

An Analysis of Toronto's Urban Ravine Policies and the Achievement of Ecological Integrity

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Executive Summary

The city of Toronto contains a valuable urban forest that is composed of street trees, parks and ravines with a combined total of over 10.2 million trees. In order to protect the previous ravines and its native species, the City of Toronto requires strong, meaningful policies that will direct the ecological management of this ecosystem. While policymakers and the managers of urban forests have often relied upon canopy cover objectives as a measure by which to direct management, the use of ecological integrity measures as a standard for guiding management has gained popularity and usage in recent years, particularly following the declaration of Parks Canada, who announced that this principle would become the primary priority with federal parks management system (Parks Canada, 2016). Ecological integrity represents a sound principle for ecological management within urban forest areas, such as Toronto's ravines. This project reviewed the critical policies of the current policy framework that guides the management of the Toronto's ravines to evaluate how well compositional, structural, and functional measures of ecological integrity were protected within this framework. These policies included the City of Toronto Official Plan, the Ravine and Natural Feature Protection By-law of the Municipal Code, and the Conservation Authorities Act. These policies were found to contain provisions which promoted the achievement of certain components of ecological integrity but were inhibited by the scope of their policy framework, lacking clear guidelines and specific management restrictions. Further, it was found that the body of policy governing Toronto's ravines contained no outright restriction on the planting of invasive species, directly compromising the compositional integrity of the ecosystem. To increase the degree to which Toronto's policy framework protects for components of ecological integrity within the ravines, both short and long-term policy recommendation were made. These recommendations included both minor provisions within the existing policy framework, as well as larger changes to the policies which guide ravine management itself.

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Introduction

The City of Toronto contains an urban forest that consists of more than 10.2 million trees (City of Toronto, 2013). These can be found along Toronto's various streets and in parks or private backyards, but also within Toronto's vast network of precious ravines. Toronto's ravines are natural corridors that contain a variety of wildlife and plant species, and also support critical natural processes within the city's densely urban environment (City of Toronto, 2016). While Toronto's ravines account for 17% of the city's total area, they contain 87% of Toronto's Environmentally Significant Areas (City of Toronto, 2016). Environmentally Significant Areas (ESA's) are natural areas of critical importance to wildlife, plant species and natural processes, and are identified by a criteria outlined within Toronto's Official Plan, which legally protects these areas (City of Toronto, 2015). Not only are the ravines highly valuable to the city of Toronto because they make up the majority of the city's ESA's, but the ravines also provide value to the city and its inhabitants due to the number of ecological, social and economic benefits that are created by this unique urban ecosystem. The ravines provide greenspace for citizens of Toronto to recreate, improving their quality of life, as well as improving the city's aesthetic (City of Toronto, 2013). Additionally, the ravines and urban forested areas like them provide climate and environmental benefits in the form of high temperature mitigation, storm water retention, and improvements to air quality through their ability to filter air pollution (Conway & Urbani, 2007).

However, given that the ravines are a component of Toronto's urban forest, they face the same series of pressures that are symptomatic of this type of ecosystem. Specifically, the ravines are vulnerable a variety of pressures due to their proximity to the rest of the city and, like other urban forests, face a significant amount of anthropogenic disturbances as a result of this (Steenberg et al., 2016). Furthermore, urban forests such as the ravines often face stresses such as invasive species and fragmentation, which may be further exacerbated by divisions in ownership classification within the forest. This is the case within

