Woodland Management Strategy

March 2024

City of Vaughan

VAUGHAN

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Land Acknowledgment

We respectfully acknowledge that the City of Vaughan is situated in the Territory and Treaty 13 lands of the Mississaugas of the Credit First Nation. We also recognize the traditional territory of the Huron-Wendat and the Haudenosaunee. The City of Vaughan is home to many First Nations, Métis and Inuit people today. As representatives of the people of the City of Vaughan, we are grateful to have the opportunity to work and live in this territory.

Project Team Acknowledgment

The development of this Woodland Management Strategy was achieved through the joint collaboration of the City's project management team and external technical professionals.

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The Strategy at a Glance

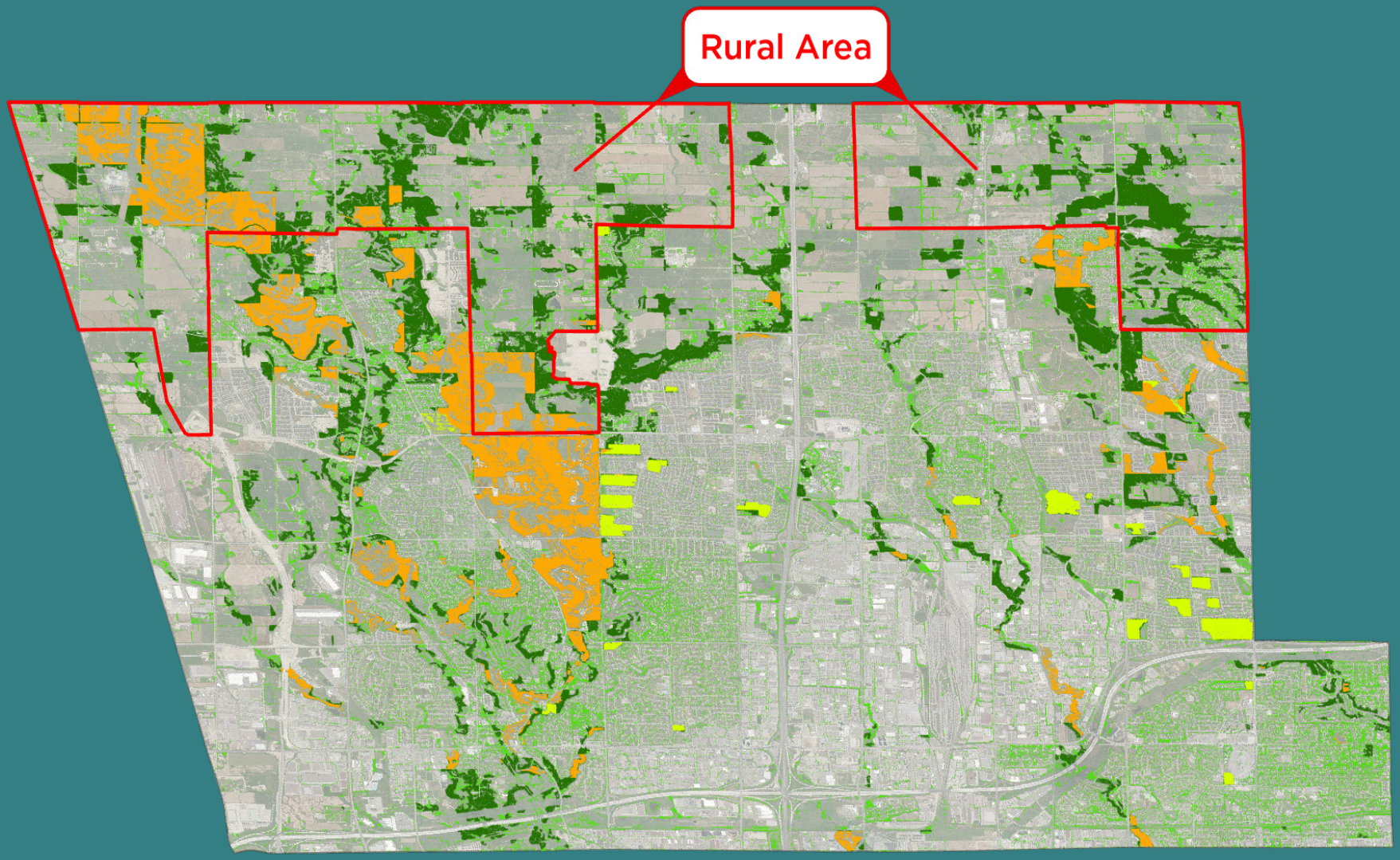
This document is Vaughan's first woodland management strategy (WMS). Woodlands are natural forested areas defined by the City's Official Plan in alignment with Ontario's *Forestry Act* and *Municipal Act*. Woodlands occur across the City on public and private property. Among woodlands, the City directly owns and manages 27 community "woodlots" that are a special focus for this document.

Vaughan is home to approximately 3,300 hectares of woodland area. Nearly 6% (200 hectares) is owned and managed by the City in one of 27 woodlots. Woodlands occupy 12% of Vaughan's land area, contributing more than half of the total tree canopy cover. Despite playing a crucial role in providing various social, cultural, and ecological services to residents and visitors, woodlands in the City have not been managed proactively. Emerging pressures from urbanization, globalization, and climate change pose challenges to the resilience of these vital community assets. A coordinated and evidence-based approach to woodland management is needed to address these challenges.

This Strategy consists of four main parts:

In **Section 1**, the Woodland Management Strategy is introduced. A broad overview of the City's woodlands is provided with the history of their management, and relevant regulatory and ecological contexts.

In **Section 2**, the strategic framework for the Woodland Management Strategy is identified. This section presents the various program actions, each categorized under one of five goal areas, along with a set of supporting objectives, indicators, and targets. **Section 2** identifies the necessary



0 1 2 4 6 km

- City of Vaughan-owned woodlot
- Woodland owned by Toronto and Region Conservation Authority
- Other woodland (e.g. private ownership or other agency)
- Other tree canopy (non-woodland)

resources, general management actions, and support structures that the City must establish to support an ongoing proactive management program.

In **Section 3**, the document outlines the City's approach to management planning for its own woodlots, a crucial element of sustainable forest management within the City's organization. While **Section 2**'s Strategic Framework outlines actions at a city-wide level to support all woodlands, it lacks specific guidance for managing individual woodlots owned and managed by the City. **Section 3** addresses this gap by detailing the woodlot management planning framework piloted for the Sugar Baker Bush Woodlot Management Plan. Woodlot management plans, or WMPs, are needed to translate the principles of sustainable woodland management from the WMS into operational guidance. The City will look to prepare a WMP for each woodlot and pursue cyclical updates to ensure its management is adaptive. The Woodlot Management Planning framework is illustrated on the subsequent page.

Section 4 identifies various program standards and guidelines to support the development and implementation of the City's woodlot management activities, but is also a resource for other landowners and managers responsible for woodlands in Vaughan.

Vaughan's Woodlot Management Planning Framework

27 Woodlots in Vaughan managed to achieve a balance of

2 Core Forest Management Values

1) Biodiversity Conservation
2) Safe and Enjoyable Human Use

The weighting of the criteria and indicators varies among woodlot types, reflecting the differing significance of indicators to the long-term management goals of each type of woodlot.

4 Woodlot Types

1 
Recreational Woodlot

2 
Lowland/ Riparian Woodlot

3 
Upland Woodlot

4 
Remnant Woodlot

Criteria and indicators are employed to generate scores for the City's two core management values. These scores serve as a condition assessment for each woodlot.

Long-term Management Objectives

Issues raised through criteria & indicator assessment inform short-term management prescriptions.

16 Criteria and Indicators

Used to assess long-term woodlot management objectives.

13 for Biodiversity Conservation

- Invasive Species
- Unauthorized Encroachment
- Regeneration
- Supercanopy Trees
- Coarse Woody Debris
- Snags
- Uncommon Trees & Rare Woodlands Communities
- Mast Trees
- Woodland Connectivity
- Woodland Size
- Species at Risk
- Relative Biodiversity
- Interior Forest Habitat

3 for Safe and Enjoyable Human Use

- Recreation Quality
- Risk Management
- Surface Water Drainage

Short-term Management Prescriptions

Shortcomings raised through the criteria & indicator assessment are used to craft short-term management prescriptions. These prescriptions are aligned with long-term management objectives.

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Definitions

Coarse woody debris (CWD) Large pieces of deadwood resting on or above the forest floor. See also **log**.

Diameter at Breast Height (DBH) As defined in Vaughan's Tree Protection By-law 052-2018, as amended.

Free to Grow (FTG) A description of a forest stand that meets stocking, height and/or height growth rate, as specified in a silvicultural prescription, and is judged to be essentially healthy and free from competing vegetation.

Interior Forest Habitat Woodland habitat setback more than 100 m from the nearest forest edge.

Links The shortest path between a wooded patch and each of its closest neighbours. Links exist both within woodlands (i.e., a measure of fragmentation) and between woodlands (i.e., a measure of connectivity city-wide). Barriers and cost of movement were not considered in the simplified links measure used in this report and the associated WMPs.

Log For the purpose of measuring **coarse woody debris**, a length of CWD at least 3m long and 7.5cm in diameter at the small end.

Rare Woodland Community Any white oak swamp, bur oak swamp, red maple-hemlock swamp, white cedar-hemlock swamp, oak-hickory deciduous stand, mixed oak deciduous stand, hickory deciduous stand, sugar maple-black maple stand, hackberry stand, red spruce stand. Non-exclusive list. Adapted from Hamill, 2001[1].

Species, Exotic Any species which is not a **native species**. This may include species from other parts of the world, other parts of North America, or other parts of Ontario.

Species, Invasive Any species considered by the City of Vaughan to pose a threat to environmental health and ecosystem integrity.

Species, Native Any species which is naturally occurring in Vaughan's native ecosystems.

