate case study sites within intensively modified landscapes in Southern Ontario. Due to the existing density and anticipated growth of regional populations, a number of sites were identified as potential case study locations. The search for case study sites was narrowed through the development of selection criteria, a reduced project radius, and recommendations from local professionals.

Case Study Selection Criteria
A combination of pragmatic and substantive criteria led to the selection of six case studies within close proximity to the University of Guelph to be representative of three key land
managers: conservation authorities, municipalities, and private land holdings. Selection criteria specified that agencies selected for analysis must be responsible for conservation and habitat enhancement projects on lands that met the following requirements:

- Located in a highly-altered landscape and/or close proximity to a dense settlement;
- Accessible and part of the public domain;
- Have experienced, and be expected to continue experiencing, significant ecological challenges as a result of human activity;
- Have an existing management strategy that cites conservation or habitat enhancement as a primary goal;
- Be monitored for clear metrics on an ongoing basis, with practitioners responding to measurements of success and/or failure;
- Been active long enough for the responsible authority to have had sufficient time to gather and respond to data on the evolution of the site; and,
- Be experiencing various ongoing social and ecological management challenges.

All case study sites were located in landscapes influenced by varying degrees of human activity, and managed considerable levels of biodiversity and environmental significance despite the pressures of their surrounding land uses. Case studies representing public lands (municipalities and conservation authorities, respectively) included the Huron Natural Area (City of Kitchener), West Minster Ponds/Pond Mills (City of London), the Leslie Street Spit/TTP (Toronto Region Conservation Authority), and Island Lake Conservation Area (Credit Valley Conservation). To represent management of private land holdings, Rare Charitable Research Reserve and the Ignatius Centre's Old Growth Forest Project were selected. Case study locations within the Southern Ontario landscape are illustrated in Figure 6.
Investigations into the management regimes of each agency included exploration and review of both primary and secondary sources, including published master plans, management plans, and semi-structured interviews with key-informants.

**Document Review**
A review of background literature was conducted for each case study site. Mandates, management plans, and master plans published by each agency informed an understanding of the context and existing management practices employed at each case study location. The document review provided a general understanding of individual land management approaches to conservation and habitat enhancement projects, and was used to substantiate and provide additional support for issues highlighted in the key-informant interviews.

**Semi-Structured Questionnaire Development**
A preliminary literature review was conducted to explore the history and applications of AM, conservation science, and ecological design, with particular reference to intensively modified...
landscapes of the present day. The evolution of land management practices and the inclusion of socio-ecological systems was also explored for its relevance to current land management metrics. Research consisted primarily of peer-reviewed journal articles and books in print. Secondary sources, grey literature, and personal communications were also used to gain perspective on the relevance of this topic to ongoing discussions among professional organizations and issues experienced by current land managers.

Review of theoretical land management literature and contextual case study documents informed the development of fundamental themes and related questions to guide semi-structured interviews with key informants directly involved in the management of each case study location. Management and monitoring, public and professional involvement, and challenges and limitations were the three broad themes pulled from the literature to provide a foundational structure for questions and discussion throughout the interview process.

Question development was guided by the pursuit of a greater understanding of ways in which land managers are applying AM techniques to the various stages of conservation and habitat enhancement projects in Southern Ontario. Adaptive land management literature emphasizes systems thinking, stakeholder involvement, collaborative management, and committed monitoring practices as key elements of a successful conservation management strategy. Interview questions were designed to reflect these elements, address knowledge gaps, and help the researcher develop a thorough understanding of internal management processes and contextual conditions that may not be explicitly described in published management and master plans. Prior to each interview, published documents were reviewed once again to improve the efficiency of the interview process, and identify any additional points that may warrant further discussion during the interviews.

**Key Informant Interviews**

The process of obtaining the interest and commitment of selected key informants to participate in the interview process began with individual email requests using a prepared script, included in Appendix I. All of the email requests received positive responses and interest in the topic of
study, which resulted in interviews with each agency that had been originally identified for case study analysis.

Key informant interviews were selected as a method of primary data collection for this study based on their known ability to "yield rich and relevant data" (Deming & Swafield, 2011, p.155) through direct conversation with individuals most familiar with the topic; in this case, the management process of each authority and case study location. Interviews consisted of a set of 18 questions, included in Appendix II, and were designed to follow a semi-structured format in order to provide structure and organization for the interview questions, while allowing flexibility for topic discussions to evolve based on information specific to each individual site. Key informants were selected based on their familiarity with the management and monitoring processes of each authority.

The duration of the interviews ranged from 45-90 minutes and took place either in person or via telephone. Each interview was recorded using a hand-held audio recording device, in addition to notes taken by the researcher throughout each conversation.

**Data Analysis**

The data collected during the interview process were transcribed, compared, and analyzed through thematic analysis and coding, as described by Creswell (2009). Transcriptions of interview responses were coded to identify sub-themes within each category of discussion. Sub-themes were used to develop summary tables of key discussion points and management issues to be incorporated in the final recommendations for future ecological design projects. A cumulative analysis of the theoretical literature, background documents, and interview results was conducted upon completion of the data collection phase. Results of these analyses were used to understand how AM is understood and incorporated into the land management practices of each authority, and how such knowledge can be used to inform successful ecological design.
Recommendations
A set of best practices for landscape architects and land managers were produced to enhance the success of future ecological design projects based on the information gathered through the interview process, as well as themes, opportunities, and barriers identified in the literature.
Chapter 4  Results and Analysis

This chapter presents the results and analysis of the comparative case study investigation, including the document review and key-informant interviews, with reference to elements discussed in the background literature review. The results presented herein provide insight into how an AM approach contributes to the long-term success of ecological design projects across land management agencies in Southern Ontario. Although local agencies recognize the value of an AM approach to land management, several barriers have been identified that challenge its long-term success and may prevent ecological design projects in intensively modified landscapes from reaching their full potential.

Six case studies were developed and key-informant interviews were conducted to inform this research and resultant recommendations. To determine how an AM approach can contribute to successful ecological design projects, land managers from local conservation authorities, municipalities, and private land holdings were contacted for their participation in semi-structured interviews to discuss current land management practices. Key informants were chosen based on their involvement with ongoing land management practices, both in general and with reference to selected case study sites. As a result, the organizational roles, educational background, and professional designations held by each interviewee varied. The professional roles of each key-informant within their respective organization are outlined in Table 1.

Table 1. Key Informant Professions

<table>
<thead>
<tr>
<th>Key Informant</th>
<th>Profession</th>
</tr>
</thead>
<tbody>
<tr>
<td>KI 1</td>
<td>Planning Ecologist</td>
</tr>
<tr>
<td>KI 2</td>
<td>Old Growth Forest Project Coordinator</td>
</tr>
<tr>
<td>KI 3</td>
<td>Ecologist, Landscape Architect</td>
</tr>
<tr>
<td>KI 4</td>
<td>Natural Areas Coordinator</td>
</tr>
<tr>
<td>KI 5</td>
<td>Restoration Projects Manager (Coordination and Ecosystem Management)</td>
</tr>
<tr>
<td>KI 6</td>
<td>Conservation Lands Planner</td>
</tr>
</tbody>
</table>

Interviews were recorded, transcribed, and coded according to common themes and subthemes present in key-informant responses. The primary focus of this analysis was to learn how each agency defines and utilizes AM in their approach to land management. This was
accomplished through discussion focused on existing management and monitoring practices, methods and extent of public involvement, and the ways in which each agency addresses observed challenges that threaten long-term success of ecological projects. The results of each interview were summarized and compared to identify common challenges and best practices.

**Comparative Case Study Analysis**

This section provides a brief description of context for each agency and site referenced in the comparative case study analysis. Individual responses generated from the discussion are organized according to three primary themes: management and monitoring, public and professional involvement, and challenges and limitations. A number of subthemes were also identified within each of the three main categories. Subthemes were used to enhance the structure of interview results and provide a more accurate representation of existing land management practices and associated challenges.
**Private Land Holding 1: Rare Charitable Research Reserve, Indian Woods**

The Rare Charitable Research Reserve is a 900+ acre ecologically and culturally significant land trust situated amidst one of the fastest growing urban areas in Ontario. Its array of aquatic, terrestrial, and wetland habitats support a diverse collection of flora and fauna, including a number of recognized significant or at-risk species. The Rare property is affectionately referred to as the Green Heart of Waterloo Region due to its biodiversity and ecological significance. Its lands are located in the City of Cambridge and the Township of North Dumfries, at the confluence of two locally significant river systems. The primary goals of the Rare property focus on conservation, research, and education. Objectives include preservation, restoration, and protection of natural systems, as well as fostering community appreciation and stewardship through the promotion and facilitation of various environmental research initiatives and educational activities (Craig et. al 2014).

The rapid expansion of the Region of Waterloo and the land use change expected to occur as a result will undoubtedly influence the function and integrity of local natural systems. The impacts of urbanization have been entwined with the management practices at the Rare property since its establishment as a charitable land trust in 2001, but these pressures have begun to intensify with encroaching land uses and densification of adjacent residential areas (Craig et. al 2014). An Environmental Management Plan (EMP) was developed in 2014 to guide land management practices on the Rare lands, including ongoing restoration, monitoring, and stewardship activities, and is intended to be reviewed and updated on a 5-year basis (Craig et al., 2014). This EMP served as the primary reference document for the Rare property in this comparative analysis investigation.

Indian Woods was selected as a reference site to guide discussion of current land management practices at the Rare property. However, due to the relatively low level management requirements for the Indian Woods area and the cohesive management style applied to land management practices across the property, much of the interview with KI1 involved discussion of higher level land management practice. Results of the key-informant interview with KI1 at the Rare Charitable Research Reserve are summarized below.
KI1 Interview Results
Rare Charitable Research Reserve, Indian Woods

MANAGEMENT AND MONITORING PRACTICE

Definition of Adaptive Management

- A structured, forward-looking process: "...defining where to undergo iterations to improve the process" (KI1, 2017)

Create a Strategy: Set Goals and Establish Timelines

Existing Management Approach

- As a private land trust, Rare relies heavily on volunteer assistance and external funding, including grants and donations to support ecological initiatives, which creates a difficult atmosphere in terms of adhering to ongoing structured management processes. Despite these challenges, land managers at Rare strive to practice AM where possible
- Various ongoing issues that require an adaptive approach to resolution regardless of funding, including maintenance and removal of problematic invasive vegetation (i.e., Giant Hogweed), public waste dumping, trespassing, unauthorized activities that present public safety issues
- KI1 described current land management practice as less structured than true AM, due to the dependence on availability of external funding:
  "We come up with [a list of] what we would like to do, what needs to be done, perceived or emerging threats to a particular system...and then we attempt to secure funding to remedy those problems. If we are able to do that then great, and if not, then it has to be put off until next year...there is not nearly enough tasks that get completed unfortunately because it's hard to find the funding for all of them" (KI1, 2017)
- Employ a mandate to use land management activities as learning opportunities wherever possible (i.e., monitoring regeneration following Buckthorn removal around old-growth forest areas using established plots to assess effectiveness of methods used; As a mandated herbicide-free site, a number of alternative control methods are used and compared to assess effectiveness and determine best practices for the Rare property that could be shared with other local land managers)
- Strive to review and update the Rare Environmental Management Plan (EMP) on a 5-year basis in accordance with emerging issues and threats; current EMP was published in 2014, and is due to be reviewed, amended, and revised in 2019

Establishing Goals, Timelines, and Determining Resource Investments

- Goals, timelines, and resource allocation for research and monitoring is dictated by an established monitoring plan, which includes activities that require monitoring at pre-defined intervals that vary according to rate of observable change (i.e., butterfly, salamander, soil, lichen, and benthic invertebrate monitoring)
- The majority of research projects are conducted by external sources, often from an
academic background, including professors and graduate students. In such cases, Rare simply provides a research site, and the goals and timelines are dictated by the individual research interests; there are a number of research projects ongoing, often simultaneously

**Determining the Influence of Site Context**
- A number of challenges were noted as being associated with an urban context, including public impact and intensification of surrounding land uses
- The biggest issue related to the context of the Rare property is the public impact; Waterloo Region is among the fastest growing urban areas in Ontario. With new housing developments currently underway and ongoing intensification of existing land uses, the public impact on the Rare property is expected to increase; Many people value the recreational opportunities that the property provides. The majority of users are respectful of the property, but there are a number of ongoing negative issues associated with public impact including littering, waste dumping, dogs off-leash, trespassing in sensitive areas, and establishment of informal paths and bicycle trail networks, which causes ecological issues as well as user conflicts
- Behavioural enforcement would be useful in reducing negative impacts of public use, but is difficult because of site ownership; Police and By-law are unable or unwilling to enforce rules and regulations on private property, yet land managers at Rare do not have the resources to monitor behaviour or the authority to actively enforce regulations themselves. The notion of a potential partnership with local colleges and policing programs has been raised, but has yet to come to fruition

**Defining Success and Failure**
- Practices of defining, measuring, and responding to success or failure could be more rigorous, although there is some follow up monitoring with a lot of the invasive-control programs now (i.e., Giant Hogweed, Buckthorn, and Phragmites have follow up programs to assess removal success, monitor re-growth, count stems per square meter, etc., which was not as well monitored in previous years)
- Bird activity has always been very well monitored on the property; an active system of volunteer birders have been contributing to data sets that extend well before 2001, when Rare was established as a charitable organization
- With limited staff available in the early years, regular monitoring did not begin until roughly 2006. Since that time, the Ecological Monitoring and Assessment (EMAN) Protocol, originally developed by the federal government to establish cohesive monitoring practices, has been used to guide monitoring procedures at the Rare site. Although defunded in the 1990s, the EMAN protocol provides a guiding framework for ongoing monitoring practices
- In terms of the Indian Woods site, management and monitoring is directed at maintenance of the existing woodlot as well as restoration of adjacent forest plantations. Activities are focused on thinning and removal of diseased or hazardous trees and transplanting of seedlings from Indian Woods, with the goal of accelerating
restoration of the adjacent areas towards old-growth forest conditions

**Focus of Current Monitoring Practice**

- The primary focus of monitoring at the Rare site are elements such as butterflies, salamanders, and soil decomposition/health, etc., which occurs across the property on an annual basis.
- To maintain old growth forest conditions, there is minimal management or monitoring activity that occurs within Indian Woods; activities include only the removal of trees that present a public safety hazard, with cut trees remaining in the forest where they fall. Other activities are focused on creating and accelerating old growth forest conditions in the periphery plantations; transplanting seedlings directly from Indian Woods as well as supplemental species determined through a plant schedule of trees tolerant to Walnut and pre-existing in the area; currently there are a number of Maples, Oaks, White Pines, Ash, and Raspberry seedlings coming up in the area.
- Monitoring activities are determined primarily by areas of interest, or in response to threats or concerns of both anthropogenic or environmental impacts (i.e., management of an excessive deer population, which presents a challenge for the success of restoration planting efforts).
- The timeline for monitoring extends indefinitely, with regular activities occurring annually when possible; the recent addition of full-time monitoring staff is expected to enhance the monitoring regime. This position will be helpful in overseeing monitoring practice, identifying and expanding activities in areas of interest, compiling data and assessing historical trends to identify issues or challenges to be addressed in the next addition of the EMP.