Toronto's ravines, as 40% of the ravines are privately owned, while the remaining 60% is on public land (City of Toronto, 2013). In order to adequately protect urban forests from the stresses they face, as well as the variety of values they provide cities, strong policy is required in order to effectively guide ecological management of urban forest ecosystems (Steenberg et al., 2016). Toronto's ravines are no different in this regard, as the ravines have been found to be highly susceptible to invasive species, insect pests, diseases amongst its trees and human disturbances. Invasive species have been found to be particularly problematic, as a large proportion of Toronto's urban forest and ravines is heavily dominated by Norway Maple trees (*Acer platanoides*) a non-native, invasive species that impedes the growth and succession of native tree species and other plants within these areas (Millward & Sabir, 2011). Norway Maple trees were heavily favoured for city planting during the mid-1900's due to their ability to thrive while in city conditions, but the invasiveness of this species has had significant impacts on Toronto's ravines and other forested areas resulting in the extirpation of native plant species (Martin, 1999). While the degree to which Norway Maple trees have impacted and impeded native species within the ravines and city has been clearly observed, the City of Toronto does not currently prohibit or restrict the planting of this invasive species within any body of policy, and remains available for citizens to plant this species on their property (Millward & Sabir, 2011). However, given the highly invasive nature of this species and the impact Norway Maple has been observed to have on impeding native plant succession within the ravines, this lack of policy threatens native plant species within the city of Toronto and its ravines. Furthermore, this is exacerbated by the fact that 40% of the ravines are privately owned, resulting in just less than half of the total area of the ravines being open to the planting of this invasive species by private citizens. As the ravines and native species within them already face significant pressure for invasive species such as Norway Maple trees, this lack of policy is highly problematic (Martin, 1999). To ensure that the ravines are able to persist within the urban environment, policy that will guide effective ecological management that protects against invasive species and other threats to the ravines is required for this ecosystem.

Policy Background

Unlike other countries, such as the United States, urban forests within Canada are managed by the municipality in which they exist and guided by municipal law (City of Toronto, 2013). As a result of this, the management of the urban forests of Toronto, including Toronto's network of ravines, falls under the jurisdiction of the City of Toronto who develop the body of policy to govern how the ravines are managed (City of Toronto, 2013). However, management of the ravines is impacted by policies from the municipal, provincial and federal levels of government, resulting in a variety of different policies that have varying amounts of influence within this policy framework. Despite this, the management of the ravines are most significantly guided by provincial and municipal policies, and therefore are managed by the City of Toronto and Toronto and Region Conservation Authority, who act on the authority of the provincial government. In addition to the City of Toronto, the majority of the ravines fall within the jurisdiction of the Toronto and Region Conservation Authority, as established by Conservation Authorities Act, which was first introduced in 1946 (Conservation Authorities Act, 1990). This is a provincial piece of legislation which assigns watersheds throughout Ontario to fall under the protection of different conservation authorities. As such, the Toronto and Region Conservation Authority (TRCA) is responsible for the management and protection of the ravines, stream corridors and valleys that fall within the eleven different watersheds under its jurisdiction, as mandated by the government of Ontario (Conservation Authorities Act, 1990). While the TRCA is responsible for a large proportion of the management activity that is undertaken within the ravines and may create management plans, the City of Toronto remains responsible for the development of legislation and policy that has the ability to further guide management specifically related to the ravines and broader urban forest. This is because the body of policy that provides the TRCA its authority in managing, conducting research and various other activities related to their work in the ravines is a broader piece of policy that encompasses and applies to all conservation authorities within Ontario. With this understanding, the City of Toronto is the primary

polycymaking institution within the context of Toronto's ravines, while the TRCA and City mutually share the management of this ecosystem. Within the City of Toronto's Official Plan, the TRCA is described as partner in managing the ravine ecosystem and natural areas of Toronto, which reflects this relationship (City of Toronto, 2013).

Methodology

This project conducted a policy analysis that critically reviewed policy framework specific to the ravines of Toronto, that the City of Toronto has in place to manage this ecosystem. Toronto's ravines are defined legally, within the Ravine and Natural Feature By-Law, as a "discernable land form with a minimum two-metre change in grade between the highest and lowest points of elevation that may have vegetation cover and that has or once had water flowing through, adjacent to, or standing on, for some period of the year" (City of Toronto, 2008). Policies guiding management on this specific type of ravines land classification were reviewed and analyzed. Policies such as the Federal Species at Risk Act, the Canadian Environmental Protection Act, Invasive Species Act, the Environmental Assessment Act and the Planning Act, while having some influence on ravines management, were not assessed within this project as these policies are not the key drivers of ravine's management in Toronto. It is further necessary to note that Toronto has a Strategic Forest Management Plan (2012-2022) as well as a Parks Plan (2013-2017), both of which actively guide management activities within the ravines. However, these plans are in place for a limited period of time, and must be created in accordance with both provincial and municipal laws and by-laws (City of Toronto, 2008). With this understanding, the framework of policies pertaining to the ravines largely have the power to influence the development of management plans, and management plans must comply with the existing policy framework. For this reason, these legal policies alone were the focus of this study.