Species, Non-woody Any species of plant that does not grow persistent woody tissue.

Species, Woody Any species of plant that grows persistent woody tissue

Stem Of a tree, any primarily upright portion of the plant from which branches or foliage may be grown.

Tree Any woody plant meeting the definition of a **Tree** as defined by the City of Vaughan's Tree Protection By-law 052-2018, as amended.

Tree, Cavity Cavity trees are dead or dying trees that have one or more holes in the trunk or main branches. Cavities can also be found in some healthy trees, such as basswoods. These dead or dying trees serve many purposes for wildlife, and can be used for nesting and raising young, protection from predators, a place to store food, hibernation and roosting.

Tree, Mast Any white oak, red oak, beech, cherry, hickory, basswood, butternut, black walnut, ironwood, or serviceberry having a dbh of 25 cm or greater.[1] Mast trees are important ecological species in that they produce significant crops of food for wildlife.

Tree, Snag Refers to a standing, dead or dying tree, often missing a top or most of the smaller branches. Snags are standing dead trees that provide feeding, nesting and perching opportunities for birds such as woodpeckers and hawks, and mammals such as squirrels and raccoons.

Tree, Uncommon Any bitternut hickory, butternut, black walnut, bur oak, white oak, ironwood, gray birch, black maple, or hackberry. Non-exclusive list. Adapted from Hamill, 2001[1].

Tree, Supercanopy Refers to any living tree with a dbh of 50 cm or greater.[1] Supercanopy trees are large, living trees that emerge above the main canopy of a stand. They create vertical structural diversity in the forest and are used by wildlife as lookouts, refuges, perches, and landmarks.

Woodland The City of Vaughan Official Plan defines a woodland as any area of at least 0.2 hectares having a minimum density of trees dependent on the tree size. The definition excludes cultivated forests like tree farms and orchards. This is a legal definition that extends from Ontario's Municipal Act and Forestry Act. In practice, 'woodland' refers to any natural or semi-natural forest found on public or private property. See Section 1.2 for more information.

Woodlot The City of Vaughan uses the term 'woodlot' to refer to specific woodlands that are owned and managed by the City. This is not a legal definition, but is used by the Department of Park, Forestry, and Horticulture Operations and the community. Vaughan is home to 27 City-owned woodlots, supporting a range of values and nearly 200 ha of woodland canopy.

List of Acronyms

ALB Asian long-horned beetle

AMP Asset Management Plan

BAF basal area factor

BBD beach bark disease

Btk *Bacillus thuringiensis kurstaki*

CWD coarse woody debris

DBH diameter breast height

DED dutch elm disease

EAB emerald ash borer

ELC ecological land classification

EOMF Eastern Ontario Model Forest

WMP Woodlot Management Plan

FTG free to grow

GIS geographic information system

HWA hemlock wooly adelgid

ICI industrial, institutional, and commercial land uses

LDD *Lymantria dispar dispar* (i.e., spongy moth)

MFTIP Managed Forest Tax Incentive Program

MTSA major transit station areas

NHS natural heritage system

OS open space land uses

OPFA Ontario Professional Foresters Association

OWA Ontario Woodlot Association

SAR species at risk

SCT supercanopy tree

SFM sustainable forest management

SOUF State of the Urban Forest (Report)

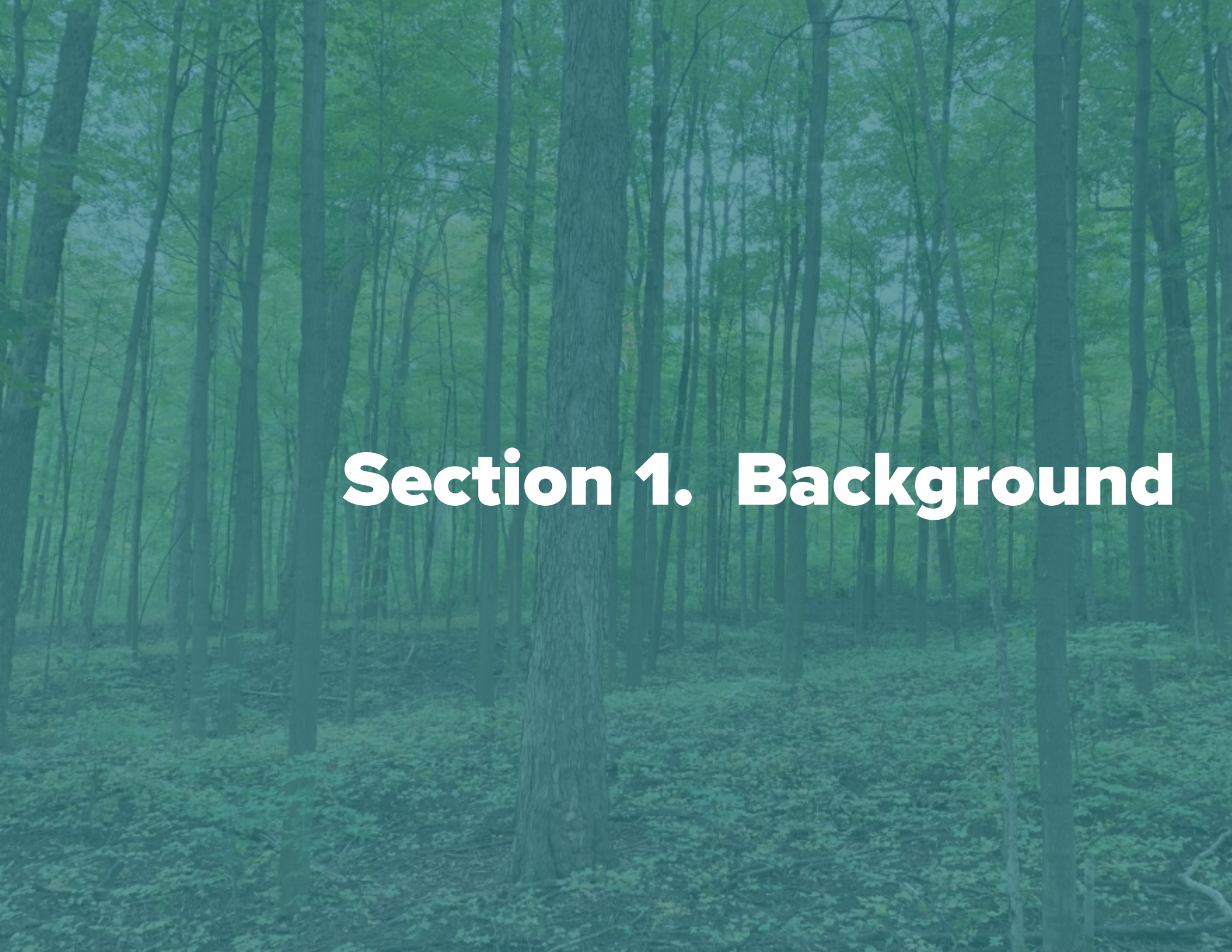
TRAQ Tree Risk Assessment qualification

UAV unmanned aerial vehicle

UFMP Urban Forest Management Plan

WMP Woodlot Management Plan

WMS Woodland Management Strategy



Section 1. Background

1.1. Introduction

The City of Vaughan has developed its first Woodland Management Strategy (WMS), designed to provide sustainable direction for the management of Vaughan's community woodlands over the coming two decades.

The WMS complements the City's Urban Forest Management Plan (UFMP), prepared concurrently with this Strategy in 2024. While the UFMP offers guidance on all facets of urban forest management taking place within the City, the WMS provides detailed recommendations and strategic guidance concerning woodlands in Vaughan, with a focus on the 27 woodlots owned and managed by the City (**Figure 1-1**).

Urban woodlands serve a broad range of human-centric and environmental roles within our community. Despite their diverse values, woodland management in Vaughan has not historically been supported by a coordinated direction or consistent level of funding. This document aims to address that gap by presenting the first comprehensive approach for woodland management in the City's history, charting a course towards holistic and sustainable woodland management for the City.

WMS Overview

The Strategy is divided into four sections, each addressing part of a sustainable approach to woodland management within the City of Vaughan.

Section 1 serves as an introduction to the woodland management strategy, providing a broad overview of woodlands in Vaughan, their values, and their current management.

Section 2 covers the strategic framework of the WMS, outlining a variety of specific program actions, each categorized under one of five goals and accompanied by a set of supporting objectives.

Section 3 outlines the City's strategy for Woodlot Management Planning, a critical element of sustainable forest management. Woodlot management plans translate the principles of the WMS into operational guidance for specific woodlots. The framework was applied to Vaughan's Sugar Baker Bush woodlot, and is intended to be applied to the City's remaining 26 woodlots over time.

Section 4 identifies specific program standards and guidelines that can support the development and implementation of woodlot management plans or woodland management planning by others in the City.

Vaughan's UFMP and WMS

Vaughan's UFMP covers all trees within the city, while the WMS is designed to guide management of woodlands with a focus on the City's woodlots. While the two documents align, the WMS offers more detailed actions tailored to the specific needs of Vaughan's woodlands.