**Responding to Observed Changes**

- The natural world moves relatively slowly, and as such the rate of response to observed change through management action is also rather slow.
- It can be somewhat project dependent. For example, assisting alvar regeneration through prescribed burning can take a number of years to progress from inception to action because such activities require managers to gather public interest, facilitate positive public relations, and acquire the necessary permits and funding, etc.

**Ensure Consistency and Commitment**

- Staff turnover is always a challenge to ensuring long-term consistency. As such, it is important to have various plans in place to guide all staff towards a common goals; an overall management plan is important, as well as various sub-plans to provide additional detail regarding specific aspects of management. For example, although it is highly dependent on the availability of funding and labour resources, an invasive management plan is used to supplement the overall EMP in terms of setting up a 5-year plan of activities that should be done.
- Weather can be a challenge as well; a difficult season of high temperatures or uncomfortable conditions can deter volunteers.
• Despite the ongoing challenges to ensuring consistency and commitment, staff try to maximize available resources and use overarching management plans to be as consistent as possible

Establish Partnerships and Learn from Others

• There is regular communication with an external advisory committee/environmental advisory committee, which is comprised of a variety of professionals and stakeholders from the surrounding community including archaeologists, representatives from the Grand River Conservation Authority (GRCA), professors and graduate students from nearby universities, as well as private consultants
• Activities are highly dependent on volunteer assistance in terms of funding, labour, and knowledge; volunteers may have a professional expertise that is particularly beneficial to an ongoing project
• Rare has various ongoing partnerships with local businesses, industries, and corporations that provide professional expertise and volunteers as well as monetary and material donations
• There are ongoing partnerships with local schools; annual service days as well as teachers who commit to student involvement and regularly volunteer to lead community interest groups
• Land managers at the Rare site reported minimal difficulty accessing expert or empirical knowledge; committed to regular monitoring and review of environmental news sites, as well as gathering knowledge of best practices for land management through professional contacts and word of mouth
• Incorporating input generated from the advisory committees as well as other interested professionals and members of government

Encourage Communication and Collaboration

• Communication and collaboration between land managers in terms of developing cohesive management plans and ensuring project success beyond site boundaries was described as in need of improvement ("spotty at best"); management interests can vary between agencies (i.e., planning vs. conservation)
• Land managers reported some interaction with local conservation authorities (i.e. the GRCA and the Upper Thames River Conservation Authority (UTRCA)), as well as occasional communication with external professionals at meetings or conferences
• The Ontario Land Trust Alliance (OLTA) attempts to bring people together through various initiatives. However, the majority of OLTA programs are on a land trust by land trust basis; funding has previously been awarded to projects on the Rare property
PUBLIC AND PROFESSIONAL INVOLVEMENT

Build Relationships

- Ongoing relationships with local businesses and community organizations that provide regular support
- The external advisory committee/environmental advisory committee fosters ongoing relationships with local professionals
- City representatives including councillors and mayors of both Cambridge and North Dumfries are generally supportive of initiatives at the Rare site; however, there are occasional challenges associated with adjacent developments. For example, the intensification of surrounding residential developments has caused a movement for additional roadways through the Rare property to alleviate traffic congestion, which demonstrates that some members of the community perceive the property as a large unused space. Similarly, a movement for installation of a cell tower in the midst of the Grassland Bird Conservation Program area was also proposed. These types of proposals require ongoing efforts from land managers in order to advocate for the environmental significance of the land, and avoid such intrusive development
- Landscape architects are involved in land management activities from time to time; currently, land managers have recruited a local landscape architect volunteer to design a rain garden system that will assist with drainage problems at the North House demonstration site. Additionally, landscape architects have also been involved with urban agricultural proposals for the Preston Flats site

Encourage Public Education and Involvement

- Volunteers and public involvement is vital to the ability of land managers to succeed in meaningful change at the Rare site; communication and volunteer coordinators are tasked with encouraging public education and involvement, including recruiting and retaining volunteers, as well as coordinating events with the local community
- A variety of community events, hikes, lectures, seed exchanges, etc. are undertaken to appeal to a wide range of people and attract community interest to the Rare site
- Many people in the area value the Rare property and defend it vigorously
- High dependence on community involvement also forces land managers to continuously find ways to adapt to a number of different public opinions
- Other advisory committees are also involved in encouraging public education and involvement, including a research advisory committee which reviews proposals and scholarships, as well as an educational advisory committee that oversees and reviews educational programming
### CHALLENGES AND LIMITATIONS

#### Public Impact: Unintended and Inappropriate Use

- Trespassing is an ongoing issue; squatters establish makeshift camps and leave large accumulations of trash and materials that present public safety hazards (i.e., syringes)
- Littering, dumping, vandalism, dogs off leash, parties and campfires, use of bikes in inappropriate areas, as well as other unauthorized activities throughout the property create management challenges from an ecological perspective, and also result in user conflicts that must be addressed; many of these issues occur on a daily basis
- Establishment of informal trail networks is also an ongoing issue and can be damaging to ecological communities and projects; land managers respond to these issues by attempting to close trails with fences or plantings. Occasionally mitigation measures are forcibly removed by users in efforts to re-establish closed trails
- Some users have a sense of entitlement to use of the property, despite its private ownership; it is difficult to change their minds and alter their behaviour
- Land managers attempt to combat these challenges through informative newsletters, experimenting with various forms of signage to communicate appropriate uses (words vs. icons), communicating with users on site when possible, employing creative measures to reduce inappropriate use (i.e., documenting ongoing issues and repeat offenders)
- In terms of including these impacts in monitoring design or investigating long-term impacts of these activities, land managers maintain that informal trail networks are either fragmenting habitat or leading to sensitive areas where public use is not allowed. They recognize that such use is undesirable from both an ecological and public use perspective, but experience difficulty in addressing and resolving ongoing issues

#### Retaining Public and Political Support

- Land management activities are particularly difficult to obtain and retain volunteer assistance for in comparison to educational or community enhancement initiatives such as the food bank gardens because it involves less appealing, more laborious work
- Differing opinions on restoration projects can present a challenge in terms of retaining support. For example, varied opinions exist among local land managers in terms of whether or not to allow natural processes of erosion to occur in stream restoration projects
- Alterations or amendments to municipal policies can indirectly present challenges to ongoing management activities. For example, the recent changes to the garbage collection regime in the Region limits residential waste pickup, and is expected to result in an increase of illegal dumping at the Rare property
- To enhance public and political support, land managers try to involve and educate the community as much as possible, explaining what initiatives are occurring as well as their importance, and why the property often perceived as a "big empty space in the middle of the city" is significant from both an ecological and social perspective
Funding and Resource Availability

- Private land holdings are constantly challenged by financial and resource constraints, which significantly influence the amount of work that land managers are able to accomplish.
- Funding is expected to continue being the number one challenge to long-term land management. Rare initiatives are not supported by government agencies or other regulatory bodies; it is funded almost entirely by grants and donations. As such, land managers continually attempt to maximize the value of monies received across various projects and initiatives on site.

Ecological Literacy

- Some members of the community do not understand the ecological and social significance of the Rare property, simply perceiving it as a large unused space. Land managers are continually battling this perception through education and awareness initiatives in an effort to improve the community perception of the site, and ensure long-term conservation of the property.
- Ecological literacy rates vary significantly among users:
  "There are people who are strongly rooted in the environment, who value the area for what it is, and understand and abide by the rules. Then there are people who are strongly rooted in the environment and believe that gives them a right to wander where they want including places that are closed to the public. There's also people who look at the area as just a public park where they can bring their dogs and their biggest concern is that we don't have washrooms on the trails. Then there's people who just don't care, who knock down gates and drive their ATVs into our fields." (KI1, 2017)
- Despite the varied degrees of awareness, those who are non-compliant with the signage and rules of the site represent only a small fraction of people, but they tend to make the most impact in terms of damages or unintended uses.
- Land managers continue to experience ongoing challenges as a result of public impacts.

Redefining 'Success'

- Land managers consider the Rare property a good example of an area managed to maintain or improve its ecosystems for long-term success, despite the challenges of its location in a region experiencing some of the most significant growth in Southern Ontario:
  "We have some ecosystems that are old growth like Indian Woods, that have never been logged and for the most part have been left alone, and we're working to improve and mange the others. I think we have a good opportunity here through the education programs and dealing with the community to really make people understand why it's important; that it's really all connected and that the human economy is a subsidiary of the environment" (KI1, 2017)
Private Land Holding 2: Ignatius Jesuit Centre, Old Growth Forest Project
The Ignatius Jesuit Centre is a religious facility located in the rural fringe landscape of Guelph, Ontario. The Centre is located on 600+ acres of land comprised of various terrestrial, aquatic, and wetland habitat types that support a number of species of flora and fauna. These lands are also protected indefinitely by a conservation easement. This landscape forms an ecologically significant corridor connecting the Ignatius lands to the Guelph Lake Conservation Area. The goals and objectives of the Ignatius Centre emphasize personal growth, community engagement, and fostering a greater connection to the natural world through various educational and ecological stewardship initiatives.

Guelph is among the numerous Southern Ontario communities anticipating significant growth in the coming years. Currently situated in the rural fringe, land managers at the Ignatius Centre are aware of the pressures increasing urbanization in the Guelph area is likely to have on the property, but have experienced relatively minimal impacts thus far. Managers remain hopeful that the visibility associated with the property’s close proximity to the urban landscape will continue to attract volunteers, increase ecological awareness, and advance its ecological initiatives. A series of plans were developed to guide land management practices on lands owned by the Ignatius Centre, including annual monitoring and management activities to facilitate the continued success of on-site ecological systems. These documents were inaccessible due to privacy constraints, and thus could not be included in the document review portion of this investigation.

The Old Growth Forest Project was of particular interest to the researcher due to its commitment to establishing old growth forest conditions across 93 acres of land, through ongoing ecological management and monitoring practices. This project is intended to enhance the landscape by providing rare old growth forest habitat, enhancing the ecological integrity of adjacent natural systems, mitigating the impacts of climate change, and providing a permanent ecological refuge for the surrounding community (Ignatius Jesuit Centre, 2017). Similarities in site conditions, goals, and land management approaches between ecological initiatives at both the Rare Charitable Research Reserve and the Ignatius Centre were noted in the case study selection process. These similarities led to the selection of The Old Growth Forest Project as the
reference site to guide the interview with KI2 in the discussion of current land management practices employed by the Ignatius Centre. Results of the key-informant interview discussing existing land management practices at the Ignatius Centre with KI2 are summarized and included below.

### KI2 Interview Results
Ignatius Jesuit Centre, Old Growth Forest Project

#### MANAGEMENT AND MONITORING

**Definition of Adaptive Management**
- "The loop of observation, reflection, and action...constantly assessing what's working, not working on many different levels. There's so many aspects that you witness in a year which then changes what you think you might do the following year...being creative with [the resources] you have" (KI2, 2017)

**Create a Strategy: Set Goals and Establish Timelines**

**Existing Management Approach**
- The current land management process at the Ignatius Centre was described as having both passive and active elements. There is a continual active pursuit of best practices and efficient techniques, including ongoing trials of various ecological approaches to land management (i.e., invasive species control without the use of herbicide, in consideration of site scale and available resources)
- Ongoing learning as a result of the environment and searching for the most effective use of resources
- The management plan for the property is reviewed and updated on an annual basis to address observed changes in the natural system. Some issues may be addressed within a shorter time frame (weeks to months) depending on the scale and degree of severity

**Establishing Goals, Timelines, and Determining Resource Investments**
- Goals and timelines are directed by the Master Plan, which guides the next 30 years of restoration work on the property
- Availability of funding and human resources have a large part in determining goals that can be accomplished in a given year

**Determining the Influence of Site Context**
- The visibility associated with being located close to an urban center was described as helpful to increasing public interest and involvement in site initiatives because people are able to see and experience the nature and biodiversity of the site. Visibility is helpful for demonstration purposes as well; land managers can demonstrate ecological restoration processes to the public in an accessible space, which can contribute to
increasing education and awareness of ecological initiatives

**Defining Success and Failure**
- Practices of defining, measuring, and responding to success or failure are determined by ongoing tracking and documentation (i.e., the number of trees planted compared to success and mortality rates, the number of people involved, hours, and budgets), as well as baseline studies (lichens, soil microbiology, etc.), which provide a sense of the effectiveness of restoration techniques in comparison to pre-conditions, and also contribute to the development data sets that can be used in determining success and failure of future initiatives

**Focus of Monitoring Practice**
- Ecological monitoring has been ongoing since 2014 and measured on an annual basis. Focus is primarily geared towards tree survival rates and invasive species management
- Timeline development is dependent on the subject of monitoring. Typically monitoring projects are revisited within the year, but land managers acknowledge that due to the varied response rate of natural systems additional time may be required; The nature of the Old Growth Forest Project requires monitoring to extend 500 years into the future; a lengthy time frame that is supported by the conservation easement recently established on the property

**Responding to Observed Changes**
- Observed changes are typically addressed through management action within the growing season to improve conditions for the following year. In some cases, observed changes may be revisited within a couple weeks, where possible

**Ensure Consistency and Commitment**
- The Master Plan for the property was established through partnerships with industry experts. It defines restoration goals and sets the project directions and timelines. Although the work that can be done is highly dependent on funding and availability of human resources, the Master Plan highlights best management practices for invasive species control and restoration initiatives, and also encourages annual updates and amendments according to progress as well as observed changes among natural systems
- Ensuring consistency among internal staff is done through rigorous documentation and reporting of work completed, motivated by creative measures of mindfulness to ensure that new employees are able to pick up where others had left off in the event of staff turnover
- A conservation easement has also been implemented on site, which specifies that management of the land is dictated indefinitely by the Ontario Farmland Trust
### Establish Partnerships and Learn from Others

- Land management at the Ignatius site involves ongoing partnerships with local experts, organizations, and consultants, particularly in the initial planning stages and land classification studies (GRCA, Trout Unlimited, Wellington Stewardship Council, the Green Legacy Program, Ontario Farmland Trust)
- Partnerships with school groups and other local organizations also provide a significant source of volunteer support for ongoing initiatives

### Encourage Communication and Collaboration

- Relationships between land managers beyond site boundaries were described as building, supportive, and relatively informal
- Ongoing communication and collaboration with local organizations who have similar ecological and land management interests
- There is a mandate to double tree populations within the Guelph-Eramosa Township and the County, so officials are supportive of the Old Growth Forest initiatives, contributing labour, material, and monetary donations
- Ongoing collaboration between internal departments to ensure planning and management of ecological projects across the site remain cohesive and complementary