The group of policies evaluated specifically included the City of Toronto's Official Plan, the Ravine and Natural Feature Protection By-law (Chapter 658 of the Toronto Municipal Code), and the Conservation Authorities Act, as these are the central policies that most significantly guide the management of Toronto's ravines. To conduct this policy analysis, this project employed the use of ecological integrity as a qualitative metric against which the pertinent City of Toronto policies were each reviewed. Each policy was individually analyzed to determine which of its provisions related to the protection and promotion of the achievement of components of ecological integrity within Toronto's ravine ecosystem.

Methodology – Ecological Integrity

While various frameworks of ecological integrity have been utilized to assess and measure ecosystems, the assessment of policies against this concept is less familiar. As such, it was necessary to develop a framework that would effectively serve to identify policies that contributed to the achievement of ecological integrity within Toronto's ravines. In 2007, Parks Canada released a report titled "Monitoring and Reporting Ecological Integrity within Canada's Parks" which outlined a program by which the ecological integrity of an ecosystem may be monitored and assessed. This has been since readdressed in 2016, at which point Parks Canada released a report on the State of Canada's Natural and Cultural Heritage Places, which proclaimed that from that point forward, maintaining and restoring ecological integrity within Canada's national parks would be the primary priority of the organization (Parks Canada Agency, 2016). Not only does this development mark a clear change in how the federal government will manage parks and natural ecosystems, it characterizes a broader popularization of the use of ecological integrity as a standard to which ecosystems should be managed. The federal government describes an ecosystem as having ecological integrity when it is "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" within the

Canada Parks Act, s. 2(1). (Canada National Parks Act, 2000). Within this definition, the ecological integrity of an ecosystem requires that that ecosystem maintain its native components, including both plants and animals, physical structure, as well as its natural processes that allow it to persist (Parks Canada, 2007). Critical components identified within this definition include native species, landscape structure, and natural processes.

While the concept of ecological integrity as a method by which to guide ecological management has become widely used within the context of larger wilderness areas and national parks, its use within urban forest management plans remains less developed (Ordonez & Duinker, 2012). This represents an important next step in urban forest management, which has previously revolved around canopy cover goals for the direction of management rather than comprehensive management criteria based on the urban ecosystem itself (Kenney et al., 2011). However, the diversity of ecosystems in which ecological integrity is used as a measurement of an ecosystem requires that ecological integrity be transferrable as a method of ecological monitoring throughout different regions (Ordonez & Duinker, 2012). This requirement of applying the concept of ecological integrity broadly is also relevant in using ecological integrity as a method by which to analyze policy. In order to effectively analyze different policies in the context of ecological integrity, it is necessary to identify key criteria of ecological integrity. Many indicators of ecological integrity have been developed for various different ecosystems, but a consensus throughout the literature on ecological integrity is that compositional, structural, and functional measures are the critical components of ecological integrity (Tierney et al., 2009) (Reza & Abdullah, 2011). For this reason, this project utilized these three components of ecological integrity as criteria by which to examine policy.