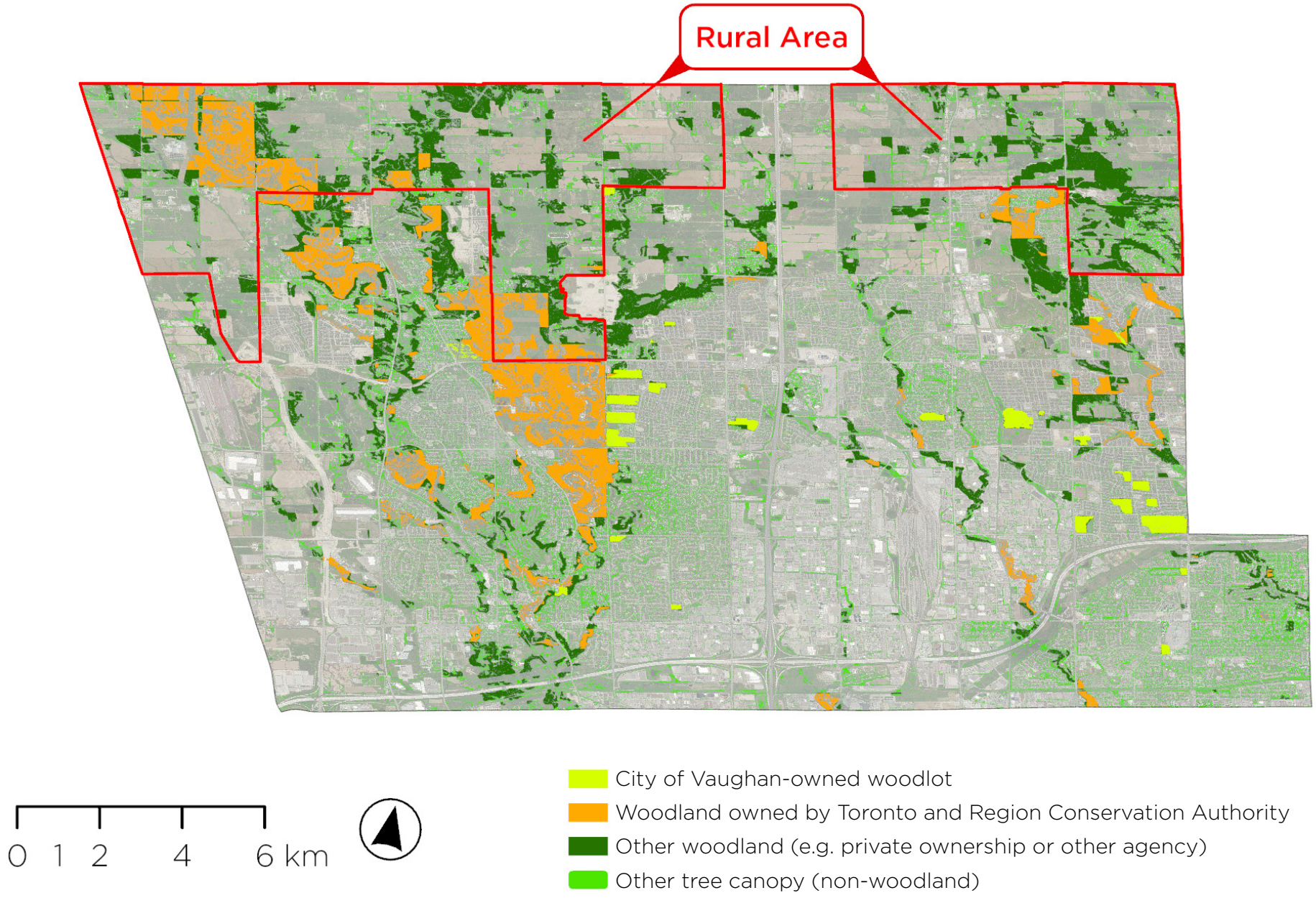


Figure 1-1. *Vaughan canopy, woodland, and woodlot mapping.*

1.2. What is a Woodland?

In practice, a woodland refers to any natural or semi-natural forest. However, in the Province of Ontario, the term is defined by legislation and carries policy implications. Under the *Forestry Act*, "woodlands" refers to land with at least:

(a) 1,000 trees of any size, per ha,
(b) 750 trees measuring over 5 cm in diameter, per ha,
(c) 500 trees measuring over 12 cm in diameter, per ha, or
(d) 250 trees measuring over 20 cm in diameter, per ha,
(e) but excludes orchards or Christmas tree plantations.

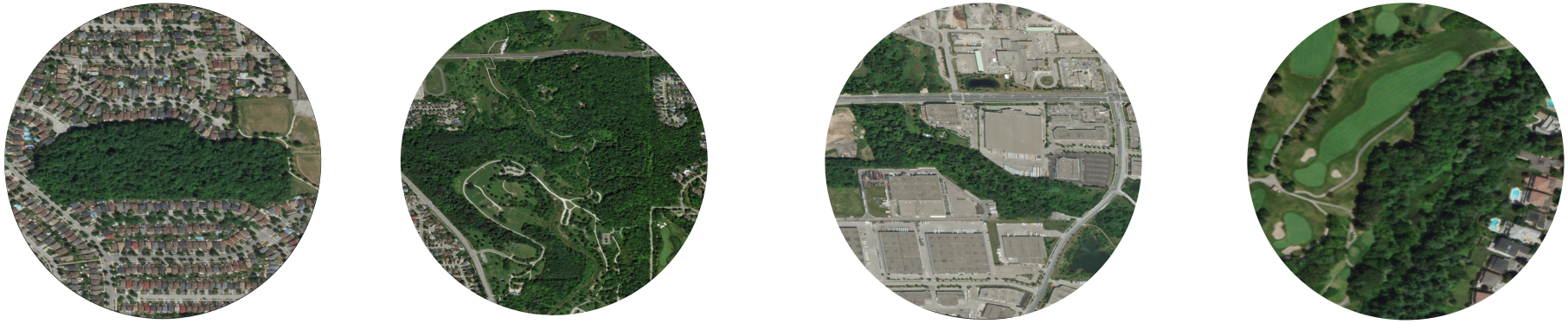
Under the *Municipal Act*, the *Forestry Act* definition applies, but with the added criteria of being 1 hectare or more in area. York Region uses the definition but applies it to areas of at least 0.2 hectares in size, a criteria repeated by Vaughan's Official Plan. Woodlands described in the WMS are areas of natural or semi-natural forest at least 0.2 hectares in size, regardless of whether they currently meet tree density requirements in the Forestry Act definition.

This recognizes the diversity of forest ecosystems that may be managed in the City for their forest value.

Despite the WMS having a focus on the City's role in woodland management, the reality is that woodlands span a range of land uses and take on many forms within Vaughan. Woodlands exist across public and private ownership structures, span the urban-rural divide, and can be found in subdivisions, along streams and riparian areas, and integrated into land uses such as open space, parks, and golf courses.

Some directions in the WMS recommend the City partner or coordinate management activities with other agencies to promote whole-system thinking about woodlands in the City. Where appropriate, guidance in the WMS can be used by other actors responsible for woodland management in Vaughan.

Vaughan contains a diversity of woodlands on public and private property



1.3. Why Are Woodlands Important?

Well-managed urban woodlands provide a multitude of benefits to all Vaughan's residents, whether human or part of our natural biodiversity. These advantages, commonly referred to as ecosystem services, encompass activities such as carbon storage and sequestration,[2] stormwater interception and attenuation,[3] the creation of wildlife habitats, urban cooling,[4] and many others. Ecosystem services are typically categorized into four main groups:

Cultural services refer to those that contribute positively to mental and physical well-being, including spiritual values, recreational offerings, and tourism.

Regulating services pertain to the regulation of the natural and built environment, encompassing activities such as pollination, air and water quality regulation, stormwater attenuation, and urban cooling. Vaughan's urban woodlands play a critical role as an element in the city-wide stormwater management network.

Supporting services are those that contribute to the conditions necessary for healthy ecosystems. These include vital processes such as the soil nutrient cycle and photosynthesis.

Provisioning services encompass the tangible products derived from woodlands, including medicines, fruits, nuts, and wood products (such as timber).

Although not formally acknowledged in Vaughan's current approach to asset management, woodlands are an important municipal asset. Similar to engineered infrastructure like roadways and sewers, woodlands offer community benefits. Therefore, it is essential to manage woodland assets on City property in a way that achieves optimal balance between public investment in their maintenance and the community benefits supported.

1.4. Who is responsible for Woodlands?

Vaughan's Forestry Operations Division, under Parks, Forestry and Horticulture Operations, is the primary agent responsible for the management of woodlands on City property. However, many internal City departments and external actors play a role in or otherwise influence management outcomes in woodlands on City property and elsewhere.

Internal Agents

Historically, Forestry Operations has had no dedicated resources to support woodland management, resulting in entirely reactive management of woodlands on City property. Woodland management by the City of Vaughan primarily consists of monitoring the severity of pest outbreaks in collaboration with partners, and mitigating hazardous trees where they are known to exist.

Other City divisions such as Parks Infrastructure, Planning and Development manage public assets within or interfacing with woodlands (e.g., trails infrastructure). Interventions to maintain, expand, or enhance these assets can impact woodland ecosystems, and in many cases involve activities that should be considered woodland management, like tree removal.

Divisions such as Policy Planning and Special Programs and Infrastructure Planning and Corporate Asset Management both develop and administer strategic initiatives and projects that impact woodlands and their management. Planning policy is one of the key mechanisms through which woodlands are protected in the City of Vaughan. Environmental Services is responsible for the management of the City's stormwater management infrastructure, of which riparian and other woodlands serve as a critical component.

External Agents

A range of actors external to the City also participate in woodland management within the City. The Province of Ontario is responsible for the administration of a policy framework for woodland protection within Vaughan through the Natural Heritage System. These include policy documents such as the Provincial Policy Statement, the Growth Plan, and the Oak Ridges Moraine Conservation Plan.

The Ministry of Transportation (MTO) and private rail corporations together own a large amount of land within the City (more than 1,100 hectares). These are some of the most sparsely treed lands in the City and present opportunities for woodland growth.

York Region administers the policies of its own Official Plan and Forest Conservation By-law, and affords additional layers of woodland protection. York is responsible for the management of all street trees lining arterial roads in Vaughan, and is widely recognized as a disciplinary leader in urban forest management.

The Toronto and Region Conservation Authority holds a major role in woodland management with the City of Vaughan, having ownership over 1,000 hectares of woodland canopy and managing more than 2,100 hectares of land area within the City. These landholdings contain roughly 25% of all canopy area within the City of Vaughan. Many of the City's woodlots are contiguous to large TRCA

woodlands such as the Boyd Conservation Area. The City actively works with the TRCA to ensure woodland management practices are aligned, and that resource use toward sustainable management is coordinated between organizations. On some lands, TRCA also has the authority to regulate, requiring approval before tree removal can take place.