### PUBLIC AND PROFESSIONAL INVOLVEMENT

#### Build Relationships

- Information signage is used to communicate information about ongoing activities
- Transparency with the local community and adjacent landowners regarding site initiatives is used to foster positive relationships
- Ongoing communication with external agencies initiated in the planning phases is used to build and maintain relationships with industry experts including the GRCA and Trout Unlimited, as well as ecologists, landscape architects, biologists, soil scientists, etc.
- Regular contact with other private land trusts on similar projects is useful for project advancement (i.e., the Rare Charitable Research Reserve)
- Land managers report minimal difficulty in accessing expert or empirical knowledge, noting an increasing amount of information available online, as well as through conferences and relationships with local experts

#### Encourage Public Education and Involvement

- There is a heavy reliance on volunteer support to complete much of the work on site. As such, public involvement is very influential on management decisions. Land managers actively encourage and seek new opportunities for public education and involvement throughout the management process, as well as ways to retain public interest to ensure continued commitment
- Annual performances and celebrations of nature are coordinated on the property; used to attract community interest to the site and the ongoing initiatives
## CHALLENGES AND LIMITATIONS

### Public Impact: Unintended and Inappropriate Use
- Issues of public impact at the Ignatius site include property encroachment, mowing of naturalized areas, dumping of compost and grass clippings, as well as trespassing, development of informal trail networks, dogs off leash, camping/fires, and vandalism, although instances have been minimal thus far and have not had any significant impacts on restoration efforts to date
- Land managers combat these challenges through information signage to direct and educate visitors, as well as the construction of boardwalks and bridges over sensitive areas to mitigate impacts
- Public impacts continue to be monitored, and land managers are committed to amending management and monitoring design as issues develop

### Funding and Resource Availability
- Funding and general availability of resources required for management, education, and outreach to attract community interest and recruit volunteers is expected to continue being a significant challenge in terms of ensuring long-term success

### Ecological Literacy
- There are certainly users who do not understand the importance of ecological areas; however, it is difficult to gauge the level of understanding among the general public
- A sense of entitlement exists among some users despite private land ownership; difficult to alter perceptions and change behaviour

### Redefining 'Success'
- Measures of success are context-specific and require realistic expectations for a site located within an altered landscape, but present significant opportunities: "[Essentially,] you can give up or you can work to be the change, work together, build community and learn in the process. Success is already seen in the work that's been done and the amount of trees that have been planted...there's a lot more land connections, and you can see people changing when they're involved in these processes" (KI2, 2017)
Municipality 1: City of London, Westminster Ponds/Pond Mills ESA
The City of London is a Southern Ontario urban municipality that supports a positive growth trend with a current population of 383,822 people (Statistics Canada, 2017b). The City contains a variety of natural open spaces including 21 publicly-owned Environmentally Significant Areas (ESAs) recognized for their unique natural features that perform important ecological functions in the landscape (City of London, 2017).

The Westminster Ponds/Pond Mills ESA was selected as a reference location for the key-informant interview with KI3 regarding current land management practices within the City of London due to its urban location, size, ecological significance, proclaimed adaptive management practices, as well as its previous and anticipated impacts of human activity and intensification of surrounding land uses. At roughly 618 acres, Westminster Ponds/Pond Mills ESA is the largest natural area in the City of London (North-South Environmental, 2014; Upper Thames Conservation Authority, 2005; Upper Thames Conservation Authority, 2015; McDougall, 2016). Westminster Ponds/Pond Mills ESA is a particularly significant site because of its size, varied topography, and range of unique natural features that support high levels of biodiversity within an urban landscape. The site provides important upland and lowland habitat as well as linkage functions, which support significant rare, threatened, and endangered wildlife species (McDougall, 2016). It contains Provincially Significant Wetlands, rare vegetation communities, and unique landforms such as kettle ponds that attract an array of species, including migratory waterfowl (McDougall, 2016; Upper Thames Conservation Authority, 2005).

Westminster Ponds/Pond Mills ESA is located in the southern portion of the City, surrounded by residential and commercial land uses. The nearby Tourist Information Centre enhances the visibility of the site, which has been beneficial in retaining resources for ongoing management and monitoring activities. In addition to the undefined impacts associated with future development of adjacent land uses, the site has also experienced significant impacts as a result of historic human land use activities including quarrying and a former sanitary landfill site (Upper Thames Conservation Authority 2005; Upper Thames Conservation Authority, 2015). Residual impacts of historical disturbances are still evident in the composition and quality of...
some habitats and vegetation communities across the site (Upper Thames Conservation Authority, 2015).

ESAs are particularly sensitive to impacts of human activity and as a result require careful management to balance ecological preservation with appropriate public use. The Westminster Ponds/Ponds Mills ESA is owned by the City of London and managed collaboratively through an ongoing partnership with the UTRCA. The primary goals for management of the area emphasize preservation of ecological and cultural integrity and long-term sustainable use, including opportunities for community engagement, education, and low-impact recreation (Upper Thames Conservation Authority, 2005). To protect and manage local ESAs including the Westminster Pond/Ponds Mills site, the City of London has established a conservation master planning process to develop unique management programs for each site through collaboration with local partners as well as the community (McDougall, 2016).

A number of documents and municipal presentations were reviewed to support discussions with KI3. Documents included the 2005 Master Plan Update, as well as the Westminster Ponds/Ponds Mills ESA Ecological Inventory and Management Zone Report Volumes 1 and 2. Results of the key informant interview and discussion of current City of London management practices are summarized and included below.

<table>
<thead>
<tr>
<th>KI3 Interview Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of London, Westminster Ponds</td>
</tr>
<tr>
<td><strong>MANAGEMENT AND MONITORING</strong></td>
</tr>
<tr>
<td><strong>Definition of Adaptive Management</strong></td>
</tr>
<tr>
<td>• &quot;A daily way of going at things...adapting and learning as you go. A buzzword that often means we're going to respond to how things are responding&quot; (KI3, 2017)</td>
</tr>
<tr>
<td><strong>Create a Strategy: Set Goals and Establish Timelines</strong></td>
</tr>
<tr>
<td><strong>Existing Management Approach</strong></td>
</tr>
<tr>
<td>• Land managers at the City of London described using an AM approach in their Conservation Master Plans (CMPs), which include invasive species management (to account for seeds that can be dormant in the soils for a number of years or new invasions), as well as following the approach in their Guidelines for Management Zones</td>
</tr>
</tbody>
</table>
and Trails in ESAs document that includes a section on monitoring

- CMPs are developed for all ESAs; compilation relies heavily on preliminary collection of ecological data followed by extensive public engagement directed at identification of concerns, gathering public feedback on suggested improvements to existing conditions, etc. consistent with the London Plan and Guidelines for Management Zones and Trails in ESAs document and process

- Review and update of CMPs is intended to occur every 10 years. Updates include the collection of additional ecological inventory and Ecological Land Classification (ELC) work for comparison with historical conditions; collection of new baseline data allows land managers to reassess ecosystem health and determine success of restoration initiatives

- Smaller management projects can be used to provide a snapshot of existing conditions between formal review periods

- Reliance on partners and previous works to leverage existing knowledge and use BMPs wherever possible

- Close working relationship with the UTRCA who are retained under contract with the City in regards to the management, monitoring, and by-law enforcement duties in the ESAs

- Adopt an ESA and Friends of groups and City staff apply for grants from other levels of government to supplement available project funding

- The establishment of programs such as the Adopt an ESA Program are used increase community involvement in addition to existing partnerships with local community groups

- Place a high degree of emphasis on public consultation and involvement at all levels of management

- The City of London maintains a proactive approach to land management; known as a leader in invasive species management when compared to other municipalities and levels of government (the first municipality to initiate a city-wide invasive species strategy)

**Establishing Goals, Timelines, and Determining Resource Investments**

- Overarching policy documents (i.e., Provincial Policy Statements, London Plan, London’s Environmental Management Guidelines, and Guidelines for Management Zones and Trails in ESAs) direct goals and objectives for land management, which are subsequently addressed through smaller site-specific projects and implementation of Provincial, Invasive Species BMPs at the local level (i.e., treating least invaded or most sensitive areas first for the protection of Species at Risk and Significant Wildlife Habitat, followed by the more problematic ‘lost cause’ areas, as time and funding permits)

- Monitoring timelines as specified within the CMPs and Guidelines for Trails in ESAs extends approximately 10 years and includes short term, medium term, and long-term goals. Goals are intended to be reviewed at the 10 year mark when possible and assessed for progress towards improving and protecting ecological integrity at a landscape scale to build resilience to climate change and other large scale issues

- Community update meetings are conducted on a bi-annual basis to review project
status with the community in terms of accomplishments and works in progress for a given site

- Land managers at the City of London address ecological issues through a science-first approach. Projects typically begin with ecological mapping (i.e., conducting ELC studies, determining presence of species at risk, locations of significant wildlife habitat, etc.). Data collected are used to develop management zones within the City that dictate appropriate land uses

- Once management zones, Species at Risk, and Significant Wildlife Habitats are identified, other professionals including landscape architects, foresters, ecologists and biologists may be brought in to help with site specific design and restoration work

**Determining the Influence of Site Context**

- Site location is particularly influential on the rate at which issues are able to be addressed, in addition to protection of Species at Risk and significant wildlife habitat; visibility is a key factor that contributes to the identification of high-profile locations and determines project interest and ability of land managers to acquire funding for management and monitoring activities

**Defining Success and Failure**

- To assess project success or failure land managers compare their work against surrounding municipalities, trail organizations, nature based NGOs, and other levels of government; continually strive to do more

- Feedback and comment from community groups is used to measure project success and identify additional areas of improvement

- Success and failures are assessed every 10 years upon renewal of each CMP, at which point management and monitoring regimes may be adjusted according to observations of environmental health

- Through monitoring for Species at Risk and other ecosystem health indicators, the City of London has achieved many successes with Provincial and Federal recognition

- Recognized with the Lee Symmes Municipal Award by Ontario Nature as a Conservation Hero for commitment to protecting ESAs. The award recognizes municipalities that demonstrate community leadership and exceptional achievement in planning or implementing programs that protect and regenerate the natural environment within a community. The City of London also won a 2017 OALA Award for Service to the Environment for Guidelines for Management Zones and Trails in ESAs, which were developed through a multi-year, community-engagement process led by a multi-disciplinary team of landscape architects and ecologists from the City of London with support from external consultants. The goal was to develop a science based, repeatable, transparent trail planning policy and process that enhances the community engagement experience, stewardship and protection of ecological features and functions

- Federal Government recognition for work to protect and increase the knowledge of a Species at Risk in the Proposed Recovery Strategy for the False Rue-anemone in Canada. A mitigation and management plan was developed with Dillon Consulting Ltd. in 2014,
which outlines a plan to control Goutweed in the vicinity of this threatened species, and has demonstrated excellent results to date in terms of improving knowledge of species abundance, distribution, biology, and local threats.

**Focus of Current Monitoring Practice**
- Ecological integrity and protection is the ultimate goal for management and monitoring regimes across all levels of policy; CMPs are updated as frequently as possible to ensure land managers are able to react appropriately to observed changes.

**Responding to Observed Changes**
- Smaller projects are helpful in giving snapshots of project status between high level revisions; enable land managers to respond and react to issues involving known Species at Risk, sensitive habitat, or invasion.
- Close working partnerships with the UTRCA through a City funded contract allow land managers at the City of London the opportunity to react quickly to observed changes if necessary based on daily on-the-ground observations from UTRCA staff, as well as public observation reports. Non-urgent issues may be documented and included as a capital project for the following year.

**Ensure Consistency and Commitment**
- Top down management style; conservation activities specified within CMPs are directed by over-arching documents including Provincial Policy Statements and the City of London Official Plan, Guidelines for Management Zones and Trails in ESAs, and the Environmental Management Guidelines which ensure consistency in management actions throughout ESAs; land managers work toward implementing recommendations and objectives over multi-year projects with varied timelines.
- In addition to the guidelines provided by the CMPs, regular community update meetings and observation reports from the public also help ensure consistency and commitment.
- The City of London strives to develop cohesive management plans across project boundaries through collaboration with adjacent towns and municipalities, as well as communication with private landowners. Recommendations for management of ESAs that extend into both public and private property are included in site CMPs and provided to adjacent landowners.

**Establish Partnerships and Learn from Others**
- Restoration plans and management proposals are circulated for comment among stakeholder organizations and council advisory committees to encourage community involvement and leverage the knowledge of other organizations (i.e., existing BMPs).
- There is a significant reliance on partners to learn BMPs from work that has already been done in order to use resources most efficiently and avoid re-inventing the wheel.
- To access to expert and empirical knowledge land managers regularly attend and present at conferences. Such involvement presents the opportunity to contribute knowledge gained from ongoing projects, and also to learn from others and ensure the
latest science and best management practices are used in municipal projects

- Inspiration for internal projects can come from adjacent municipalities with similar ecological goals. For example, City of London staff attended workshops for ongoing ecological initiatives in the neighbouring town of St. Thomas to become Phragmites Free by 2020; information gained can be incorporated or mimicked within City projects to encourage ecological integrity at a landscape scale, and foster a collaborative partnership with adjacent regions

**Encourage Communication and Collaboration**

- There is active encouragement and communication with the community in an effort to increase awareness and extend a stewardship ethic beyond site boundaries
- Relationships with neighbouring municipalities allow collaborative efforts to achieve ecological integrity at a landscape scale; mimicking initiatives at an appropriate scale

**Be Proactive**

- The City is a leader in invasive species management among other municipalities and levels of government; recently discovered that no other municipality has completed a city-wide invasive species strategy; recently received federal recognition in a Recovery Strategy for invasive control projects to protect a Species at Risk
- Land managers embrace the uncertainty inherent in ecological projects; understand that not all undertakings have a precedent project to look to, but that such projects present unique opportunities to collaborate with industry experts to develop new approaches and solutions, which can then be contributed to the local knowledge base and utilized by others to solve similar problems in other regions
- Continually measure themselves against other municipalities and levels of government; trying to do more to improve the state of the environment
- Awareness and application for grants from other levels of government to supplement funding for ongoing projects

**PUBLIC AND PROFESSIONAL INVOLVEMENT**

**Build Relationships**

- The City of London maintains a long-term partnership and funds a contract and capital projects for the UTRCA to actively manage ESAs, including monitoring and enforcement; management activities directed by City officials
- Ongoing partnerships and funding for local organizations who possess similar ecological goals (i.e., Reforest London, Ontario Invasive Plant Council, Carolinian Canada, Ontario Nature)
- Initiated programs such as the Adopt an ESA Program to run in conjunction with community organizations and conservation initiatives (i.e., Friends Of groups)
- Partnerships and funding for the UTRCA allow the opportunity for quick response to urgent issues; staff are present daily and able to send observation information quickly to alert of problems requiring immediate attention
External consultants engaged throughout the various stages of a conservation project. Professionals such as environmental scientists, biologists, ecologists, and botanists are involved in the initial ecological inventory work. Landscape architects may be involved in the later stages to implement design aspects following the Guidelines for Management Zones and Trails in ESAs document and process. Public consultation consultants are engaged to facilitate public involvement. Internal and external communication is encouraged throughout the process, with comments circulated to various stakeholders and used to develop final management documents.