The compositional component of ecological integrity is concerned with the various species within the ecosystem of focus, measuring the composition of the species that are present, as well as to what extent those species are native or invasive (Reza & Abdullah, 2011). Achieving a high level of compositional ecological integrity would prioritize the insurance that native species pools occupy the ecosystem, while invasive species do not (Tierney et al., 2009). With this understanding, policy that protects for the compositional measures of ecological integrity within an ecosystem would aim to maintain and promote native wildlife and plant species and control for invasive species. Next, the structural component of ecological integrity is largely concerned with the physical environment and landscape of the ecosystem itself and ensuring that the ecosystem has the necessary physical requirements to support the compositional and functional aspects of the ecosystem (Taylor et al., 1993). While this is largely related to ecosystem resilience, policies that would protect or promote the structural component of ecological integrity would be those that maintain an ecosystem's ability to be resilient and intact (Tierney et al., 2009). For example, this would include policies that mandate the retention of a certain volume of coarse woody debris (CWD), standing deadwood or protect the ecosystem from destruction to the landscape (Tierney et al., 2009). Maintaining the physical structure of the ecosystem is key to this component. Finally, the functional component of ecological integrity concerns the critical processes of an ecosystem. This may include ecological, hydrological, or even evolutionary processes, but is concerned with an ecosystem's ability to be self-organizing, resilient and sustainable (Reza & Abdullah, 2011). Within this regard, policies that benefit tree growth rates or nutrient cycle of an area by protecting the ecosystem from contaminants or other threats to that ecosystem may contribute its functional ecological integrity (Tierney et al., 2009). While a variety of different ecological integrity frameworks exist, the majority of work on the topic concludes that measures of composition, structure and function are the three critical components of ecological integrity criteria for an ecosystem (Tierney et al., 2009) (Reza & Abdullah, 2011). This project relied upon a qualitative analytical framework that

was structured around these three components of ecological integrity and analyzed how effectively the City of Toronto's different policies, that direct management within the ravines, achieve protection for these ecological integrity measures.

Results

The City of Toronto's Official Plan

The City of Toronto's Official Plan contains policies that lend themselves to the achievement of compositional, structural and functional measures of ecological integrity within Toronto Ravines. However, the language utilized within the Official Plan limits how effective these policies are in enforcing certain ecological standards due to their lack of specificity and explicit requirements regarding the ravines. Policy 3.4.1. (a) i) and ii) of the Official Plan both concern minimizing and containing soil, and groundwater contaminants (City of Toronto, 2015). Ensuring contaminants are removed from soil and groundwater benefits the nutrient cycle of the ecosystem and serves as a benefit to the functional component of the ravines ecological integrity (Tierney et al., 2009). However, due to the language of this policy, there is no specific requirement on ensuring or minimizing contamination; the requirement is only that efforts occur. As there is no measurable requirement set for the extent to which soil and groundwater contamination must be minimized, the policy is flexible and does not mandate the strict avoidance of all contaminants from the ecosystem (City of Toronto, 2015). This is seen again within section (a) iv) of the same policy, which requires the release of invasive species only to be minimized, not restricted. While the aim of this policy is to contribute to the compositional integrity of the Toronto's urban forest and ravines, assisting the regeneration of native species, it limits its success in this objective by failing to employ decisive language within the policy framework that will effectively restrict the proliferation of invasive species (City of Toronto, 2015).

Ravine and Natural Feature Protection By-law

Chapter 658 of the Toronto Municipal Code, known as the Ravine and Natural Feature Protection By-law, evolved from a series of former by-laws that governed the ravines within Toronto, and is now a singular by-law applying to all ravine areas that fall within the description outlined within this policy. Alternative to the Toronto Official Plan, provisions within the By-law are specific in their requirements and objectives, creating clear restrictions and constraints on certain activities within the ravines. The provisions within this policy protect the ravine ecosystem by prohibiting the “injury or destruction of trees”, alternation of the slope or grade of land, and the filling, grading, dumping of soils and other materials within the ravines (City of Toronto, 2008). The by-law mandates that for these activities to occur, a permit must first be attained by the applicant, submitted to the General Manager of Parks, Forestry and Recreation, and approved. In cases where the permit is requesting the removal of a tree, the permit must include a detailed tree inventory, protection plan, tree removal plan and also a tree replacement plan. Alternatively, in cases of a permit requesting to alter the grade of land within the ravines, the applicants permit must include a plan showing existing site conditions, a future drainage plan and a geotechnical report of the area (City of Toronto, 2008). The By-law lists the 14 contexts under which permits for the removal of trees or alternation of land grade may be approved by the General Manager and four additional criteria under which a permit may be issued with conditions. These contexts for permit approval include conditions such as those in which tree removal is required for the remediation of contaminated soils, tree removal required as it is threatening structural damage of a building, or if in cases where the tree or landscape change is required based on an approved ravine restoration or forest stewardship plan (City of Toronto, 2008). Conditions under which a trees removal does not require a permit require that the tree be certified by the General Manager as dead or highly diseased. Additionally, changes in land grade or slope may occur without a permit if the area of concern and change is minor (grade change <10% and 5 cubic metres), or if the change is being managed by the TRCA (City of