Local Enhancement & Appreciation of Forests (i.e., LEAF) is a non-profit organization that broadly supports community education and outreach. LEAF administers such programs as the backyard tree planting program; where residents can have a tree planted for a relatively low fee. LEAF is leader in Ontario's urban forestry non-profit space, and offers an important partner to Forestry Operations in continuing to build community interest, education, and capacities.

Various other partner organizations such as Vineland Research and Innovation Centre, the Ontario Woodlot Association and Eastern Ontario Model Forests, and the Ontario Urban Forest Council, and the International Society of Arboriculture (Ontario Chapter). Each support important relationships, often supporting knowledge exchange and expertise, program capacity, supporting outreach, program reputation, or developing resources.

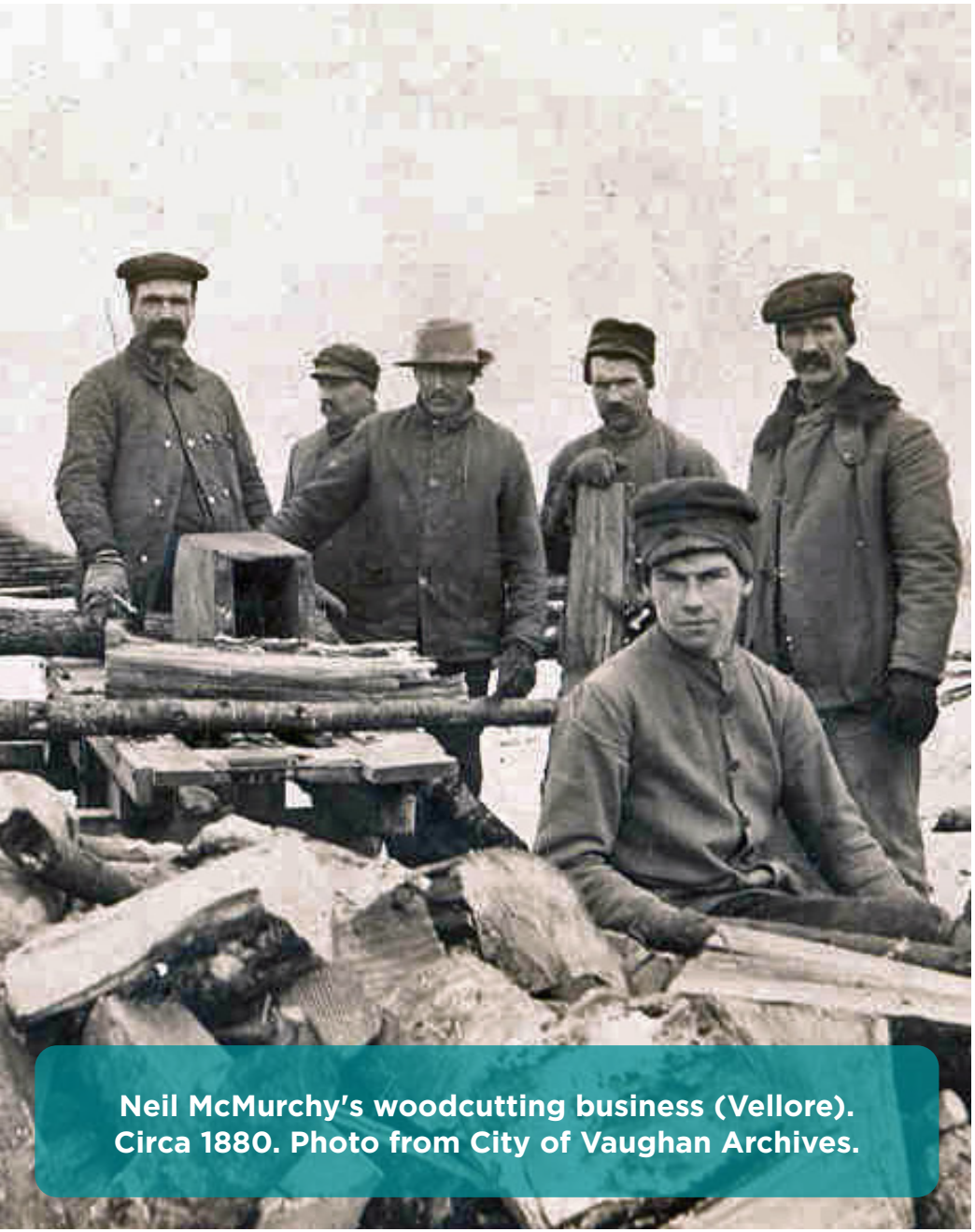
1.5. Our Woodlands, Through Time

From the Anishinaabeg to the Haudenosaunee, Attawandaron confederation, and the Métis, Indigenous communities have thrived on these lands. Indigenous Peoples have engaged hunting, fishing, and foraging within the forests and waters of this area long before the arrival of colonial settlers. The 17th century saw the influx of Europeans, triggering conflict and the displacement of Indigenous Peoples from what is now south-central Ontario.

The 19th century witnessed a surge in new settlements, drastically increasing Canada's population from a few hundred thousand in the early 1800s to an estimated five million at the turn of the 20th century.[5] This growth led to the widespread transformation of natural landscapes, with settlers clearing forests for timber export and agriculture. Sawmills, like those established at Edgeley, Elder Mills, and Kleinburg, now part of Vaughan, played a pivotal role in these activities.

Extensive conversion of land to support agricultural production depleted soils across the province over the 19th century, leaving lands susceptible to wind erosion, and in some areas exposing dried, infertile sands. Some estimates put the area of degraded soils at its worst as high as 150,000 ha within Ontario—an area 50% larger than the Greater Toronto Area (GTA) today.[6] The government responded to the issue of erosion and declining agricultural productivity over the next century with legislation, education programs, and tree planting initiatives. As a consequence of this history, most of Vaughan's existing woodlands are considered "second-growth", having regenerated after earlier land clearing or another disturbance.

Colonial settlement also introduced new plant species to Vaughan, driven by residents seeking familiar resources. Apples were introduced sometime in the 19th century. Buckthorn,[7] a highly invasive species in modern times, was introduced as an ornamental shrub for fence rows and windbreaks in agricultural fields. In fact, many of the



Neil McMurchy's woodcutting business (Vellore). Circa 1880. Photo from City of Vaughan Archives.

invasive plants that now impact Vaughan's woodlands were introduced as ornamental or agricultural plants.

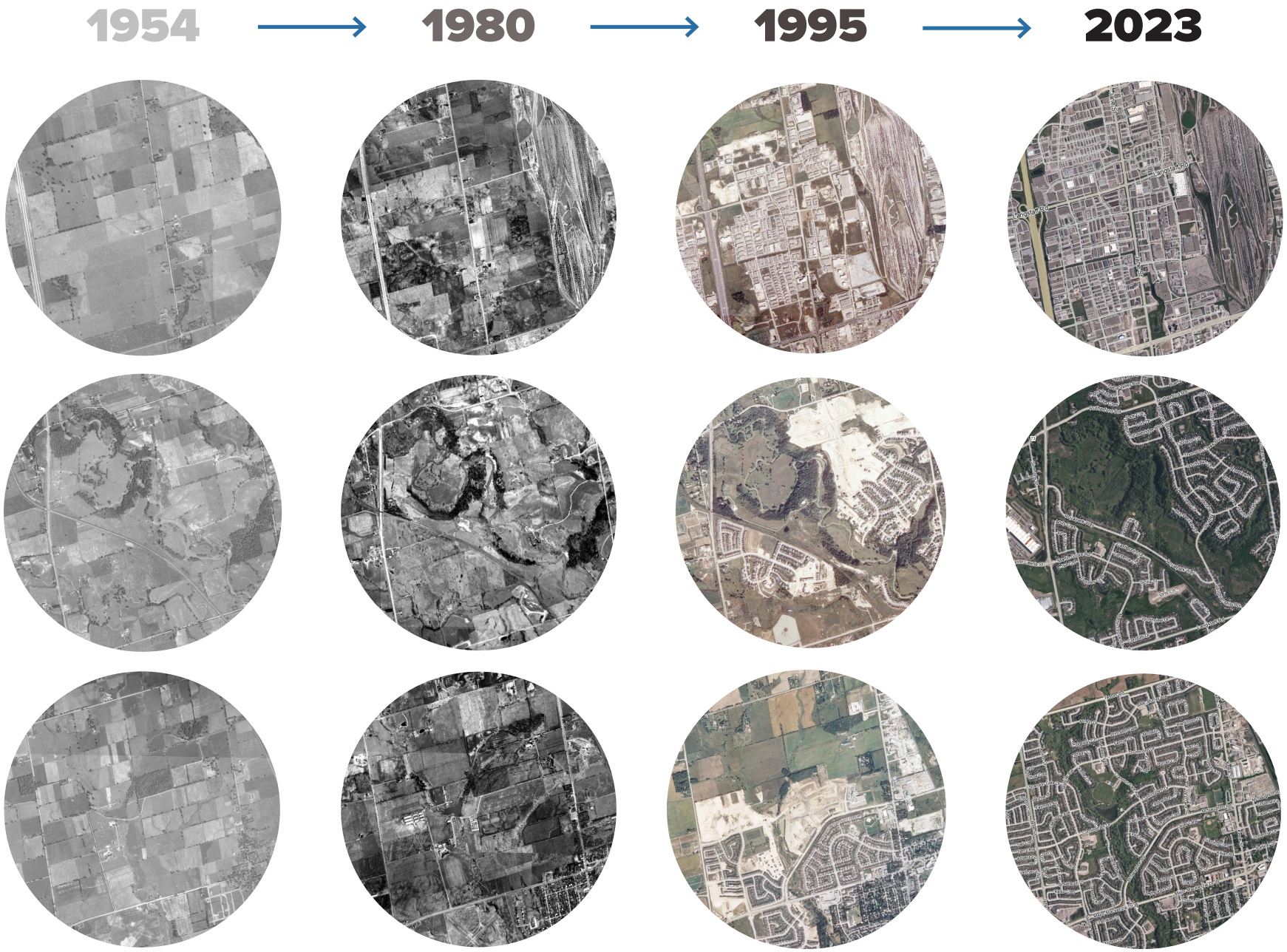
The latter half of the 20th century was marked by Vaughan's shift from an agricultural area to an urban community. Increased trans-oceanic shipping heightened the introduction of exotic pests and diseases. The introduction of exotic pests and disease has had a devastating impact on tree species like chestnut, elm, and ash. Billions of native trees have been lost over the past century to pests and disease not originally found on this continent. New exotic threats are still emerging, such as the Emerald Ash Borer, Japanese beetle, and most recently, Oak wilt (confirmed in Canada for the first time in June of 2023).[8]

The 21st century also brings new challenges, including climate change, globalization, and urban intensification. The modern challenges demand a coordinated and adaptive approach to woodland management. An evidence-driven regimen promotes sustainable, healthy ecosystems. By securing the services provided by Vaughan's woodland ecosystems now, we can ensure that they are preserved for the present and future generations.