**Encourage Public Education and Involvement**

- Employ a collaborative approach to land management; best approaches are decided and agreed upon through much public consultation, through the CMP, Local Advisory Group and Local Implementation Committee and Trails Advisory Group processes which give stakeholders and community groups the opportunity to provide feedback and suggestion for project improvements.
- Land managers encourage a high degree of public involvement throughout the management process; the last update for the London Official Plan was reported as having the highest level of public consultation and engagement of any Official Plan in Canada.
- Members of the public are encouraged to submit observation reports regarding observed changes in natural systems.
- All land management actions are based on the CMPs; actions, achievements, and progress are continually relayed back to community groups. Regular community meetings are held on a bi-annual basis to update local stakeholders and citizens about project status, including achievements to date as well as number and success of in-progress recommendations.
- CMPs are developed through consultation with Local Advisory Committees, which include stakeholders from all community associations, as well as the broader public, although final decisions are subject to Council approval.
- The development of the CMPs are used to establish management plans for each site, but also to enhance community engagement and awareness and extend a stewardship ethic beyond the boundaries of public property.
- All trail decisions and design solution proposals originate from the CMP or the Trails Advisory Group (not City staff) that includes representatives from the Thames Valley Trail Association, Nature London, Advisory Committees of Council including the Accessibility Advisory Committee and Ecological and Environment Advisory Committee, Adopt an ESA Groups, Community Associations, UTRCA and others. This community group is included in any trails-related issue that needs to be addressed, and are provided with the necessary information to make informed decisions on matters such as relocations, surfacing, and/or boardwalk additions. Proposed changes are then introduced to the larger community through the bi-annual CMP update meetings.
- Additional education and awareness initiatives include news advertisements, mail outs, signage, and promotion of stewardship initiatives such as the Adopt an ESA Program.
City conservation initiatives typically receive positive feedback and support from the community, other levels of government, and professional associations.

**CHALLENGES AND LIMITATIONS**

**Public Impact: Unintended and Inappropriate Use**

- Some public impacts such as encroachments have been observed throughout publicly-owned ESAs. Behavioural enforcement is improving but remains an ongoing management issue; enforcement of by-laws including ticket issuing is typically done by the UTRCA. Orders to comply and court hearings scheduled if necessary.
- Most property encroachments have been mapped within each ESA.
- Signage, stewardship mail outs, engagement, and enforcement measures by City by-law enforcement staff are a primary tactic for addressing issues of public impact; newsletters and brochures are distributed to inform adjacent landowners of best practices for living in close proximity to natural areas.
- Graduate student research is currently underway to investigate increasing stewardship by looking at best practices employed in other municipalities; methods used in other municipalities to change negative public behaviours and increase by-law compliance.
- Try to be proactive in management and design initiatives. For example, the sooner a formalized trail is implemented, the less likely informal trail networks are to develop. In terms of managing informal trail networks, land managers will often choose an existing trail and close the rest following the Guidelines for Management Zones and Trails in ESAs document and process.
- Long-term influences of public use are assessed during the CMP development and revision processes and addressed through implementing formal trails, removing informal networks, and establishing timelines going forward to review and address other issues.
- City staff attempt to combat any issues of public impact through signage and by providing alternatives when possible. For example, implementation of more off-leash areas is used to reduce the occurrence of dogs off leash in ESAs. However, compliance is sometimes low, particularly in areas with low visibility. Such impacts can be as much a social issue as an ecological issue because of the level of user conflict that can result; management of these activities begins to tie in with principles of Crime Prevention through Environmental Design (CPTED).
- Land managers note that gauging the level of improvement from year to year is a difficult task, but increasing the level of public awareness of ongoing issues to improve local stewardship can always be improved through mail outs, ongoing research, engagement, and daily user education from staff on the ground.
Funding and Resource Availability

- Funding was identified as among the most significant barriers to ensuring long-term success through management and monitoring: "We do what we can with the budget we have, but would appreciate being able to do more"
- Resource constraints can influence the rate of occurrence of CMPs revisions intended to operate on a 10-year renewal period. Renewal is a demanding process in terms of time and resources. As a result, each CMP is addressed as time permits and updated as often as possible given resource constraints
- Land managers remain hopeful that methods of citizen science, including programs such as eBird, eNaturalist, and the Marsh Monitoring Program will become more widespread so it may be used to improve current monitoring practice and long-term success through reduction of cost and greater community involvement

Redefining 'Success'

- Land managers remain optimistic about achieving long-term success for conservation and habitat enhancement projects despite the challenges of intensively modified landscapes:
  "There are a lot of success stories; it's a young field, and the science is quite young. Just over the last 10 years, we have learned so much. I believe we can have long term success...but [it will require] ongoing monitoring and touch-ups" (KI3, 2017)
Municipality 2: City of Kitchener, Huron Natural Area
The City of Kitchener is a heavily urbanized landscape with a population of 233,222 people, recognized as the largest municipality in the Region of Waterloo (Statistics Canada, 2017a; Region of Waterloo, 2010). The anticipated growth of the Region in the coming years will certainly magnify the existing pressures on the health and integrity of local ecological landscapes within the City of Kitchener (Region of Waterloo, 2015).

The Huron Natural Area was selected as a reference location for the key-informant interview with Kl4 regarding existing land management practices within the City of Kitchener due to its size, urban location, and ecological significance. The site is the City of Kitchener's largest natural park, covering approximately 250 acres of land that was nearly lost to industrial development in the 1980s (Kitchener's Natural Areas Program, 2008). The Huron Natural Area contains a variety of sensitive aquatic, terrestrial, and wetland habitat systems, including forests, meadows, and provincially significant wetlands that support an array of wildlife species representative of Kitchener's local biodiversity, many of which have been ranked regionally or provincially significant (City of Kitchener, 2017; Kitchener's Natural Areas Program, 2008). One of the City of Kitchener's last cold-water stream systems also passes through the site (City of Kitchener, 2007).

The Huron Natural Area is located in the southern portion of the city, surrounded primarily by industrial development, with some residential areas to the south of the park boundary. The site is used on a regular basis as a space for outdoor educational activities and awareness initiatives for local school groups and park users (Kitchener's Natural Areas Program, 2008). As the Region of Waterloo continues to expand, pressures of human activity on local natural areas will continue to intensify (Region of Waterloo, 2015). Recent developments in the Huron Natural Area are contributing to ongoing responsible use of the land through the incorporation of a series of new trail systems, including boardwalks and lookouts, as well as enhancements to public gathering and educational spaces (Kitchener's Natural Areas Program, 2008).

The Huron Natural area is a publicly-owned landscape that is managed by the City of Kitchener with the assistance and cooperation of local school boards. The site has been recognized for its
ecological importance and potential for providing educational opportunities for the community. As such, goals of the collaborative management practices at the Huron Natural Area include maintenance and enhancement of ecological integrity, as well as promoting ongoing community involvement, awareness, and education of local ecosystems (City of Kitchener, 2017). The City of Kitchener strives to create site-specific management plans, within its overarching Parks Master Plan, to direct individual management and monitoring practices for its natural areas according to the conditions present at each location (City of Kitchener, 2010).

The Huron Natural Area Management Plan and the City of Kitchener Parks Master Plan were the primary documents reviewed to support discussions with KI4. Results of the key informant interview and discussion of current City of Kitchener management practices are summarized and included below.

<table>
<thead>
<tr>
<th>KI4 Interview Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Kitchener, Huron Natural Area</td>
</tr>
</tbody>
</table>

**MANAGEMENT AND MONITORING**

**Definition of Adaptive Management**
- A systematic way of learning by doing; "iterative, using decision-making while dealing with uncertainty. In this case, applied specifically to resource management" (KI4, 2017)

**Create a Strategy: Set Goals and Establish Timelines**

**Existing Management Approach**
- Existing management practices employ both passive and active approaches depending on project-specific goals or intended outcomes for a given site
- Actions are always guided by learning, particularly in urban areas where there is a high level of uncertainty involved with land management since conditions are always changing
- Passive management is common practice in many cases primarily as a result of resource constraints; active intervention occurs when required in response to observed changes that elicit concern
- The City of Kitchener has recently developed its first city-wide land management strategy; compiled existing site-specific data into a cohesive document to direct overall management activities and work towards solving documented issues
- Site-specific land management initiatives have been ongoing for approximately 10 years, with updates occurring on a project-to-project basis; typically updates and revisions will occur based on 3, 5, or 10 year intervals, depending on project requirements
- The City maintains a very detailed, site-specific approach to land management tailored to the presence of particular conditions in natural areas. Land management initiatives may be natural area specific, species specific, or on a restoration project to project basis.
- Recent introduction of a novel ecosystem approach to management; looking at natural areas and determining whether intervention and restoration is a feasible option, where and how to intervene, or if a system is too far gone for intervention to have a desirable impact; a triage approach is used to determine which areas need the most help, which can be left alone to passively evolve on their own, which systems need intervention or risk the loss of desired goal or function.

**Establishing Goals, Timelines, and Determining Resource Investments**
- Goals are determined based on existing ecological conditions and input from the community. Once established, goals are supported by related policies and strategies, which come together to dictate ideal management action for a given situation. A formal management plan is then created to dictate ongoing management activity in consideration of external pressures, stakeholder interests, and other factors that influence decision-making and management processes.
- Establishing timelines for monitoring goals on a landscape scale is yet to occur as current focus is on interpreting baseline data and understanding how to use that data to develop appropriate broad-scale timelines. However, 5-year cycles have been established for individual site plans, at which time predefined targets are reviewed to assess success in terms of short medium, and long term goals set during the initial management plan drafting process.

**Determining the Influence of Site Context**
- The degree of public use is a major consideration in terms of ongoing management activity; HNA experiences perhaps the most significant public use in comparison with other city parks.
- Surounding industrial land use is advantageous because it is has a reduced level of ecological impact than would be expected if the area were surrounded by residential developments.
- The HNA has significant cultural and historical value, which also influences management activities in terms of keeping the area intact and maintaining its ecological health.

**Defining Success and Failure**
- Definitions of success and failure vary according to project. For example, if a species population is identified as low, replacement habitat is developed and monitored in subsequent years to assess use. If activity is observed by the target species within the replacement habitat area, it is considered successful.
- Success may also be determined through techniques including inventories, monitoring, and comparison of existing conditions to historic baselines to understand the degree of change, as well as indicators such as plant growth or dominance of native versus non-native species.
• Review and re-intervention is employed using different approaches or techniques in the event of observed failures, or when targets are not adequately met

**Focus of Current Monitoring Practice**

• Landscape scale monitoring practice is currently in the early stages; human and recreation-impact monitoring has recently been completed. Current focus is on conducting inventories and understanding indicators of condition

• Primary focus of monitoring is on understanding ecosystem integrity or intact systems, as well as some attention on planning for anticipated impacts of climate change on local natural systems

• Vegetation monitoring plots have been installed in some areas to assist land managers in establishing a baseline understanding of existing conditions, in order to assess change over time, and aid in the development of long-term restoration or management targets

• Key monitoring targets or indicators of change commonly included in data collection and assessment of City parks include vegetation, amphibians, birds, and bats

• Monitoring at HNA: Extensive monitoring and data collection occurred to prior to the establishment of the area as a formal park in 2006 to understand the existing natural conditions. Staff have not yet had the opportunity to conduct a review of this information, although it is identified as an upcoming capital project

• Rapid assessments are used in between formal review periods to get a snapshot of existing environmental conditions assess the state of parks across the city, including how intact they are. Rapid assessments typically include evaluation of human impact, habitat quality, species at risk, and degree of historical change within a given site

**Responding to Observed Changes**

• Reaction to observed changes are project dependant, and may be determined by best management practices that have been used previously within the industry so there is a baseline for comparison; could be annual, but may be every 5 years for example, if necessary to accommodate certain ecological conditions (i.e., nesting initiatives)

• Changes as a result of human or recreational impacts can contribute to the novel ecosystem management framework; assessing whether or not these impacts are contributing to a degree of change within a park that would be too difficult or costly to reverse. In some cases, change may be considered acceptable and a system allowed to function differently than it originally had. Novel responses to observed change require an understanding of sensible resource investments and conditions that can be realistically restored

**Ensure Consistency and Commitment**

• Staff turnover and budget changes from year to year can have significant influence on the level of consistency and commitment achieved in long-term management and monitoring practice

• Strong baseline information and well-documented projects that demonstrate program success, and monitoring plans that clearly outline goals and objectives are critical
• Retaining a large amount of public support is also influential; public support can be very powerful in terms of driving change, as well as ensuring budget allocation and council support for ongoing projects
• Ensuring projects support overarching policies and strategies is helpful in dictating management action
• Development and application of the broad-scale management plan will also be helpful in maintaining cross-site consistency in terms of long-term management actions

Establish Partnerships and Learn from Others
• Ongoing working partnerships with university researchers investigating specific topics related to natural areas
• Partnerships with overarching bodies such as the Ministry of Natural Resources and the Region of Waterloo
• Volunteer groups including local field naturalist groups, Friends Of groups, and neighbourhood associations are key partnerships involved with education, stewardship, management, and data collection activities related to ongoing natural areas projects; including the community as part of the process is critical to retaining public interest and support, and can be influential in achieving council support for natural areas projects
• Continual education and awareness of industry best management practices, which can be applied to City projects is an important aspect of ongoing partnerships
• Expert and empirical knowledge is consulted and applied when possible; land managers recognize that there is significant interest from the academic world to contribute to effective land management practices, but note that the challenge lies with the ability to coordinate the information and apply it to individual projects

Encourage Communication and Collaboration
• Active relationships with the Region of Waterloo and the local conservation authority (GRCA); all have a slightly different focus for resource management. Policies and staff at the Region of Waterloo are generally supportive, but the conservation authority has different focus for projects within the city, with goals and objectives that extend beyond land management. Collaboration does occur from time to time, but could be improved
• Ongoing communication with surrounding municipalities to establish a working group to share ideas and best practices
• Collaboration with other land managers does not happen on a regular basis, but conference attendance and involvement with various associations provide occasional opportunities to meet and share best practices with other land managers
• Land management activities typically do not extend beyond municipal boundaries; tend to work on similar projects, but do so separately
• A stewardship council exists within the Region of Waterloo, which brings individuals together in a collaborative environment to work on a variety of stewardship projects
## PUBLIC AND PROFESSIONAL INVOLVEMENT