Toronto 2008). While there are some changes under which the Ravine and Natural Feature Protection By-law allow for the removal trees and alternation the physical landscape within the ravines, this policy effectively mitigates these alternations to the natural landscape. In this way, the Ravine and Natural Feature Protection By-law protects the both the structural and functional elements of the ravine ecosystem by prohibiting interference and destruction of the trees, forest structure, and physical landscape conditions within the ravines. The Ravine and Natural Feature Protection By-law does not contain policy provisions that contribute to compositional measures of the ravine's ecological health.

Conservation Authorities Act

The Conservation Authorities Act, R.S.O. 1990, C.27, is a provincial statute that first came into force in 1946, now a Revised Statute of Ontario (R.S.O.), that governs and assigns 36 conservation authorities throughout Ontario to the management of their respective jurisdiction based on watersheds (Conservation Authorities Act, 1990). Section 5 of this statute designates the Toronto and Region Conservation Authority (TRCA) as responsible for 11 watersheds within the Greater Toronto Area. The Conservation Authorities Act establishes the TRCA as having power to conduct research within their jurisdiction, create structures and reservoirs through dam construction in areas susceptible to flooding, and also regulate the dumping of fill in areas significant to the control of flooding and pollution (Conservation Authorities Act, 1990). An important amendment to the Conservation Authorities Act was included in 2006, which expanded the area regulated by conservation authorities as well as the regulatory authority of the TRCA. This mandated that any development, site alteration, construction, or placement of fill by property owners within these regulated areas would first require a permit from the respective conservation authority (Lyons, 2015). This regulation is known was Ontario Regulation 166/06, and it focuses largely on protecting waterways and stream corridors within the TRCA's jurisdiction, which serves to benefit both structural and functional elements of the ravine ecosystem. Specifically, this regulation within the

Act assists in primarily protecting and regulating critically important hydrological processes within Toronto's ravines. Furthermore, the regulation of dumping and site alterations within the TRCA's jurisdiction protects the physical structure of the ravines, in addition to limiting pollution within the ravines and thereby contributing to the nutrient cycle's protection and the ravines functional processes (Lyons, 2015) (Tierney et al., 2009). Similar to the Ravine and Natural Feature Protection By-law, the Conservation Authorities Act does not contain policy provisions that protect for the compositional integrity of the ravines ecosystem, or other protected areas under TRCA authority.

Discussion

Both the Toronto Official Plan and the Conservation Authorities Act are policies that are broad in scope. The Toronto Official Plan contains a variety of policy issues ranging from regulating public transportation within the city to concerns regarding economic growth, while the Conservation Authorities Act is a provincial policy that concerns the assignment of over 30 conservation authorities throughout the Ontario (City of Toronto, 2013) (Conservation Authorities Act, 1990). Within the context of the Toronto Official Plan, the lack of detailed objectives within these policies is likely a symptom of the nature of this piece of legislation, as the Official Plan has a broad spectrum of objectives and covers a variety of policy issues. As a result of this, the Official Plan provides numerous provisions on a variety of topics and develops broad goals and directions for these policies, but lacks the specific objectives that contain measurable standards and strict directives to guide management within policy areas such as the ravines. However, the provisions within policy 3.4.1 of the Toronto Official Plan remain beneficial to the achievement of ecological integrity measures within Toronto's ravines as they identify the need to preserve growing environments for trees, improve habitat for native species, regulate the removal and destruction of trees, and support physical processes of Toronto's natural areas (City of Toronto, 2015). Each of the policy sections identified within Toronto's Official Plan by this project have been found to