1.6. Regulatory Context

The management of woodlands in the City of Vaughan is subject to a range of legislation, regulations, policy, standards, and guidelines. Key amongst these are by-laws which regulate tree and woodland removal—Vaughan's Tree Protection By-law (052-2018) and York Region's Forest Conservation Bylaw (2013-68). Both of these documents regulate tree removal within Vaughan's woodland areas, as well as any criteria associated with permit issuance. It is important to recognize that where the management

Vaughan Through the Years



of woodlands is concerned, activities undertaken or authorized by the City of Vaughan or York Region would be exempt from the requirements of each by-law. Vaughan or authorized contractors are, in most cases, the only entities authorized to undertake woodland management activities in the City's woodlots. Exemptions may apply where the work of other governmental organizations, Crown corporations or utilities corporations occurs in or adjacent to woodlots.

Other legislation can influence woodland management decisions and processes (e.g., Canada *Species at Risk Act* and Ontario *Endangered Species Act*, *Forester's Act*, and *Forestry Act*). The City undertakes due diligence respecting the requirements of those laws and/or any regulations in undertaking woodland management activities.

The Natural Heritage System

Few policy tools or regulations have the same influence on woodland management and protection as the Natural Heritage System (NHS). The NHS is the primary means through which "significant" environmental features such as woodlands are protected on both public and private land within Ontario. Through certain criteria, woodlands and other natural features can be identified as "significant" or not. *While all "significant" woodlands are woodlands, not all woodlands meet the policy criteria to be considered "significant"*.

The NHS is protected first through policy at the provincial level, which must then be conformed to through all lower levels of planning policy, including municipal. While the protection of the NHS is a broad requirement of communities in southern Ontario, local municipalities do

York Region's Significant Woodland Criteria (3.4.30):

That significant woodlands be verified on a site-by-site basis and shall include those woodlands meeting one of the following criteria:

a. Is 0.5 hectares or larger and:
   i. directly supports globally or provincially rare plants, animals or communities as assigned by the Natural Heritage Information Centre; or,
   ii. directly supports threatened or endangered species, with the exception of specimens deemed not requiring protection by the Province (e.g. as is sometimes the case with Butternut); or,
   iii. is within 30 metres of a provincially significant wetland or wetland including those identified on Map 4, waterbody, permanent stream or intermittent stream;

b. Is 2 hectares or larger and:
   i. is located outside of the Urban Area, Towns and Villages, or Hamlets and is within 100 metres of a Life Science Area of Natural and Scientific Interest, a provincially significant wetland or wetland including those identified on Map 4, significant valleyland, or fish habitat; or,
   ii. occurs within the Regional Greenlands System;I

c. Is south of the Oak Ridges Moraine and is 4 hectares or larger in size;

d. Is north of the Oak Ridges Moraine and is 10 hectares or larger in size;

e. On the Oak Ridges Moraine the woodland will be evaluated for significance based on the requirements of the Oak Ridges Moraine Conservation Plan and associated technical papers; or,

f. On lands in the Greenbelt Natural Heritage System, the woodland will be evaluated for significance based on the requirements of the Greenbelt Plan and associated technical papers; or,

g. On lands in the Lake Simcoe watershed, outside of the Greenbelt, the Oak Ridges Moraine Conservation Plan, and existing settlement areas, the woodland will be evaluated for significance based on the requirements of the Lake Simcoe Protection Plan and associated technical papers.

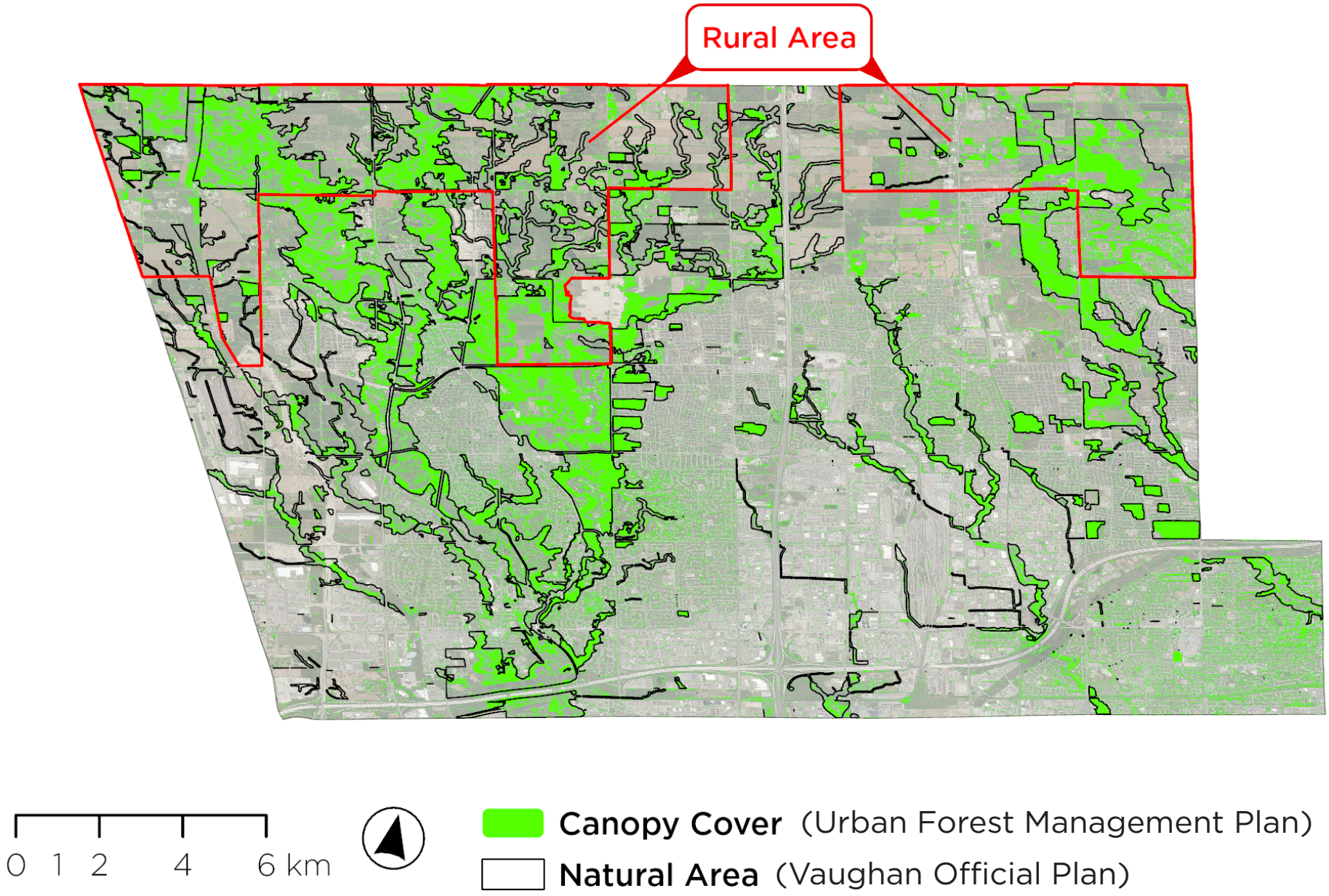


Figure 1-2. *Natural areas in Vaughan.*

have some influence over NHS mapping and woodland protection through NHS policy.

Vaughan's current Official Plan defers the definition of "significant" woodland to York Region. York Region uses a criteria-based policy definition for the establishment of significant woodlands (**previous page**). Despite strong policy language at the upper-tier level, many lower-tier municipalities in Ontario have chosen to further refine their implementation of natural heritage policy through definitions in their own Official Plans. York Region has also chosen to establish a canopy cover target of 40% and woodland cover target of 25% in its Official Plan. These targets and policies have implications for woodland management in the City of Vaughan, as a lower-tier municipality in York Region.

1.7. Vaughan's Woodland Communities

Among Ontario's three distinct ecological zones, Vaughan falls within the Mixedwood Plains, which is characterized by its Phanerozoic Calcareous bedrock, warm-to-hot summers, and cool winters (**Figure 1-3**). The Mixedwood Plains ecozone is the smallest in Canada, spanning the Quebec City-Windsor corridor and encompassing the densely populated region of Southern Ontario. The Mixedwood Plains is home to half of Canada's population, including the country's two largest cities, Toronto and Montreal. Additionally, the ecozone is home to one of the major storm tracks in North America.