### Build Relationships
- A working group of City staff, stakeholders, and community members is developed and engaged throughout the decision-making processes for each natural area; a conduit for communication between City staff and the community including collaborative identification of goals and objectives, as well as ongoing meetings to address concerns and discuss progress and targets
- City councillors are typically quite engaged and involved in ongoing projects through participation in the working groups, which enhances communication with higher level support systems
- Industry experts and external consultants are engaged in natural areas projects, often from niche scientific backgrounds
- Internal professionals are engaged depending on the nature and requirements of the project
- Landscape architects are typically involved in early phases of a project; site level design work such as user accessibility, trail design and development, species selection for on-site plantings

### Encourage Public Education and Involvement
- Emphasis is placed on facilitation of educational and informative events, annual celebrations, as well as increasing awareness through interpretive signage to continually encourage community involvement and support of ongoing initiatives; the more public is engaged, aware, and involved, the greater the support; public interest can drive municipal change
- Overall people want to get involved, understand what is going on, and how they can contribute to project success
- An internal environmental committee was developed within the City of Kitchener that presents another opportunity for individuals to get involved in the decision-making processes, and work with council to address issues

## CHALLENGES AND LIMITATIONS

### Public Impact: Unintended and Inappropriate Use
- Common challenges include recreation and encroachment issues, such as yard waste dumping, vegetation clearing, construction of bike jumps, littering, property encroachment, trespassing, parties, and development of informal trail networks; data on existing public impacts have been collected and inventoried in a baseline record indicators of human impact
- Response to issues of unintended or inappropriate use are generally supported by local by-laws that speak to natural area impacts, particularly staying on trails, encroachment, property standards, and allow support in reaching out to individual residents, although enforcement can be challenging; court dates and restitution for damages associated
with inappropriate use can be arranged in extreme cases

- Land managers also combat these issues through passive approaches including distribution of brochures and signage to increase awareness of public impact in an effort to foster behavioural change and reduce the occurrence of undesirable uses
- In considering the influence of these activities on long-term success, human and recreational impacts were described as contributors to the novel ecosystem management framework in terms of understanding where to invest resources, and assessing whether or not observed impacts are contributing to significant change that might be too difficult or costly to reverse

**Funding and Resource Availability**

- Budget changes or a loss of public interest may mean a project is not awarded sufficient funding

**Ecological Literacy**

- The primary focus of much of the general public is maintaining natural landscapes for recreational use, or for views from adjacent residential developments; many may not think about the impacts of inappropriate use on natural systems. However, although not formally tracked for measurable change, improvements have been observed in terms of increasing public interest in natural areas projects; land managers need to keep informing and educating citizens about natural areas projects, goals, and the role of the public in achieving success

**Improving Communication**

- Active communication and collaboration to develop cohesive management plans across boundaries is not a frequent occurrence; surrounding land managers often have different focus or approaches to achieving their goals and objectives
- Although occasional opportunities for communication and collaboration exist through conference attendance and ecological associations, it does not occur as frequently on a routine regular basis
- Public education and information accessibility can be used to help overcome challenges; the more the population is educated, the more likely they are to participate and make decisions that support environmental management initiatives

**The Uncertainty Factor**

- Uncertainty can be a significant barrier. Municipalities are often under pressure for immediate action from the community. It can be difficult for people to understand the long-term approach to land management; it takes time and will not always be successful
- The dynamic, unpredictable nature of ecological systems is a challenge for decision-making in itself. There will always be uncertainty associated with projects involving natural systems that will always require an AM approach
**Time Constraints**

- The inability to dedicate large amounts of time to long-term studies directed at exploring alternative solutions to ecological issues means decisions must always be made with a degree of uncertainty. Thus, use of an AM approach and a practical understanding of what can realistically be achieved helps land managers identify where and how to intervene in natural systems.

- The municipal framework also presents a challenge for long-term management; municipalities typically operate on a 4-year basis, with councillors appointed for a 4-year term. This can be influential for land management because councillor priority determines which projects will be the focus of municipal efforts during their term. Thus, strong programs supported by thorough baseline data can ensure project success despite changes in high-level decision-makers.

**Redefining 'Success'**

- Land managers speculate that long-term success for conservation and habitat enhancement projects can be achieved in intensively-modified landscapes, but requires a shift in the perception of success:

  "We're not going to achieve pristine wild systems, untouched, undamaged, and without people, so our definitions of success need to change. A system may be functioning, but its function may be contributed by both native and non-native species. By our definition, that is [still] a successful system. We can't define success based on the fact that we got rid of all non-native species, and it's now only a native system. In a lot of restoration projects, this is the approach that we need to take...we will have to move targets as a system is changing [because] we will only be living in altered landscapes...that's our world. The more people work on these projects, the more we will learn" (KI4, 2017)
Conservation Authority 1: Toronto and Region Conservation Authority (TRCA), Tommy Thompson Park

Located in a highly urbanized watershed, the TRCA strives to work collaboratively with stakeholders and municipalities to reduce the impact of human activities on the natural landscape, preserve and enhance ecological systems, and encourage a sense of appreciation and stewardship among local communities (Toronto and Region Conservation Authority, 2016).

Tommy Thompson Park was selected as the reference location for the key-informant interview with KIS due to its unique location, size, and demonstrated ecological success in the midst of intensely modified surroundings. Located along the Toronto Waterfront, TTP is part of the Leslie Street Spit: a man-made peninsula of dredged and surplus fill material that extends 5 km into Lake Ontario, and has evolved into a thriving urban wilderness located minutes from the heart of Toronto (Toronto and Region Conservation Authority, n.d. a).

Designed and managed for long-term sustainability, TTP is comprised of functional and critical habitat that support a variety of wildlife species. At over 1200 acres, the TTP site contains a number of aquatic, terrestrial, and wetland communities, and is among the largest natural areas along the Toronto Waterfront (Toronto and Region Conservation Authority, n.d. a). The most dominant ecological community within the TTP site are meadows, with forest, marshes, and shoreline communities also present. Although TTP supports a range of terrestrial and aquatic wildlife, it has been officially recognized as a Globally Significant Important Bird Area for its important role as a stopover location for various species of migratory songbirds and waterfowl. Various habitat enhancement projects continue to occur within the TTP site, several of which are directed at improving habitat conditions for sensitive bird populations that have been observed at the site (Toronto and Region Conservation Authority, n.d. b).

Its highly urbanized location presents a number of challenges in terms of regulating and reducing the impacts of human activity. Management of this unique landscape, including mitigation of human impacts and ongoing habitat enhancement initiatives, is guided by the TTP Master Plan, which outlines a number of objectives for the site that emphasize ecological integrity and conservation through habitat enhancement, preservation of significant species, and protection of environmentally significant areas. Conservation design incorporates
consideration of natural succession processes to create functional habitats and contribute to the ecological success of the park (Toronto and Region Conservation Authority, n.d. c).

The current TTP Master Plan was the primary document reviewed to support discussions with KI5. Results of the key informant interview and discussion of current management practices within the Toronto and Region Conservation Authority are summarized below.

<table>
<thead>
<tr>
<th>KI5 Interview Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto and Region Conservation Authority, Tommy Thompson Park/Leslie Street Spit</td>
</tr>
<tr>
<td>MANAGEMENT AND MONITORING</td>
</tr>
</tbody>
</table>

**Definition of Adaptive Management**
- "Adaptive management is what we do on a day to day basis...learning and doing better by evaluating the ecological response to [your actions]. Learning from past experiences and adapting your techniques...to make sure you're putting your best product forward" (KI5, 2017)

**Create a Strategy: Set Goals and Establish Timelines**

**Existing Management Approach**
- The existing management strategy at the TRCA was described as a combination of proactive and reactive techniques; proactive in the sense of understanding and considering site ecology as well as planning for expected human influence, and reactive in terms of actively responding to unexpected events or outcomes
- Management at Tommy Thompson Park (TTP) was described as undergoing continual review and adjustment according to changes observed on a day-to-day basis, which demonstrates the reactive nature of management. Staff on-the-ground monitor changes at the site to ensure both ecological and social issues are addressed within an appropriate timeframe
- Observed changes may trigger review and update of formal management strategies. Additional collection and analysis of empirical data may be required from year to year to address an observed issue and inform management practices for the following year

**Establishing Goals, Timelines, and Determining Resource Investments**
- The TTP Master Plan specifies four main objectives of the park that influence goals, resource investment, and overall management action: (1) preservation of significant species, (2) protection of environmentally significant areas, (3) creation of significant marsh/wetland habitat, and (4) site preparation to allow succession of vegetation communities to occur over time
- Management is influenced by existing conditions and addressing problematic ecological situations that arise from time to time. Due to the artificial nature of the site and the
precariousness of shoreline management, the legal climate is also highly influential in terms of directing management action

- Timelines for monitoring goals are project dependant; goals and targets are identified in the establishment phase. Following that, the post-establishment phase includes more detail and scientific rigor (i.e., surveys, transect monitoring, point counts), which extend indefinitely
- Documenting, reviewing, and prioritizing the greatest needs or uncertainties to ensure resources are applied appropriately
- Resources and funding are an ongoing issue because a lack of resources limits the degree of improvements that can be made to the natural system
- Funding availability is variable. For example, funding may be available to undertake specific species at risk programming in a given year, but not for addressing other necessary management activities
- The ultimate goal for the site is ecological function, but the nature of the site requires particular attention to a number of other aspects as well

Determining the Influence of Site Context

- The context of TTP has been a significant influence on management practices from an ecological and social perspective
- TTP is an entirely man-made park, which presents a significant degree of uncertainty associated with the level of ecological function that can be achieved. The complex nature of the site makes it difficult to set targets for management since the ecological capacity of the area is unknown. Criteria for establishing targets require some adjustment because previous targets for natural cover and ecological function have been exceeded, thereby demonstrating the strength and resilience of nature despite considerable contextual challenges present at TTP
- The highly urbanized setting of TTP is also extremely influential in terms of establishing targets for ecological function. For example, a target for completely indigenous plant cover would be unrealistic in such a setting, given the likelihood of non-native seeds entering the system from the surrounding urban areas
- The location of TTP on the north shore of Lake Ontario makes the site a significant stop over area for migratory birds, which is influential on management and monitoring practice; need to dedicate monitoring and research into understanding requirements for migratory birds, and ensuring sufficient resource availability
- TTP is considered a site of regional and global significance for certain species of migratory birds, so management and monitoring activities must ensure that the park is providing for these key ecological functions on a local, regional, and global level

Defining Success and Failure

- Definitions of success and failure at TTP ties back to ecological function; achieving advances in vegetation communities, ensuring functional ecological systems
- Measurement of success and failure includes both short and long-term measurements. On a short-term level, the success of tree and shrub plantings may be monitored at the
1, 3, 5, and 10-year mark to inform subsequent management decisions. On a long-term level, monitoring may focus on elements such as the ELC communities and responses of flora and fauna over time.

- Since the park is so young, it is difficult to determine how to account for matters such as natural succession in the long-term management regime. Land managers are uncertain about whether to attempt to halt processes of natural succession in order to maintain conditions for specific fauna, or let the ecosystems evolve to eventually support completely different species.
- Long-term definitions of ecological success on the Leslie Street Spit and TTP are still to be determined; criteria for developing targets need to be re-assessed through the Natural Area Enhancement Plan, in consideration of the success that has been achieved at the site thus far.

**Focus of Current Monitoring Practice**

- Focus of monitoring is project dependent. For example, habitat restoration and enhancement projects are focused primarily on ensuring success, whereas shoreline projects may be focused on a number of things including improvement of aesthetics, natural cover, and in-water structures.
- TTP is also part of the Toronto and Region area of concern; due to its location along the Toronto Waterfront the remedial plan also has an aesthetic component to it.
- Monitoring duration and timelines vary. Informal monitoring goes back to the original establishment of the park (1974). Different areas also have different protocols. Some restoration projects require monitoring at 1, 3, 5, 10-year intervals, depending on funding and permit requirements.

**Responding to Observed Changes**

- Response rate is project dependent; some projects will have visible changes within a year, others are more long-term. For example, installation of fish gates to control carp populations in wetland areas resulted in observable change after 1 year. Conversely, transitioning Cormorant populations from tree-nesting birds to ground-nesting birds in an attempt to reduce their impact on area trees required a period of 10 years to identify significant change.
- Changes as a result of public impact are monitored and addressed on a daily basis when possible. If a problematic issue is identified, management is adjusted accordingly as soon as possible, in order to reduce impacts on sensitive areas.

**Ensure Consistency and Commitment**

- Proper documentation is key to ensuring consistency and commitment.
- Land managers at the TRCA noted that they had been fortunate to retain a lot of consistency and institutional knowledge associated with TTP in particular, because many key contacts are still involved with the organization in some capacity.
- Maintaining the Natural Area Enhancement Plan and associated reports are helpful in providing consistency and guidance for management activities.
Establish Partnerships and Learn from Others

- Partnerships with volunteers and community groups are a great source of support for land management activities and ecological initiatives.
- An ongoing partnership with the City of Toronto oversees operational management, infrastructure, and facility issues at TTP; TRCA is responsible primarily for natural resources issues.
- Partnerships with local schools create educational opportunities for students that can be incorporated into activities meaningful to the overall park objectives (i.e., plantings, tree monitoring, and data collection that can be used to inform future management decisions).

Encourage Communication and Collaboration

- Among internal staff, communication and collaboration is constant; only a small group dedicated to overseeing management of TTP.
- Beyond site boundaries communication and collaboration takes on a variety of forms. While there is a high level of collaboration, it is not always among land managers exclusively. For example, the TTP can act as habitat compensation space or a 'habitat bank' for developers along the Toronto waterfront who need to compensate for habitat lost due to development activities; TTP has a significant role in terms of habitat compensation, particularly along the waterfront, in contributing to the restoration of a portion of the original habitat that existed before intensive urbanization occurred.

Being Proactive

- Incorporating opportunities for anticipated activities (i.e., trails, fishing) to reduce conflict and attract users to the most ideal locations is useful in limiting the degree of public influences and ecological impacts.
- Early identification of desirable views or public interest areas can inform land managers of ideal trail locations and reduce the likelihood of issues such as informal trail development.