contribute to the compositional, structural and functional components of the ravine's ecological integrity, but remain limited in their ability to mandate stronger ecological requirements for this ecosystem due to a lack of measurable requirements within provision and the broad scope of this particular policy. Despite this, the Toronto Official Plan still contains policy provisions that contribute towards the compositional, structural, and functional measures of the Toronto ravine's ecological integrity. The Official Plan repeatedly states its prioritization of native species, as well as the need to regulate the destruction of trees, contributing to the ravine's compositional integrity (City of Toronto, 2013) (Tierney et al., 2009). Further, the Official Plan includes provisions discussing the need to minimize and remediate soil and water contamination within the city's natural areas, control invasive species and maintain a growing environment for trees within the ravines (City of Toronto, 2013). These provisions serve to benefit compositional, structural and functional aspects of the ravine ecosystem by guiding the management plans and management activities to pursue these objectives, despite their lack of specificity (Reza & Abdullah, 2011).

The Ravine and Natural Feature Protection By-law of Toronto's, Chapter 658 of the Municipal Code, includes clear restrictions and guidelines within its policy framework, prohibiting certain land activities within the ravines or requiring the acquisition of approved permits prior in order to authorize physical changes within the ravines. Specifically, the Ravine and Natural Feature Protection By-law prohibits the removal and destruction of trees within the ravines, as well as the dumping within the ravines, and alterations of the slope and grade of land. While the by-law provides that these activities may occur when a permit to do so is attained and approved, the series of conditions under which a permit may be approved do not appear to allow for the compromise of the ravine's ecological integrity and are most often approved when justified by a greater ecological objective. One exception to this can be found under sections 658-6(2) and 658-6(3) of the By-law. Section 658-6(2) states permits may be obtained,

“Where site plan approval, subdivision approval, consent or Committee of Adjustment approval under the *Planning Act* has been obtained, and:

(a) Tree injury or destruction is required based on plans approved by the Ontario Municipal Board, City Council, or a final and binding decision of the Committee of Adjustment.

(b) The placing or dumping of fill or the alteration of the grade of land is required based on plans approved by the Ontario Municipal Board, City Council, or a final and binding decision of the Committee of Adjustment.

(3) Where a building permit, front yard or boulevard parking permit or permission for driveway widening has been obtained, and:

(a) Tree injury or destruction is required to facilitate construction in accordance with an approved permit or permission.

(b) The placing or dumping of fill or the alteration of the grade of land is required in order to facilitate construction in accordance with an approved permit or permission.”

(Ravine and Natural Feature Protection By-Law: Toronto Municipal Code, 658-6(2-3). 2008.)

Both of these provisions allow for the destruction and removal of trees, as well as the dumping of fill and alteration of grade of land based on building requirements for parking lots, subdivisions, or other structures, so long as the building has attained the necessary permits (City of Toronto, 2008). Unlike the other conditions within the by-law that allow for the approval of a tree removal or grade change permit, these provisions are not based on ecological considerations or the betterment of the ravine ecosystem.

While the majority of this by-law protects for structural and functional elements of the ravines by limiting

damage to the forest and landscape structure within the ravines, as well as disturbances to the grade of land that are critical to natural processes within the ravines, these particular provisions represent a gap within the policy, leaving the areas of the ravines vulnerable to development. An additional policy gap within the by-law is the lack of focus on compositional measures of ecological integrity within the ravines. Specifically, the by-law lacks planting guidelines, restrictions, or any other measure to control invasive species within the ravines and also fails to include measures to prioritize and promote native species against invasive species pressure. Due to extent to which the ravines and its native species have been observed to be vulnerable to invasive species pressure, particularly Norway maple trees, this appears to be an obvious gap which requires attention (Martin, 1999).

The Conservation Authorities Act contains provisions within it that provide more specific measures of regulation than the Toronto Official Plan, including clear limitations on dumping and filling, restrictions on development within the TRCA's protected stream corridors and waterways in order to maintain hydrological processes. While this serves to protect structural and functional aspects of the ravines ecological integrity, the Conservation Authorities Act does not contain regulations that contribute to compositional aspects of the ecosystem's ecological integrity. This reflects a gap in the achievement of policies pertaining to the achievement of ecological integrity within the ravines, as structural and functional components of the ravines are protected with the body of provisions, while compositional aspects of the ecosystem are not. The Conservation Authorities Act also regulates development within its protected areas, ensuring that no development can be undertaken without the approval of a TRCA permit (Conservation Authorities Act, 1990). This serves to assist in 'filling' the policy gap within the Ravine and Natural Feature Protection By-law's lack of regulatory power limiting development, as it contains greater conditions pertaining to protecting hydrological processes, such as ensuring any proposed development has a detailed drainage plan (Conservation Authorities Act, 1990).