Within the Mixedwood Plains ecozone, Vaughan is situated in the Lake Simcoe-Rideau ecoregion. Typical natural environments include upland forests of common deciduous trees like sugar maple, American beech, white ash, white

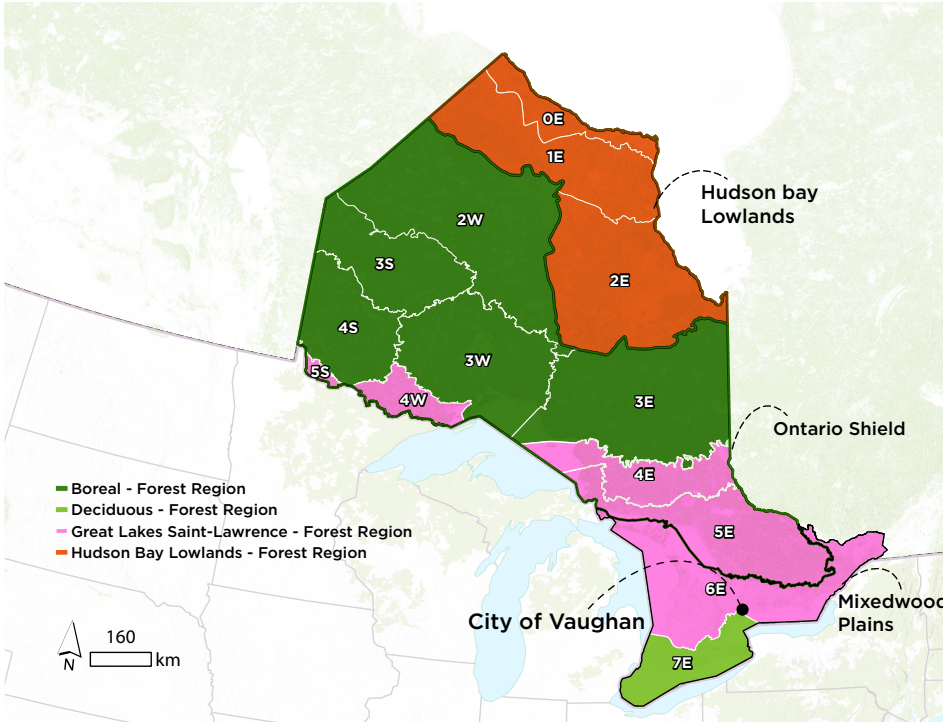


Figure 1-3. *Vaughan context map within forest regions.*

and red oak, trembling aspen, paper birch, yellow birch, black cherry, and butternut, with the coniferous eastern hemlock, white pine, and red pine sometimes found. Lowlands and riparian areas contain woodlands also, including forests of green ash, silver maple, red maple, yellow birch, black ash, and the conifers eastern white cedar, balsam fir and tamarack. The ecoregion is heavily populated and forests have been fragmented by suburban and agricultural development. Forest cover now occupies less than 20% of the ecoregion, though historically would have been much higher[9].

Grassland-associated ecosystems are present in limited, isolated areas. Plants thriving in these ecosystems include big bluestem, little bluestem, sundial lupine, and New Jersey tea. Because of Vaughan's proximity to the more southerly Carolinian forest type, distinctive species such as blue ash, red mulberry, sycamore, Shumard oak, pawpaw, and cucumber tree may on rare occasion be found in Vaughan's woodlands.

Wildlife making use of Vaughan's woodlands may include white-tailed deer, Northern raccoon, striped skunk, and woodchuck. Many birds also find homes in upland and lowland forests, including hairy woodpecker, field sparrow, wood thrush, and rose-breasted grosbeak. Woodlands near wetlands, rivers, and lakes protect amphibians like the northern leopard frog and red-spotted newt, as well as the riparian value for fish such as yellow perch, rainbow darter and pearl dace[10]

Vaughan's Woodland Canopy

Vaughan's 3,300 hectares of woodland canopy make up 60% of the city's total canopy area. Natural Heritage policy protects more than 85% of this area.

The Toronto Region Conservation Authority (TRCA) manages around 1,000 hectares of woodland canopy and 2,100 hectares of land area within the City. The remaining woodland canopy (around 1,200 hectares) is found on lands under the ownership and management of private landowners, crown corporations, or other levels of government.

Vaughan itself oversees the management of 27 unique community "woodlots" (**Figure 1-5**). These woodlots are not managed for their timber values, but to serve a balance of recreation and conservation functions. Vaughan's woodlots contain a collective 180 hectares of woodland area, and range in size from under 1 ha to more than 30 ha (**Figure 1-4**). More than half of the City's woodlots are greater than 10 ha in size.