PUBLIC AND PROFESSIONAL INVOLVEMENT

Build Relationships

- A number of external consultants are involved in the development of infrastructure to improve management and monitoring within TTP (i.e., buildings that function as a tool to manage the site). For example, a staff booth that provides a 280 degree view of the park was recently installed to assist with monitoring public impact.
- Relationships with local Universities are used to inform and enhance management activities (i.e., University of Guelph has previously contributed to iterations of the TTP Master Plan).
- Landscape architects have been engaged in infrastructure improvements to revitalize the main entrance of the park; currently working on integrating a new building into the existing landscape to provide facilities, control vehicular access, encourage pedestrian...
and cyclist activity, and generally improve flow within the park

Encourage Public Education and Involvement

- Public consultation and involvement is a significant influence on management practice, and is critical to ensuring decisions are as informed as possible. As such, regular consultation and public feedback is encouraged
- Volunteers and community groups provide assistance with monitoring as well as regular feedback and comment on observations that are used to inform management decisions
- A Citizen Advisory Group comprised of a number of stakeholders involved with ongoing activities at the site, has been involved with the TTP since the early 1990s; members meet regularly to review management and monitoring activities, as well as to provide observations and suggestions to the TRCA
- Newsletters and social media (Twitter) are used to increase public interest and awareness
- Staff is often present onsite, particularly on weekends, to gather feedback from users and relay comments to land managers

CHALLENGES AND LIMITATIONS

Public Impact: Unintended and Inappropriate Use

- A wide range of public impacts have been experienced at TTP including raves, unauthorized camping, encampments created from site attributes, establishment of informal trail networks, unauthorized plantings, ad hoc art communities rearranging site features into demonstrations and displays
- Due to the composition of the site there is the impression that the area is a landfill, which creates issues of public waste dumping
- Land managers respond to public impacts in a variety of ways including use of the City of Toronto's outreach program, signage to inform and direct users, fence installations and plantings that incorporate prickly vegetation reduce activity in problem areas, as well as ongoing monitoring
- Public impacts play a significant role in informing design enhancements

Funding and Resource Availability

- Funding was identified as a significant challenge for management and monitoring at the TTP as well as natural spaces in general
- Ongoing investigation into best practices to inform management decisions and ensure the use of the most cost effective and innovative techniques
<table>
<thead>
<tr>
<th>Retaining Public and Political Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Ongoing public consultations to retain public support and encourage ongoing community interest and observational feedback</td>
</tr>
<tr>
<td>- In terms of policy support for green spaces in highly urbanized areas, there is currently no mechanism outlined in the Planning Act requiring developers to allocate funding for the management of park or green spaces adjacent to new condominium developments, despite the anticipated impacts that are likely to result from the significant increase in use from residents: &quot;We know all those people will treat that space as a backyard, yet there is no investment into managing the use of that park, investing into its ecological health, monitoring how the park is being used, where people should stay out of, where activity should be concentrated...that [is] a huge barrier&quot; (K15, 2017)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ecological Literacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Overall, land managers noted a significant lack of ecological knowledge and understanding among the general public, particularly in highly urbanized areas like Toronto; users generally lack understanding of the interconnectedness of nature and the greater impact of their actions on ecological health</td>
</tr>
<tr>
<td>- Ongoing public involvement is used to increase ecological awareness, but much work remains to be done</td>
</tr>
<tr>
<td>- Land managers acknowledge that the complexities of nature extend beyond even professional understandings, making management and monitoring decision-making particularly difficult in terms of ensuring long-term success</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Improving Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Land managers describe little difficulty accessing expert or empirical knowledge, but acknowledge that there are gaps. Although there has been a significant degree of progress toward understanding human impacts on nature, it can be difficult to find specific information. For example, success rates of artificial habitat structures (particularly for swallows, in the case of TTP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Redefining 'Success'</th>
</tr>
</thead>
<tbody>
<tr>
<td>- In terms of achieving long-term success for ecological projects in intensively modified landscapes, land managers posit: &quot;TTP is proof that meaningful habitat can be achieved in an urban area, in a man-made park. It wouldn't be an internationally significant important bird area if that wasn't an achievable goal. It depends what your definitions of success are, and [whether] you are being realistic about what's achievable. I think that highly altered landscapes have vast opportunities that can result in meaningful habitat with the proper investment and management of those resources&quot; (K15, 2017)</td>
</tr>
</tbody>
</table>
Conservation Authorities: Credit Valley Conservation, Island Lake Conservation Area

Urbanization is the most significant challenge for current land management practices within the Credit River Watershed, as it is one of the most rapidly urbanizing watersheds in Ontario today. The agricultural and open space lands that currently comprise the majority of land cover in the Credit River Watershed are quickly being converted to urban land cover in order to compensate for the significant population growth that is expected to continue within the Greater Toronto Area (Credit Valley Conservation, 2012). To incorporate the peripheral influences of such rapidly encroaching land use change on management practices, the Island Lake Conservation Area (ILCA) was selected as the reference location for the key-informant interview with K16. ILCA is located just outside the Greater Toronto Area, east of the Town of Orangeville, and occupies a land base of approximately 812 acres, making it the second largest land holding owned by Credit Valley Conservation (Credit Valley Conservation, 1997).

The site is comprised of a man-made reservoir, originally intended to improve water quality in the upper Credit River. In the years since implementation, the ILCA has evolved into an important natural heritage system including a rich landscape of aquatic, terrestrial, and wetland areas that have been recognized for their distinct ecological and cultural value, as well as varied opportunities for both recreational and educational use. The diverse habitats that exist within the conservation area support a range of flora and fauna that are important to the health and integrity of the headwater system and surrounding natural areas (Credit Valley Conservation, 1997).

Management of the ILCA landscape is guided by a management plan, which outlines a number of objectives for the site associated with protection, appreciation, recreation, and tourism. Goals intend to protect natural features and ecological functions through active monitoring and land management, and foster a sense of appreciation for natural systems among the community as well as an understanding of the pressures associated with human use and the various initiatives intended to lessen these impacts. Since the site is also one of the CVC's top conservation areas, the management plan for the ILCA landscape also seeks to provide appropriate opportunities for community recreation and tourism (Credit Valley Conservation, 1997).
The current ILCA Management Plan was the primary document reviewed to support discussions with KI6. Results of the key informant interview and discussion of current management practices within Credit Valley Conservation are summarized and included below.

**KI6 Interview Results**
**Credit Valley Conservation, Island Lake Conservation Area**

**MANAGEMENT AND MONITORING**

**Definition of Adaptive Management**
- Adaptive management was described as a difficult notion to define. A way to describe "using the best available information that you have to make a decision on a specific land management issue, and then you test to see how it works through [environmental or social] monitoring. Then reassess and make modifications to your intervention as you go" (KI6, 2017)

**Create a Strategy: Set Goals and Establish Timelines**

**Existing Management Approach**
- Primarily passive and reactionary in the past, and in some cases remains as such on a day-to-day basis; addressing issues as they present themselves due to a lack of time required to address site specific issues more holistically. However, management overall has begun to shift towards a more active approach in the past decade. Resources have become more readily available for internal investigations and research, as well as implementation of best practices (i.e., trail counter programs, installing physical instruments in the field to measure park use)
- In terms of sites that possess a formal planning process (i.e., Master Plan or Management Plan documents), information generated from monitoring practices is integrated into the process to ensure more holistic and informed decision-making based on observations of public use
- Management strategies are reviewed and updated on a regular basis, as time and funding permits, but have been influenced and interrupted by budget cuts in the past
- A general policy operations manual was created to guide general land management practice
- Management plans are typically established based on an ideal 5-year horizon, yet staffing and resource availability can result in management plans that follow a 10-year track for implementation and review
- Degree and extent of management is somewhat dependent on the issues present. For example, aspects that may be considered hazardous or present a risk to public or environmental health tend to be met with more active management practices
- In terms of ILCA, management and monitoring practices are more diffused overall in comparison to other areas operated by the CVC because the impacts of urbanization are not yet as pronounced. Although the ILCA has experienced increased use as a result of
intensification within the Greater Toronto Area, it remains a rural community. However, increasing recreational interests and frequency of use has lead to concern among the local community about degradation and potential overuse of the area. CVC land managers are addressing these concerns through investigation of preventative measures, policy interventions, and alterations to landscape design that may be used to enhance protection of sensitive areas against increasing public impact. The Master Plan for the ILCA sets a baseline for consultation and adjustment to the management regime over the next 10-year period.

- Smart design is also being explored to help achieve policy directives at other CVC sites

**Establishing Goals, Timelines, and Determining Resource Investments**

- Goals and resource investments can be significantly influenced by community interest and resource or funding opportunities and availability
- Establishing goals can be somewhat of a reactive process; responding to specific issues, such as boundary encroachments, and attempting to get matters under control before they become more problematic
- Resource limitations can influence land management goals primarily as a function of funding. Funding and grant opportunities from other levels of government can drive planning goals and priorities; federal infrastructure funding may be available from time to time to support specific types of development (i.e., accessible infrastructure). As a result, project priorities may shift in favour of those that qualify for the assistance of federal funding opportunities
- Public interest and enthusiasm about a specific area can drive a project much faster and further than it would otherwise be completed, and to a level of detail that may not have been outlined in the existing management plan
- Timelines for management and monitoring initiatives vary between 5, 10, or 25-year horizons depending on the subject of monitoring; some environmental trends require a longer monitoring period to assess observable change

**Determining the Influence of Site Context**

- Opportunity and visibility is highly influential on land management activities. High-profile sites are typically allocated more resources for planning and monitoring activities. Most heavily used conservation areas including the ILCA typically require more extensive programming and management because of a higher public expectation, and also offer opportunities for self-generated revenue that can be used to fund land management initiatives at other sites
- The currently rural context of the area is helpful in the sense that the impacts of some common challenges are diffused, which allows land managers the opportunity to be more proactive in land management techniques; establishing policy interventions, infrastructure or land use changes to control increasing recreational uses and protect ecologically sensitive areas
Defining Success and Failure

- Success, failure, and identification of meaningful targets were noted as being particularly difficult to define from both social and ecological perspectives, when dealing with ownership of such a large landscape.
- The newly established Natural Heritage System (based on a holistic systems approach to habitat preservation specifies minimum area required to sustain wildlife populations), and the Green Land Securement Strategy (defines areas that are eligible for acquisition as a means for conserving land) are helpful in understanding measures of success and failure on a landscape scale.
- On a broad scale, success could be measured through percentage of land acquired for conservation, yet targets can be difficult to define from an ecological perspective, and also to difficult to achieve in consideration of the resources required.
- Success and failure are difficult to define from a systems perspective as well. However, internal zoning systems are used to guide planning and development and to direct people to natural areas most able to sustain their use. This allows the majority of areas to remain passive and conservation focused, many without any formal public access.

Focus of Current Monitoring Practice

- Monitoring occurs at least a year before the Management Planning process begins.
- In general, monitoring is focused on informing area programming: information surveys monitoring use (i.e., trail counter program), trail quality, site quality and accessibility, boundary lines, encroachments (i.e., unauthorized sheds, toppled fences, refuse dumping), ecological inventories, including type and location of invasive species.
- New programs have recently been initiated to monitor and assess the effectiveness of ecological restoration techniques based on observed successes from year to year.

Responding to Observed Changes

- Rate of response to observed changes is dependent on priority, and may be influenced by resource availability. Although rapid responses occur particularly in situations that present a high level of public or ecological hazard (i.e., Emerald Ash Borer).
- Rapid changes may include policy amendments or additional design work to address and improve a particular concern.

Ensure Consistency and Commitment

- Board-approved Management Plans are helpful in ensuring strong support for land managers to follow through with the staffing, budgets, etc. necessary for a project.
- CVC also has an over-arching Strategic Plan and Integrated Watershed Program that outline directives, goals, and objectives for a 5-year period, speaking to appropriate land management, master planning, and monitoring across the watershed.
- Staff can improve consistency at a departmental level by working to ensure budget allocations for monitoring is made available from year to year; being pro-active and determining the work plan at least 5 years out to account for ongoing monitoring activity.
Establish Partnerships and Learn from Others
- Partnerships are a critical component of land management activities at the CVC
- Close working relationships with the Ministry of Natural Resources as well as member municipalities, including long-term partnerships and lease agreements that assist with overall land management as well as funding
- Support local school boards through subsidizing outdoor recreation; leasing lands to school boards for nature centers (one of which is located at ILCA)
- A variety of partnerships with NGOs and other local organizations exist as well, including relationships with the Ontario Heritage Trust (assistance with management and planning) and the Bruce Trail Conservancy (land acquisition and use licensing)
- Volunteers and local service clubs represent critical partnerships in terms of facilitating and supporting ongoing planting, restoration, and monitoring activities

Encourage Communication and Collaboration
- Land managers described good collaboration among Conservation Authorities, likely attributed to resources and similar management challenges
- Participation in an annual Conservation Area workshop, as well as local conferences and managers meetings to share best practices and lessons learned
- An internal email list was established as a method of sharing expertise and solutions between Conservation Authority staff, learning from existing projects
- Communication between inter-jurisdictional authorities varies; partnerships between some member municipalities are closer and stronger than others
- Occasionally collaboration is born as a function of interest, or a common topic forcing practitioners together

PUBLIC AND PROFESSIONAL INVOLVEMENT

Build Relationships
- A stakeholder advisory committee is involved in regular meetings throughout the Management Planning process. By building on each meeting and moving towards plan completion, land managers maintain a working relationship with the committee, keeping them engaged and representative of local communities
- Key properties that experience significant use are typically associated with Friends Of groups (ILCA has the Friends of Island Lake); special interest groups with a particular interest in the area. These groups are constantly involved in the decision-making and management processes. They provide assistance with funding, implementation, and feedback on observed change within the site
- A broad array of professional support is engaged throughout management processes, both in house and external. Landscape architects are involved in the Master Planning
process, as well as geotechnical engineers, civil engineers, heritage architects, shoreline engineers, planners, trained facilitators to help with public meetings, surveyors, appraisers, environmental scientists. Niche expertise is typically brought in from external sources, although CVC has retained the capabilities to do a much more specialty work in house recently

- Landscape architects are primarily involved in implementation of smart design techniques to help achieve policy directives; they are valued more for planning and quality design activities specifically at the site level (i.e., grading, design of facilities, gathering spaces, renderings for environmental assessments), rather than at the landscape scale. In-house landscape architects handle items such as boardwalk design and small-scale trail development, etc. Large-scale development is typically overseen by planning staff, with input of landscape architects solicited for best design practices

Encourage Public Education and Involvement

- The key method of keeping stakeholders involved and engaged is through consultation meetings that occur throughout the Management Planning process
- Public information centers and consultations are also used to involve the greater community in the planning process, although land managers are conscious of over-consulting and burnout; exhausting the public may influence community interest and involvement in a project
- Press releases are used to enhance public education and involvement
- The internal communications department may be engaged if needed to facilitate public relations regarding challenging issues
- Use of social media platforms (i.e., Twitter) to provide project updates to the greater community

CHALLENGES AND LIMITATIONS

Public Impact: Unintended and Inappropriate Use

- Frequency of unintended and inappropriate use of natural areas is typically quite high, although enforcement remains low as a function of resources
- A historical backlog of issues related to public impact contributes to the current volume of management issues, but have been difficult to address due to resource constraints; a complete inventory of all the known encroachment issues has been collected and documented, but addressing these issues has been a challenge because enforcement staff are minimal and under-resourced
- Continual monitoring and management of public impacts are considered in management plans; may receive additional funding through ongoing Master Planning processes to address some of these issues. An enforcement strategy has also been developed, but still requires the establishment of corresponding policies and procedures for its use, as well as board support in order to move forward with implementation
- A greater opportunity exists for behavioural enforcement within the heavily used areas since staff have a regular presence, in comparison with less frequented areas where
staff are only present occasionally to conduct inventory work