Policy Recommendations

Strong policy that is well constructed is necessary in order to effectively guide ecological management within the ravines. Unlike a management plan which may be relevant for a specific park or time frame, a policy has binding legal authority over the issues that it outlines, until that policy is replaced, amended or removed (Béland, 2009). A policy that pertains to Toronto's ravines, has binding authority over all areas that fall under the outlined definition of ravines within the Toronto. This provides policies a widespread, authoritative impact on policy subjects, allowing them the potential to serve as highly effective tools to guide management in an impactful way. However, when policy gaps are identified and policy change is required in order to improve management outcomes, the process of policy change has been observed to face institutional constraints that impede how this change can occur and resulting in the process of policy changing becoming one that is incremental (Béland, 2009). For this reason, seeking to make policy changes and recommendations to a body of policy that is less broad and therefore less constrained by varying objectives, is more easily amended and changed than one with a broad scope of policy objectives (Béland, 2009). Due to these considerations, the process of policy change for the Toronto Official Plan, or the Conservation Authorities Act would face a greater series of institutional impediments compared to the process of policy change for the Ravine and Natural Feature Protection By-law, which is a municipal body of policy with a more concentrated focus of objectives. Further, previously conducted amendments to the Ravine and Natural Feature By-law are encouraging that this by-law could be further adapted for the betterment of the ravines, towards the achievement of greater ecological integrity within a shorter period of time (City of Toronto, 2008). For this reason, both short and long-term policy recommendations have been made. Short-term policy recommendations have been created within the context of the Ravine and Natural Feature Protection By-law's policy framework, while longer-term recommendations have been made towards the Toronto Official Plan, as well as towards new policy for the City of Toronto.

Short-term Recommendation

To begin with a short-term recommendation, within section 658-5 B. 3(d), 658-6 A. 12(c), 13(c), 14 (b) 658-6 B. 1-3, the by-law contains guidelines which mandate the replanting of new trees to replace damaged or injured trees that have been removed, as well as trees that have been removed for the purposes of development and soil remediation. A simple yet highly beneficial amendment to these provisions would be to require that all tree replanting guidelines and provisions require the planting of native species of trees native species within the ravines, benefiting the native composition of the ecosystem. This would serve as an ongoing benefit to the ravine's native species composition, while working within pre-existing policy provisions, as these replanting guidelines currently exist within the by-law. Next, to further benefit native species and control for invasive species within the ravines, it is recommended that an outright prohibition be introduced on the planting of invasive, non-native species within the ravines, such as Norway maple. This policy provision would effectively forbid the planting of invasive species within the areas outlined by the Ravine and Natural Feature By-law.

An additional policy that is recommended to be made in the near to immediate future is the adoption of the Toronto Ravine Strategy. The Toronto Ravine Strategy is an ongoing project that seeks to guide the policy and management of Toronto's ravines, and prioritizes the restoration of ecological integrity within the ravines (City of Toronto, 2016). While the Ravine Strategy is currently going through the City of Toronto's policy process and ultimately awaiting budgetary approval and the adoption of the final strategy, it would serve to be highly beneficial and improve the policy framework surrounding the Toronto ravines, allowing for the greater protection ecological integrity within this ecosystem. One such component contained in the Toronto Ravine Strategy that would bolster ecological integrity is proposed requirement of management plans for all Environmentally Significant Areas within the City of Toronto. It is recommended that the Toronto Official Plan, the body of policy which designates ESA's, require that

management plans be created for all ESA's in order to better ensure their preservation. As Toronto's ESA fall under the varying ownership of the Toronto and Region Conservation Authority, the City of Toronto, and private citizens respectively, it is necessary to mandate the requirement of management plans for ESA's by way of policy to ensure that ESA's within each of these different ownership categories are forced to have management plans created. Mandating this action by way of policy will assist in ensuring this action occurs, despite the challenge created by varying public and private ownership categorizations. However, given that this policy recommendation can be expected to create more significant impacts on the structure of ravines management, it requires a greater amount of time to attain institutional approval, as demonstrated by the current Toronto Ravine Strategy timeline, which has been underway for well over three years (City of Toronto, 2016). For this reason, this policy recommendation of adopting the final Toronto Ravines Strategy and mandating the creation of management plans for all Toronto ESA's has been established as a long-term recommendation.