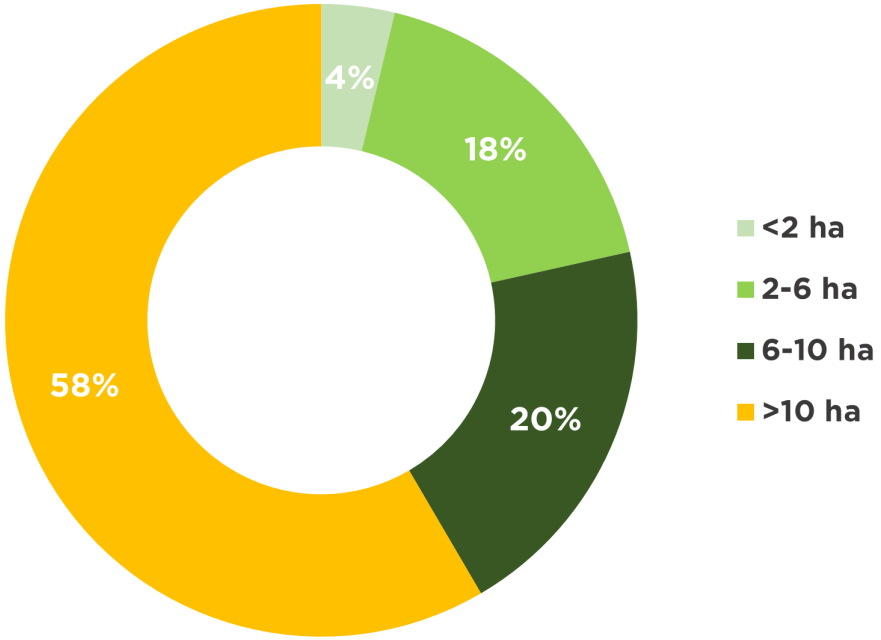


Figure 1-4. *Patch sizes of Vaughan's woodlots.*

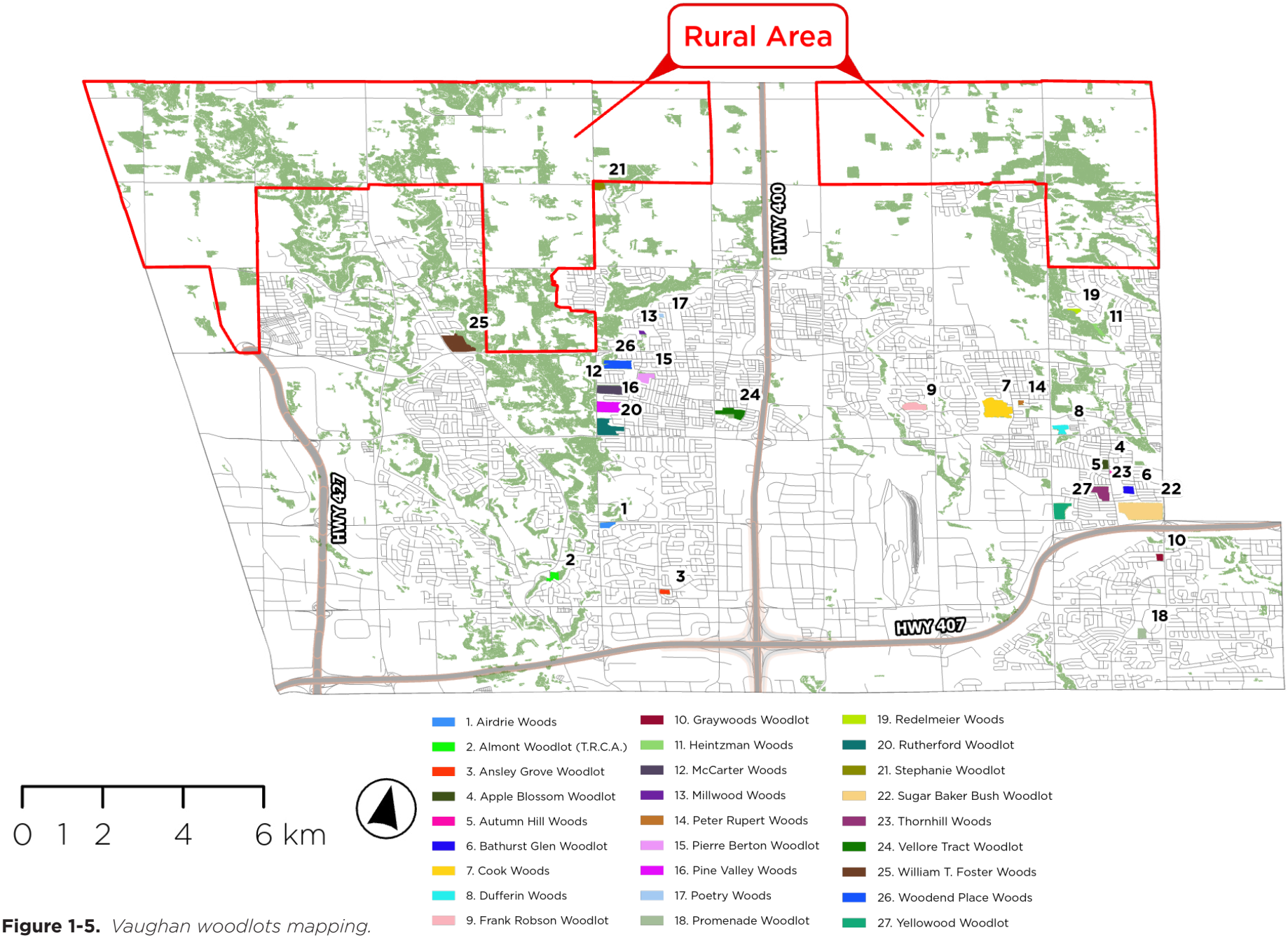


Figure 1-5. *Vaughan woodlots mapping.*

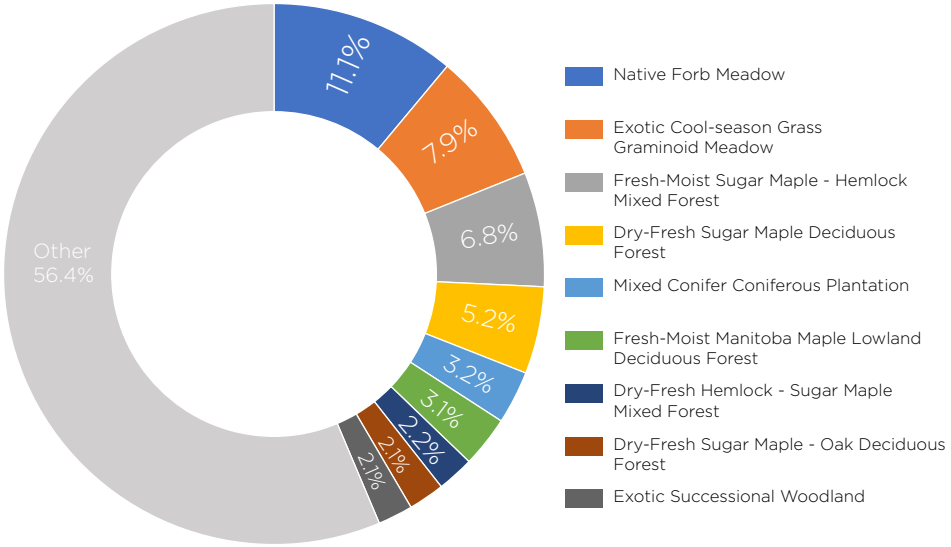


Figure 1-6. *Vaughan woodland communities by ecological land classification description.*

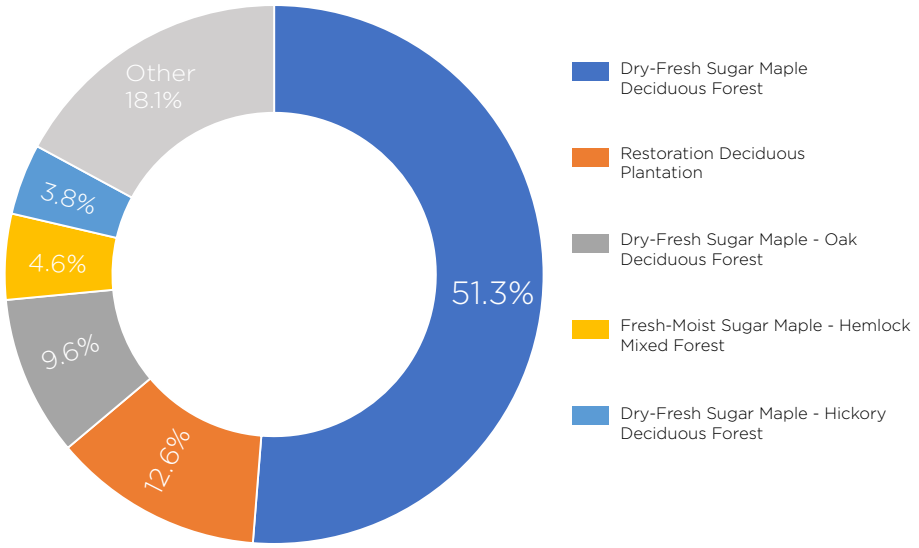


Figure 1-7. *Vaughan woodlot communities by ecological land classification description.*

Woodland Composition and Structural Qualities

In collaboration with York Region and the City of Vaughan, the Toronto and Region Conservation Authority supports a broad range of monitoring and mapping initiatives within regional watersheds. The TRCA leads biological inventories and assessments and administers a long-term fixed plot inventory program. Ecosite datasets available through the TRCA have informed the following analyses.

Within the City of Vaughan, woodlands are dominated by deciduous and mixed forest communities. The most abundant woodland community in the City is fresh-moist sugar maple - hemlock mixed forests (FOM6-1) which makes up nearly 7% of all (classified) woodland area (**Figure 1-6**). Dominant woody species in the FOM6-1 include sugar maple (*Acer saccharum* ssp. *saccharum*), and eastern hemlock (*Tsuga canadensis*). Common associates include American beech (*Fagus grandifolia*), eastern hop-hornbeam (*Ostrya virginiana*), yellow birch (*Betula alleghaniensis*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), white cedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*) and dogwoods (*Cornus* sp.). Dry-fresh sugar maple deciduous forests (FOD5-1), a sugar maple-dominated community, are also relatively common (5% of mapped). Vaughan's most abundant communities are actually non-forest, including native forb meadows (CUM1-A) and exotic cool-season grass old field meadow (CUM1-B). The former, CUM1-A, is a community of native wildflower species like late goldenrod (*Solidago gigantea*) and native asters as well as native grasses. CUM1-B on the other hand, is a meadow community where invasive or exotic grasses and native species compete for space and resources.

Within in Vaughan's own woodlots dry-fresh sugar maple deciduous forests (FOD5-1) dominate (**Figure 1-7**). Deciduous plantations (CUP1-A) represent 12.6% of woodlots. These are most often stands where the decline of native overstory ash and/or elm have enabled invasive species such as buckthorn, boxelder, and garlic mustard to become established within the stand. Though their potential for restoration needs to be confirmed, these communities could be priorities for future restoration efforts. Dry-fresh sugar maple - oak deciduous forest make up 10% of City-owned woodlot area (**Figure 1-7**). These are generally upland sites where sugar maple and red oak (*Quercus rubra*) dominate in association with beech, hop-hornbeam and basswood (*Tilia americana*).

Mean canopy height in Vaughan's woodlots ranged from 9 m to 28 m, with several woodlots having trees up to 34 m tall. LiDAR-derived stem densities averaged 130 stems per hectare in woodlot areas, but ranged from just 50 to 420 stems per hectare.

Concerns

Datasets from the TRCA also provided some insight into the frequency and severity of common woodland health issues in Vaughan.

The data suggests that trash dumping is a concern in more than half of the City's woodlots. Further, more than 80% of woodlots are identified as containing unauthorized trails or instances of trail trampling. Patterns of dumping and unauthorized trail development appear to impact some woodland communities and woodlots more than others.

TRCA datasets also provided insight into the presence of invasive and exotic species in Vaughan's woodlots. Data suggests that about 60% of Vaughan's woodlands contain a "light" presence of exotic species, an additional 30% a "moderate" presence, and 2% "severe". European buckthorn (*Rhamnus cathartica*), garlic mustard (*Alliaria petiolata*), dog-strangling vine (*Vincetoxicum rossicum*) are each identified as a concern in city woodlots.

Boyd Conservation Park, photo by Simone Wessels-Bloom via Unsplash

1.8. Why do we need a Woodland Management Strategy?

Vaughan's woodlands face a range of contemporary challenges and threats. The City's historical management approach, characterized by its reactive nature, has lacked the resources necessary to formulate or implement a sustainable approach for the management of the City's woodland areas. Given that woodlands make up more than 60% of the City's total canopy area and represent a foundational element of our community fabric, a sustainable and coordinated approach to woodland management is now imperative.

The challenges confronting Vaughan's woodlands serve as the primary motivators for the goals and objectives outlined in the Strategic Framework detailed in **Section 2** of this document.

Improve Program Governance and Capacity

Woodland governance encompasses the broad structure of rules, relationships, systems, and processes through which woodland management is achieved and supported within the City. A lack of historic priority toward woodland governance has contributed to reduced investment in the management of these critical assets. Strengthening woodland governance in Vaughan could involve enhanced collaboration with partner organizations, dedicated resourcing for woodland management, and consideration of third-party certification. These measures could significantly fortify woodland governance within the City.

Abiding by the standards stipulated by third-party certification, such as that overseen by the Sustainable Forestry Initiative (SFI) could also play an important role in reinforcing improved woodland governance. Third-party certification of woodland management supports the establishment of public trust and enhances awareness of a City's program.

Case Study

The **Town of Oakville** was the first local municipality in Canada to have all of its woodlots achieve **Forest Stewardship Council® (FSC®) certification**.

Introduce Asset Management

Asset management is the mechanism through which the city plans for and finances maintenance activities for assets under the City's management. Traditionally, this has encompassed grey infrastructure, such as roads and sewers, but more recently, there has been an expansion to include recognition of natural assets into asset management planning under Ontario Regulation 588/17. Despite this, inclusion of natural assets within Vaughan's asset management approach are presently limited. This exclusion has played a role in the ad hoc management of Vaughan's woodlots to date.

The integration of woodlands into the City's asset management approach would enable the establishment of clear levels of service and supporting resource allocations.

Case Study

The **City of London** successfully integrated its urban forest assets into the corporate portfolio, valuing the urban forest at over $400 million in the 2019 Asset Management Plan. This includes $320 million for manicured park and street trees and $80 million for woodlands. The plan relies on a comprehensive inventory and assessments for street, park, and woodland assets. Woodland assets are valued at $67,300 per hectare, covering planning, preparation, soil restoration, plant propagation, and planting costs.

This approach highlights the financial value and holistic management urban trees and woodlands, serving as a model for other Canadian urban centers.