- Consideration is given to adjustments that could be made through the Master Planning processes to reduce the occurrence of undesirable activities (i.e., relocation of main entrances to reduce parking issues and regulate access, decrease vandalism, etc.)
- Users seem to have a general abstract understanding of the impacts of inappropriate use, but a personal disconnection with their own behaviour. For example, there is relatively high compliance with basic issues such as waste disposal and use of trash receptacles, but a low compliance for more complex relationships to ecological impacts such as dogs off leash
- Educational and directional signage and mitigative opportunities (i.e., waste receptacles) have been provided in public use areas. Although there appears to be measurable change as far as compliance, evidence is mostly anecdotal; have not formally tracked the success of response rates after educational or awareness initiatives

Funding and Resource Availability

- Resources and funding was identified as the biggest barriers for long-term management and monitoring
- In addition, retaining the management and political support to move forward with long-term management and monitoring initiatives is also a challenge

Ensuring Consistency and Commitment

- Long-term monitoring is typically not as desirable as some other projects, it is can be difficult to retain support and funding from year to year; people tend to have more interest in funding projects that are more tangible
- Ensuring consistency and commitment in the long-term is about communicating the importance of continued monitoring, and convincing people why it should be done Showing outputs in digestible, interesting ways is helpful in communicating this message and making it adaptable and understandable to internal clients

Time Constraints

- While considerable expert and empirical data exists regarding best practices for natural areas management, it was noted that public land managers typically do not have the luxury of time and resources to conduct internal research directed at the collection and digestion of available data to develop best policy practices. References are made when possible, but best practices are more commonly discovered through communication and partnerships with other local agencies and professionals

Retaining Public and Political Support

- Success is highly dependent on the public appetite; it is difficult to make anything happen without political and social support
- Communities can be resistant to change (i.e., amendments to the management plan calling for dogs on leash to reduce ecological impacts), so it is important to gradually introduce these changes, beginning with education and awareness campaigns followed
• Overall, conservation areas are intended for conservation of natural lands as well as recreation; these spaces provide a different type of nature than what is found in playgrounds and public parks. Thus, managing high-quality landscapes is important from an ecological perspective as well as a social perspective in terms of attracting users to these spaces and fostering an appreciation for what makes them valuable in the landscape.

• Making existing knowledge practical is also a challenge, particularly for abstract concepts. Understanding and communication of the most effective best practices can be enhanced through exploration of case studies via conferences or workshops that illustrate application of complex concepts in a way that can be easily understood and applied to local scenarios.

Redefining 'Success'

• Long-term success for conservation and habitat enhancement projects in intensively modified landscapes is a difficult challenge that requires a delicate balance between ecological preservation and social use:

"The only way conservation in urbanizing areas is going to survive is if we allow populations to get into those areas and enjoy them. That is the key pressure point: What's the balance? What's the appropriate level of use? Where and how should we be using it to protect the ecological features as best as possible, but at the same time allowing an appropriate level of public use? The balancing act is the land manager's role...these are important natural areas. They are protected in perpetuity for a reason, and people need to come and enjoy them, but enjoy them appropriately. The decision on what is appropriate is the balance that we have to strike as land managers" (KI6, 2017)
Summary
This chapter presented the results from each of the semi-structured interviews regarding current land management practices with key-informants from six local agencies. Key considerations for successful management of ecological landscapes were identified through key-informant interviews, and are summarized in Table 2.

Table 2. Key Considerations Identified

<table>
<thead>
<tr>
<th>Management and Monitoring</th>
<th>Public and Professional Involvement</th>
<th>Challenges and Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a strategy: set goals and establish timelines</td>
<td>Build relationships</td>
<td>Public impact: unintended and inappropriate use</td>
</tr>
<tr>
<td>Ensure consistency and commitment</td>
<td>Encourage public education and involvement</td>
<td>Retaining public and political support</td>
</tr>
<tr>
<td>Establish partnerships and learn from others</td>
<td></td>
<td>Funding and resource availability</td>
</tr>
<tr>
<td>Encourage communication and collaboration</td>
<td></td>
<td>Ecological literacy</td>
</tr>
<tr>
<td>Be proactive</td>
<td></td>
<td>Improving communication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uncertainty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time constraints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Redefining ‘success’</td>
</tr>
</tbody>
</table>
Chapter 5 Discussion

This chapter discusses the results of this investigation in terms of their implications for adaptive land management in general, and provides best practices to inform future design and management decisions for ecological projects in intensively modified landscapes. This chapter also includes discussion and reflection on the research process, including the methods used and research limitations identified, as well as recommendations for future research.

Through a number of pre-defined research objectives, this study intended to explore how AM contributes to the long-term success of ecological design projects in Southern Ontario. Through case study development, document review, and key-informant interviews, the researcher was able to develop a broad understanding of how local agencies are applying an adaptive approach in current management and monitoring practices, and how land management metrics are used to evaluate and respond to project successes and/or failures (Objective 1). Through this study, the researcher was also able to determine the methods and extents of public and professional involvement in the current management processes (Objective 2), and identify the common challenges and barriers to achieving long-term success for ecological projects in intensively modified landscapes (Objective 3). The following conclusions were made based on the results of the comparative analysis and in consideration of the research objectives:

Objective 1: Determine how local agencies are applying an adaptive approach in current management and monitoring practices, and how those metrics are used to evaluate and respond to successes and/or failures.

The literature discussed general institutional and social management challenges that can influence the effectiveness of an AM strategy, but that are not necessarily reflective of the AM approach itself (Canessa et al., 2016; Rist et al., 2013; Runge et al., 2011). Among those directly attributable to the AM process, the most frequently cited barriers to success included inconsistent understandings of the AM concept and application as well as insufficient resource monitoring regimes. Particular emphasis was placed on the idea that monitoring regimes typically focus on short-term, high-frequency ecosystem responses and are generally less attentive of long-term feedback loops and slower ecological processes (Allan & Curtis, 2005;
Allen & Gunderson, 2011; Moir & Block, 2001; Rist et al., 2013; Ruhl, 2016; Williams et al., 2009). This notion was explored through Objective 1. Results suggested that local land managers across agencies possess a comparable conceptual understanding of AM, describing systematic processes of continual observation, adjustment, and re-assessment within ongoing management practices in order to facilitate both short and long-term ecological success. Metrics are generally used to evaluate and respond to success and failure through a combination of active and passive monitoring practices designed according to known observable response times; occurring on a daily basis to address issues of public impact, as well as on annual and multi-year cycles, depending on the element of interest, to monitor ecological response to management actions. Although each approach cited strong ecological priorities, there was some variation in terms of how each strategy defined long-term success. Such variations may be attributed to institutional frameworks and challenges among higher-level authorities, as well as fluctuations in human and financial resources, which can present significant barriers to ensuring consistent support for long-term monitoring practices. Further, the complexities of nature and the long-term human influence extend beyond even professional understandings of cause-and-effect as well as scale. Although land managers acknowledged this challenge, it presents ongoing difficulties in terms of decision-making to ensure long-term ecological success based on our limited understanding of the extent to which human impacts and interactions with natural systems ripple through time.

Objective 2: Determine methods and extent of public and professional involvement in current management processes:

AM literature consistently emphasizes the importance of collaboration and public involvement to facilitate successful AM processes (Rist et al., 2013; Williams, 2011). Extensive collaboration with internal and external professionals, as well as continuous public education and involvement to enhance land management initiatives was demonstrated across agencies. Ongoing consultation and engagement of the public through community work groups, citizen advisory groups, and Friends Of groups was cited throughout the goal setting and decision-making processes for high-level land managers. General volunteer involvement, education, and
ongoing community support was identified as critical to the management process and to ensuring success for ecological initiatives on privately managed lands.

Community outreach to encourage public interest and involvement in conservation and habitat enhancement projects typically involves a variety of education initiatives including press releases, newspaper advertisements, newsletters, mail outs, information signage, social media updates, as well as the development and promotion of community stewardship programs. At a high-level, public information centers are also used to involve the broader community in land management initiatives. Transparency and collaboration with adjacent landowners was also cited as particularly beneficial to increase support and awareness for ecological initiatives on private lands.

**Objective 3:** Determine challenges and barriers to achieving long-term success for ecological projects in intensively modified landscapes.

A number of issues were identified as particularly problematic toward the success of ecological initiatives in intensively modified landscapes. The most prevalent challenges were associated with funding and resource availability, public impact, retaining public and political support, and decision-making in uncertain conditions.

Funding and resource availability was identified as a significant challenge for land managers across agencies. The amount of funding allocated to ecological projects significantly influences the amount of work land managers are able to accomplish, and also the degree of ongoing monitoring that can occur. Funding is a particularly significant challenge for private landholders because they are heavily reliant on grants and donations, as they are typically not supported by overarching government agencies or other regulatory bodies. However, funding is also a barrier for higher-level land managers, who expressed difficulties associated with retaining monetary commitment to long-term monitoring projects as a result of budget changes, staff turnover, and overarching decision-making processes inherent in the institutional framework.

Unintended and otherwise inappropriate public uses of natural spaces are a rampant challenge among land management agencies, which can present a multitude of barriers to achieving long-
term success for ecological projects. Property encroachment, trespassing, vegetation clearing, littering and waste dumping, development of informal trail networks, vandalism, and a general disregard for property use rules and signage are among the difficulties land managers are faced with on a daily basis. However, despite these negative influences, land managers rely on public use, interest, and involvement to support ongoing ecological initiatives, noting that success is highly dependent on the public appetite for such initiatives, as it is difficult for higher-level land managers to make anything happen on public lands without political and social support. Thus, maintaining a balance between ecological health and public use is a delicate task that all land managers must be cognisant of throughout the decision-making process.

The uncertainty inherent in managing ecological landscapes was also noted as a common challenge for the decision-making process. The dynamic and unpredictable nature of the environment is a challenge in itself, but due to the political and social climate of municipalities and larger public landscapes, there is often a high degree of pressure for immediate action from the community and over-arching bodies. Thus, it can be difficult to implement a long-term approach to land management in most cases, and decisions must often be made despite high levels of uncertainty; adaptive management offers land managers a flexible approach that can facilitate decision-making and also accommodate responses to observed changes in natural systems as they occur.

Other issues such as ecological literacy rates among the general public and improving communication between land managers across jurisdictional boundaries were also noted as challenges to facilitating long-term success of ecological initiatives on public and private landscapes.

Objective 4: Establish best practices to inform design and management of ecological projects in intensively modified landscapes from an adaptive management perspective.

A series of best practices were developed in consideration of the data collected through this study and the conclusions established through investigation of each of the previous objectives. Overall, it appears that the design and management of ecological landscapes can be improved through embracing a greater degree of formal citizen science involvement, investigating
methods of buffering ecological landscapes against intensification of adjacent landscapes, and redefining our traditional definitions and perceptions of successful ecosystems.

Citizen science presents an opportunity to promote further community education and involvement, and to reduce funding challenges. Based on interviews with land managers, establishing more formalized use of citizen science data collection applications may be useful in reducing the challenges expressed in terms of funding for ecological initiatives through the reduction of costs associated with long-term monitoring.

Awareness of relevant planning policies and anticipation of how surrounding development will impact natural spaces is another important aspect of facilitating long-term success of ecological landscapes. Although densification of the urban landscape is beneficial in terms of responsible development, conserving valuable land, and reducing sprawl, land managers must be cognisant of the influences such intensification can have on ecological landscapes within these intensively modified areas. As such, further investigation is warranted in terms of establishing methods for buffering conservation and habitat enhancement projects and urban natural spaces from the influences of increasing intensification within adjacent properties.

Further to that, understanding the context of these ecological landscapes and adapting our traditional definitions and perceptions of success to what can realistically be achieved within intensively modified systems was acknowledged and expressed by the land managers involved in this study. Land managers recognize that pristine, wild systems, free of public impact are an unrealistic outcome for ecological initiatives in intensively modified landscapes. Yet the case studies explored herein demonstrate that meaningful ecological landscapes, including habitat and conservation projects, can be achieved within complex human-dominated systems with proper resource investment, management, and a novel approach to defining successful ecosystem function.

**Lessons from the Case Studies**

Results of the key-informant interviews reinforced a number of ideas presented in the literature in terms of opportunities and challenges of an AM approach to land management. The following discussion highlights a number of key issues based on trends observed in key-
informant responses in comparison with information from the literature regarding AM practices and the design of ecological landscapes that can be used to inform the design and management of future ecological projects in intensively modified landscapes. Landscape architects and land managers entering into ecological design projects within the context of AM might design with the following aspects in mind in order to enhance the likelihood of long-term success for projects located in intensively modified landscapes.

A number of commonalities were observed across case studies in terms of definition and application of AM, collective community-based decision-making practices, public impact and involvement, as well as internal and external challenges and barriers to long-term success of ecological projects. Extent of management and monitoring plans varied as a function of time, resources, and policy. However, the uncertainty, variation, and generally slow rate of response inherent in management of natural systems was recognized and incorporated into management plans across the case studies through ongoing monitoring practices guided by overarching policies and documents. In intensively modified landscapes, the luxury of time is often not available due to the availability of resources, and the rate at which intensification occurs, leaving land managers to make decisions based on uncertainty. Private landholders are often restricted by the availability of resources, and must re-arrange land management priorities based on available funding and external support for particular initiatives. Publicly-owned lands are also subject to fluctuations in higher-level support as a function of the municipal framework, which operates on a 4-year election cycle and can influence the availability of funds and higher-level interest in a particular project.

**Existing Management Strategies**

As stated in the literature, an AM approach is comprised of three major components: (1) a management policy to guide actions, (2) a monitoring plan to guide system responses, and (3) a management system to put a plan into action (McCarthy & Possingham, 2007; Parma, 1996). Each case study demonstrated adherence to this structure, having developed site-specific management policies to direct management actions in terms of short, medium, and long-term goals. In the cases of publicly-owned landscapes, these guiding policies were often
supplemented with additional higher-level documents to create cohesive management targets across a larger landscape scale.

Challenges were experienced across all case studies as a function of funding and resource availability, as well as retaining support for ongoing monitoring practices, particularly within the higher-level land management agencies. Continued public involvement also presents an opportunity to reduce challenges associated with funding and resources because land management action within the public realm is heavily reliant on public interest and support for ecological initiatives. By retaining community support, public land managers increase the likelihood for higher-level project support in the long-term.

Public involvement
The challenges associated with maintaining equilibrium within socio-ecological systems was evident throughout the case studies. The public context of intensively modified landscapes is both a benefit and a challenge in terms of fostering the long-term success of ecological landscapes. Public and stakeholder support was frequently referenced in the literature as imperative to successful integrated land management practices in terms of knowledge integration and establishing meaningful human-nature connections in the collective pursuit of ecological objectives (Marsh, 2010; Miller, 2005). Based on results of the comparative case study analysis, several commonalities were identified across land management agencies in terms of both positive and negative aspects of public impact on ecological landscapes.