A final, long-term policy recommendation relates to Toronto's Official Plan. While Toronto's natural areas are prioritized within this plan, the ravines themselves are not specifically designated under individual policy provisions. As the ravines represent a unique and valuable natural ecosystem to the City of Toronto, it is recommended that an amendment be made to the Official Plan to prioritize and protect the ravines specifically. Further, within the wording of this policy provision, it is recommended that ecological integrity be used as the standard to which the ravines are directed to be managed, "protecting and promoting compositional, structural and functional measures of ecological integrity within the ravines". While the adoption of the Toronto Ravine Strategy will greatly benefit the management of the ravines, the Toronto Official Plan represents a superior body of policy. For this reason, it will serve as beneficial to the ravines to be acknowledged and protected within this policy.

Conclusion

Toronto's urban forest, and the highly valuable ravine ecosystem within it, is a precious resource to the city of Toronto that requires protection in order to ensure its longevity. In order to protect the ravines, strong policy is required to guide ecological management and sufficiently protect the ravines from the various pressures that it faces, such as invasive species and urban development. This requires policies that go beyond canopy cover objectives and instead represent a nuanced policy framework that is reflective of the different requirements of the ecosystem over which they govern. By reviewing the body of policy that guide the Toronto ravine's ecological management for provisions that protect compositional, structural and functional components of the ecosystem, this project analyzed these policies to determine how effectively they protected and promoted the ecological integrity of the ravines. While the Toronto Official Plan contained a variety of provisions that related to the benefit of compositional, structural and functional measures of ecological integrity, these provisions were non-specific and lacked clear guidelines that could be enforced within the ravines and natural areas. Next, the Conservation Authorities Act contained clear measures and restrictions with its framework, particularly protections for structural components of the physical landscape, as well as protections for stream corridors and waterways within the TRCA's regulated area, maintaining functional, specifically, hydrological, processes. Finally, the Ravine and Natural Feature Protection By-law was found to maintain both structural and functional processes through restrictions within the by-law, limiting the destruction and removal of trees, as well as the alteration land grade or filling within the ravines. However, both the Conservation Authorities Act and the Ravine and Natural Feature Protection By-law failed to include provisions that protected the ravines against invasive species, and lacked considerations towards the composition of the ecosystem. It is imperative to note that this analysis strictly assessed the policy framework that guides management within the ravines, identifying gaps within that framework. Both the TRCA and City of Toronto conduct management activities that go beyond the mandated requirements of the bodies of policy which direct

them, however what is important to understand about this is that stronger policy requirements for the ravines have the ability to increase the standard of management that must be achieved within this ecosystem. This represents the opportunity for ecological integrity to be placed within the policy framework of the ravines as a management guiding priority.

While policy gaps were identified within each of the policies, short and long-term policy recommendations were made for the Ravine and Natural Feature Protection By-law and Toronto Official Plan, as well as the forthcoming Toronto Ravine Strategy. Policy recommendations were made within the current policy framework to allow for the achievement of greater measures of ecological integrity protection within a short period of time, but recommendations were made to the policy structure surround the ravines as a whole. While these recommendations will require a greater amount of time to achieve due to the institutional constraints that inhibit the process of policy change, they will create more meaningful protection of ecological integrity within Toronto's ravines and mandate management based on the requirements of this ecosystem. This has been repeatedly acknowledged as an effective basis for the sustainable management of an ecosystem, as the compositional, structural and functional components of an ecosystem may act as indicators for the integrity of that ecosystem, assisting managers in the formation of management objectives and direction (Reza & Abdullah, 2011).

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