Benefits
Public involvement and the use of citizen science proved to be a critical component of the ongoing management and monitoring at each case study site. Citizens were vital throughout each management process, representing key sources of knowledge and support for ongoing ecological projects. Key-informants emphasized consistent public involvement throughout the decision-making, management, and monitoring processes in the forms of both formal and informal community groups, citizen advisory groups, and stakeholder committees involved in the initial development of goals and objectives through to project completion. Volunteer support is a particularly critical element to sustaining the ongoing management, monitoring, and educational initiatives among the private land holdings. Research has demonstrated that
nature is perceived as a valuable component of the landscape, and support for its protection has persisted (Clayton & Myers, 2009). In all cases, passionate volunteer groups dedicated to the long-term success of the project actively maintain communication with land managers to provide data collection, observational reports, feedback, and updates on project status. This on the ground, active monitoring is vital to facilitating a successful adaptive management process, as it allows land managers the opportunity to respond to observed changes.

**Challenges**

Land managers across agencies described public involvement as a key component of their land management strategy, but also experienced a number of issues with negative public impact in terms of unintended or inappropriate use of natural spaces on an ongoing basis. Many of these issues were linked to ecological literacy, user perceptions of ownership or entitlement, or a lack of resources for behavioural enforcement. The impacts of these activities can be far-reaching and can be difficult to address from both a design and management perspective, creating ongoing challenges in terms of ensuring long-term success of ecological design projects. Considering the dynamic nature of these impacts, an adaptive approach, which is evident across cases in varying forms, is perhaps the most effective method of addressing these impacts as it allows land managers the opportunity to respond to challenges associated with public impact as they arise. The commonality of many of these impacts allows an opportunity for enhanced communication and collaborative management in order to identify and build on existing best management practices. Many of the negative impacts of human influence are inherent with intensively modified landscapes. However, pre-emptive measures can be incorporated into the design process to reduce their occurrence. For example, proactive and timely measures regarding the placement of formal trails and lookout points in natural areas can reduce the development of informal trails, and avoid unnecessary damage to sensitive ecological communities.

**Policy Context**

The impacts associated with urban intensification are evident throughout the Southern Ontario landscape. The impacts, challenges, and responses of agencies who oversee the design and management of ecological design projects in heavily urbanized areas offer valuable information
to land managers responsible for ecological landscapes in growing regions. In terms of compensations for development impacts in urban areas, KI 5 of the TRCA spoke to a unique challenge for ensuring long-term health of natural spaces in heavily modified landscapes that can act as a warning to other land managers in less urbanized locations. Although compensation is required for habitat and natural space lost to development in major urban areas, current policy does not fully account for the impacts of densification on adjacent natural areas. KI 5 stated that there is currently no mechanism in the Planning Act that requires developers to allocate funds to the management of adjacent parks and green spaces in anticipation of the impacts that will be caused by rapidly intensified use of the area. This means that there is currently no requirement for investment in managing the use of the space, its ecological health, or differentiating between areas capable of withstanding heavy use from those with greater ecological sensitivities. The lack of such a mechanism can present a significant challenge in terms of ensuring long-term success of ecological design projects in urbanized landscapes.

**Defining Ecological Success in Modified Landscapes**

Current land management practices embrace AM throughout the design, decision-making, and monitoring processes because its ability to allow a structured but flexible approach is useful in addressing dynamic socio-ecological issues. Yet, considering the inherent variability in these systems, how does AM help land managers achieve successful ecological design in the long-term? When asked to comment on whether long-term success of conservation and habitat enhancement projects is achievable in intensively modified landscapes, interviewees were cautiously optimistic. Many suggested that in order for success to be achieved, perhaps our definitions of the term require some adjustment. Success can be achieved in social terms through strengthening the human-nature connection and fostering a sense of community stewardship to provide the support necessary to keep ecological initiatives moving forward. However, being realistic about what is achievable in intensively modified landscapes is also an important consideration. The ongoing intensification of existing urban spaces will continue to drive change within local ecosystems, making the notion of pristine, untouched ecosystems that are free of human influence an unlikely target in these landscapes. However, highly altered landscapes have demonstrated the ability to offer opportunities for the development of
meaningful habitat through proper investment of resources; such success is demonstrated through projects such as Tommy Thompson Park in Toronto which despite an entirely artificial origin and location within a highly developed area, has been recognized as an internationally significant bird area. Further to that, embracing the notion of novel ecosystems in definitions of successful ecological projects in human-dominated landscapes may also warrant additional exploration. Non-native species are often considered a threat to the integrity of local ecological systems. Yet combinations of both native and non-native species may provide conditions supportive of healthy ecological function among ongoing impacts of an altered landscape.

Reflection on the Literature Review
The literature review included discussion on a number of aspects associated with land management and ecological design practices in terms of the health and integrity of habitat enhancement projects in intensively modified landscapes. Overall, the case studies explored through this investigation reflected the concepts included in the literature, embracing AM and socio-ecological systems thinking through integrated land-management practices and extensive public involvement. The primary gap identified through the literature review was in terms of how knowledge of anticipated management practices can influence ecological design, which was used to inform the research question and produce the results herein.

Reflection on Methods
The three methods, including case study development, document review, and key-informant interviews, were used to explore six case studies and address the pre-defined research objectives intended to explore how AM contributes to the long-term success of ecological design projects in Southern Ontario. The use of these methods allowed the researcher to gather a wide range of site-specific data for each case study. The questionnaire developed to guide the key informant interviews was designed to incorporate a number of issues identified in the literature in a 45-60 minute interview. However, considering the time limitations and number of case studies involved, the breadth of the information gathered was restricted to broad-scale management. Although the methods were successful in obtaining appropriate information within the allotted time limits and developing a broad sense of land management practices among local agencies, recommendations may have been enhanced through the use of fewer
case studies as well as fewer but more concentrated questions to allow the researcher to delve more extensively into the AM process. A more restricted comparative analysis between two projects, one in a highly developed area and the other in a less developed area that is expected to experience significant growth, may yield useful information for enhancing resilience and the ability of a particular ecological design project to withstand the impacts of intensification.
Chapter 6 Conclusions

Landscape architects are among the professionals most influential on the existence and health of ecological systems in intensively modified landscapes. While there are many challenges associated with facilitating the long-term success of ecological design projects in complex landscapes, there remains a significant desire among the public to retain and manage natural spaces for ecological enhancement purposes as well as recreational use. There is a delicate balance between socio-ecological components of natural landscapes, as public involvement is both necessary and detrimental to ecological systems in intensively modified landscapes. The success of conservation and habitat enhancement projects can be increased through AM practices and integrated land management strategies, involving all levels of the community in the collective pursuit of ecological goals. Based on this study, land managers appear to recognize and utilize AM to varying degrees throughout the decision-making and management processes. Similar challenges and opportunities are experienced across case studies in terms of public influence and resource availability. Landscape architects are typically not involved in both the design and ongoing management of ecological design projects, but there is a clear opportunity for project enhancement through knowledge of anticipated management practices.

Limitations

Case study development was the primary method used in this research, and included document review as well as key-informant interviews. The effectiveness of the document review was constrained due to the inaccessibility of background documents for one of the case study sites as a result of privacy issues, which limited the comparative analysis portion of this research. The number of case studies included, as well as the number of key-informants interviewed and the breadth of literature reviewed was restricted by the timeframe of this investigation. Six case studies were investigated including two from each authority in order to allow equal representation to each of the three major conservation land managers identified for the purposes of this study. However, the time constraints of this investigation limited the depth of analysis possible for each case study site. A single case study analysis or comparison of only two case study sites using the methods presented in this study may enhance the understanding of
the adaptive management approach, and allow for further recommendations in terms of ensuring long-term success of ecological design projects.

**Implications for Landscape Architecture**

Design decisions alter environmental conditions and influence the overall function of natural systems. Effective ecological design can work to ensure the continued health of the environment while also addressing the needs of public users. This research has demonstrated that the involvement of landscape architects in ecological design projects can often be quite limited, particularly within the public realm where a collaborative system often dictates professional roles and level of involvement in project development. Based on the results of this research, it is evident that landscape architects could have a greater role in contributing to ecological projects. In an increasingly urbanized world, incorporating ecological considerations into site design and management is imperative to maintain integrity and facilitate long-term success within ecological landscapes.

**Recommendations for Future Research**

This research has provided a brief insight into how AM is used by local land management agencies to facilitate long-term success of ecological design projects. Due to the time limitations of this study, in-depth investigation of each of the six case studies was not possible, thus a cross-case comparison approach was undertaken. While Deming and Swafield (2011) recognize the benefits of comparative case study analysis in the realm of landscape architectural research, they also discuss the rich and descriptive information that can be gleaned from in-depth analysis of a single case study. As such, future research may enrich the information presented in this thesis through in-depth analysis of AM in the context of a single ecological design project, or perhaps a smaller comparative case study analysis using only two case study sites. The comparison of a highly urbanized site with another from an area in the early stages of urbanization could yield recommendations for coping with intensifying development, and provide more detailed recommendations for landscape architects in terms of ecological design projects in an AM context.

Further investigation into creative strategies for buffering ecological landscapes from the influences of intensification in adjacent areas would be beneficial to enhancing land
management strategies and facilitating long-term success of ecological initiatives. Additional exploration of formalized citizen science approaches and their ability to improve challenges land managers experience in terms of funding, as well as informing landscape architectural practice would also be of great relevance to land managers and landscape architects in facilitating successful design, implementation, and management of conservation and habitat enhancement projects in intensively modified landscapes.
References


Dramstad, W., Olson, J., & Foreman, R. (1996). Landscape Ecology Principles in Landscape

101


https://doi.org/10.1007/s00267-016-0721-3

https://doi.org/10.1016/j.jenvman.2010.10.039

https://doi.org/10.1016/j.biocon.2016.01.012


Appendices

Appendix I. Key Informant Participation Request Script Email

Contact Email - Draft

Dear [Name]:

My name is Chelsey Trendle and I am a graduate student in the Master of Landscape Architecture program at the University of Guelph, working under the supervision of Dr. Karen Landman to complete my master's thesis.

I am currently conducting a research project on habitat conservation planning and land management in Southern Ontario. The objectives of my research are to:

- Understand the planning and management practices of public and private agencies
- Determine how an adaptive management approach contributes to the long term success of conservation and habitat enhancement projects in highly altered landscapes
- Understand major challenges for conservation land managers
- Identify the role of landscape architects in ensuring the long term success of conservation and habitat enhancement projects
- Generate recommendations to facilitate more cohesive management regimes at a landscape scale

You have been contacted to contribute to a perspective on this subject by participating in an interview, which will take approximately 45-60 minutes of your time. If you are willing to participate in this interview, or have further questions about the project, please let me know.

I look forward to hearing from you.

Sincerely,

Chelsey Trendle
Master of Landscape Architecture Student
Student Investigator
University of Guelph
Response Email - Draft

Dear [Name]:

Thank you for your interest in this study. You will have the opportunity to review the write up and consent to the use of information gathered through the interview process and its analysis prior to publishing. Interview questions will also be provided prior to the scheduled meeting date.

Please note that interviews will be recorded for the purposes of this study and the name of each organization identified in the final write up. We will not include names of individuals interviewed, but with your consent, we do request permission to refer to professional training and/or designations of interviewees.

Interviews can take place by phone or in-person. Please advise on a date or time that is most appropriate for your schedule.

Thank you. Your participation in this study is greatly appreciated.

Sincerely,

Chelsey Trendle
Master of Landscape Architecture Student
Student Investigator
University of Guelph
Appendix II. Key Informant Interview Questions

MANAGEMENT AND MONITORING

1. Define adaptive management. Would you say this accurately describes your management approach?

2. Would you describe your management process as passive (gradual process, guided by factors other than learning to improve conservation) or active (active pursuit of learning)?

3. Does your management strategy involve partnerships with other local organizations? *Partnerships with Conservation Authorities, schools, etc*

4. How often do you review and update your management strategy?

5. Considering the dynamic nature of ecological systems and the uncertainty associated with system responses to management action;
   a. How do you set goals for what you are trying to achieve, and how do you determine where to invest resources for research and monitoring? *Ex. Guided by external pressures, stakeholder interest/values, legal responsibility, resource/funding availability etc.?*
   b. How has the context and location of your site influenced management practices? *(Challenges/limitations, opportunities, mitigating impacts of adjacent land uses)*

6. How do you define, measure, and respond to success and failure in terms of conservation and habitat enhancement projects?

7. How do you ensure consistency and commitment (incl. consultants, temporary and maintenance) in terms of management and monitoring practices in order to achieve long term goals, despite changing conditions in funding, staff, resources, etc. from year to year?

8. Describe your monitoring design
   a. In terms of [the case study site], how long has monitoring been ongoing?
   b. What is the primary focus of your monitoring regime? How often are these parameters measured?
   c. How do you set a timeline for your monitoring goals? How far do they extend?
d. How quickly would you say observed changes in system response are translated into management action?

9. In general, how would you describe the relationship between conservation land managers? Is there active communication and collaboration to develop cohesive management plans and ensure project success beyond local boundaries?
   *Ex. Strong, actively involved vs. lack of communication - to ensure cohesiveness in management initiatives, and conservation success extends beyond agency boundaries

PUBLIC AND PROFESSIONAL INVOLVEMENT

10. How do you keep stakeholders involved in the decision-making, management, and monitoring processes?
   (Public consultations, outreach, address tensions, conflicts of interest, etc)

11. How does public involvement influence management decisions?
   *Ex. Political pressure, external policies, city counsellor decisions made independent of public involvement

12. Do you involve external consultants in the establishment or adjustment of a management regime? If so, what types of professionals are included?
   *Ex. Landscape architects, ecologists, biologists, engineers, planners, etc.

CHALLENGES AND LIMITATIONS

13. What impacts of unintended or inappropriate use have you experienced on the site?
   How frequently does this occur, and how are you responding?
   *Ex. Property encroachment, mowing of 'naturalized' areas, waste dumping, trespassing, parties, informal trail networks (that do not reflect ecological design principles)

14. Have the impacts of these unintended uses been included in your monitoring design or investigated for potential influence on the long-term success of conservation and habitat enhancement projects?

15. Would you say citizens understand the impacts that inappropriate use can have on the health of natural spaces?
16. Do you find it difficult to access expert/empirical knowledge about how current use of natural spaces influences overall ecological health (in order to support your planning and management decisions)?

17. In general, what are the most significant barriers for long-term management and monitoring, and how could this be improved?

*Ex. Resource/funding availability, availability of staff to monitor/control/enforce/clean up, communication, time, trained personnel, elements that extend beyond the scope of a project etc.

18. In your opinion, can long-term success of conservation and habitat enhancement projects be fully achieved in highly altered landscapes? Explain why or why not.