Manage the Impacts of Woodland Pests and Disease

Insects and diseases pose a significant challenge to native ecosystems, particularly in areas where the natural environment interfaces with urban development. Disease outbreaks and pest infestations can lead to significant tree mortality in woodland areas, creating potential hazards for the public, and having adverse effects on biodiversity and ecosystem function. Southern Ontario has grappled with the impacts of pests and diseases in the past. The cumulative effects of chestnut blight, Dutch elm disease (DED), and emerald ash borer (EAB) have resulted in the loss of billions of North American trees.

There are several pest and pathogens that pose an imminent and significant risk to Vaughan's native biodiversity. These include beech bark disease, hemlock woolly adelgid, Asian long-horned beetle, and most recently, oak wilt. While the host plants vary for each pest and disease, all have a preference for at least one native tree species in Vaughan's woodland ecosystems.

Establish Inventory, Monitoring, and Reporting Processes

In urban settings, woodlands are influenced by both human activities and broader environmental changes. Monitoring these changes is crucial to informed and effective management interventions.

Conducting repeated field-based inventories would provide important insights into changes in woodland health, composition, and structure over time. These ongoing measurements are critical for comprehending the scope of woodland health concerns and monitoring alterations in woodland composition and structure. Both the TRCA and York Region undertake periodic measurements of woodland assets under their care. These organizations offer

Case Study

Since 2014, the **Town of Oakville** has demonstrated proactive urban forestry management by annually auditing a third of its woodlands in a three-year rotation. These audits, focusing on pests, diseases, and disturbances, are transparently communicated through public "report cards," informing subsequent management actions. In 2019, Oakville allocated $216,000 in capital funding for audits and invasive control, exemplifying its commitment to urban woodland health and setting a proactive management example.

an important resource as Vaughan considers how to best support monitoring in its own woodland assets.

Respond to Invasive Plants

Invasive plants also pose a significant threat to urban woodlands. These species are non-native and have been introduced to Vaughan and south-central Ontario over decades past. Due to their adaptations and genetics, invasive species have a negative impact on Vaughan's native ecosystems once they become established. While the dynamics of these effects varies among species, most alter the natural competitive dynamics, favouring the invasive species and often at the expense of native biodiversity and plants. It's crucial to note that not all introduced plants are invasive. Many exotic species have been planted along Vaughan's streets and in parks, and most of these exotic species are not considered invasive.

The management of invasive species in Vaughan has historically lacked funding, and treatment (such as removal) has occurred only in rare and isolated instances. The TRCA and York Region each manage invasive species to varied degrees within their own woodlands, and there may as a result be opportunities for coordination moving forward. Other cities, such as Mississauga, have leveraged public capacities in implementing an enhanced woodland management program.

As invasive species become established in woodland settings, their competitive advantages enable them to increasingly replace and out-compete native plant species, leading to a degradation of local biodiversity and woodland health. It is best to address invasives as soon as possible, as the costs of abatement typically rise with their spread.

Native, Invasive, or Exotic?

The distinction between native, invasive, and exotic species can sometimes be unclear. Simply put, a native species is one naturally present in local ecosystems. An exotic species, in contrast, is any species not native, including those from different regions globally, other parts of North America, or other areas in Ontario. While exotic species don't contribute to native ecosystems in the same ways as native plants, they are **not always a threat** to native biodiversity. On the other hand, invasive species, like buckthorn, Norway maple, Manitoba maple, emerald ash borer, and invasive honeysuckles, are exotic species with **widely recognized negative impacts** in local ecosystems. Typically, invasive species possess a competitive advantage over native species and/or lack natural controls in the native ecosystem, allowing them to spread and negatively impact the ecology.

Utilizing exotic plants in woodland settings is inappropriate since they don't contribute to the local ecosystem as effectively as native plants. However, in non-native urban ecosystems, employing exotic species as ornamental plants is both widespread and advantageous, enhancing the genetic diversity of the urban forest and passively bolstering resilience against pests and diseases. **The use of recognized invasive plants is unsuitable in nearly all situations.** These plants pose a threat to local ecosystems and tend to "escape" into natural environments, even when employed as ornamental trees in urban settings.

A significant challenge arises when the City undertakes tree removal in woodland areas (e.g., to eliminate hazard trees), creating openings in the woodland canopy where invasive species can establish. In this scenario, tree removal in areas with known invasive species can often result in the proliferation of the invasive plant(s) if resources are not allocated to the removal of the invasive as well.

Invasive species are present in several of Vaughan's woodlots. Managing established invasive species in these stands can be challenging and demands an allocation of resources. The goal of managing invasive species is rarely to eradicate on a city-wide scale; instead, the objective of the City's woodland management program should be to limit the presence of invasive species below a threshold where they do not significantly diminish the native biodiversity and function of woodlot assets.

Establish a Risk Management Program

Tree risk management encompasses the identification, assessment, and ranking of potential risks associated with trees, whether in woodlands or urban areas. Tree risk management generally incorporates a combination of tree inspections, risk assessment, and management strategies, which may involve pruning, removal, or other interventions. It also includes measures to mitigate the risk to infrastructure, such as preventing damage to woodland trails or trail assets (e.g., bridges). The objective of tree risk management in woodland settings is to ensure that trees within woodlands do not present an unacceptable risk to the public and to minimize the potential for damage, while at the same time considering the impacts of risk management interventions on the health of the tree. Currently, the City manages an estimated 31 km of woodland edge, and 12 km of woodland trails.

Extreme weather is often a catalyst for tree failure events. Proactively identifying and mitigating high-risk trees ahead of storm events is the City's most effective mechanism for reducing the risk posed by woodland trees during these storms.

Case Study

The **City of Mississauga's Invasive Species Management Plan and Implementation Strategy** (ISMP&IS) offer a coordinated approach to efficiently manage terrestrial invasive species. This strategy aims to enhance the City's native biodiversity and overall ecological integrity in natural areas. The ISMP&IS in Mississauga strives to accomplish three core objectives:

1. Reduce the relative abundance of invasive species and increase ecological integrity,
2. Optimize resources through collaboration with partners and the public, and
3. Monitor the effectiveness of ISMP&IS.

A coordinated strategy, even when not as detailed as Mississauga's, provides advantages by informing the required resource levels to address the invasive species issue.

Grow the City's Woodland Areas

Achieving the City's 25% canopy cover target by 2051 necessitates more than 1,400 hectares of new canopy within Vaughan over the next 30 years. Modelling suggests that together, lands under TRCA or City ownership could support an additional 130 hectares of woodland canopy toward achievement of this goal.

Afforestation refers to the creation of a woodland in an area that has lacked recent tree cover. Afforestation projects typically yield substantial canopy contributions in the years following planting. However, compared with the planting of individual urban trees, these projects tend to be more resource-intensive and necessitate dedicated monitoring efforts to ensure their success.

Afforestation will need to be a fundamental component of the City's overall strategy to achieve a 25% canopy cover and 14% woodland cover target by 2051. Besides contributing to canopy growth, targeted afforestation efforts can enhance the ecological value of many of the City's woodlands, improving the connectivity and quality of urban habitat. It is crucial to recognize that not all ecosystems are forested. Certain wetland and tallgrass prairie varieties, which may include trees, do not maintain continuous canopy cover in the same manner as woodland communities. Despite this difference, these communities are equally important, and where present in Vaughan, they should be managed with consideration for their natural qualities and successional traits.

While the City can directly influence afforestation on public land, private land afforestation is at the owner's discretion. Given the substantial privately owned land in Vaughan, promising afforestation opportunities lie in these areas.

With over 4,400 hectares of non-forested rural land in Vaughan, afforestation potential exists, acknowledging that rural lands often serve other crucial roles, like agriculture. The City aims to collaborate with partners to promote access to subsidy programs, including the Managed Forest Tax Incentive Program (MFTIP) and Forests Ontario's 50 Million Trees program, encouraging woodland management and afforestation.

Guide Woodland Restoration

Often, the pressures acting on urban woodlands erode woodland health and/or condition through which the deterioration of woodland health can be reversed. Restoring degraded woodlands to functional ecosystems involves a multi-faceted approach. Elements of a restoration program can involve the removal of invasive species, tree planting, managing natural regeneration, and implementing measures to protect and enhance biodiversity.

In Vaughan, a typical restoration process often would involve removing invasive species and subsequently replanting those areas with a selection of native plants. Restoration specifications may include soil amendments to rebuild soil profiles and enhance site capacity in cases where soils have become degraded. Restoration processes serve as a critical woodland management tool, supporting native biodiversity and the positive ecological services associated with woodland environments.

Presently, the City lacks dedicated resources or a program to support a sustained restoration effort. Without dedicated funding for restoration projects, woodland restoration activities will likely continue to be undertaken only when external funding opportunities arise.

Protect Woodland Areas

Safeguarding woodlands involves two elements: (i) policy and regulatory safeguards preventing the conversion of woodland areas to non-woodland land uses, and (ii) safeguards against practical misuse, such as littering or encroachment.

The majority of Vaughan's woodlots are safeguarded through natural heritage policy. Woodlands correctly identified in natural heritage layers benefit from protection through provincial policy, typically rendering them ineligible for development. In addition, York Region administers a Forest Conservation By-law that extends certain protections to woodlands larger than 0.2 hectares.

Protection of woodlands against impacts such as encroachment and dumping is typically addressed through a combination of staff resources, enforcement action, and educational initiatives. While education can enhance public awareness of the harm caused by activities like dumping and encroachment, wilful misuse of woodlots will always necessitate enforcement action (where applicable) and subsequent remediation or restoration activities. Presently, Forestry Operations have no resources to administer a regular woodland management program. Consequently, instances of woodland misuse are addressed only as capacity permits. Educational programs that support community awareness of the challenges facing woodlands and their management are provided only on an opportunistic basis.

Support Community Education and Outreach

Community education and outreach can play an important role in bolstering the woodland management

Case Study

The **City of Mississauga's Garlic Mustard Task Force** (GMTF) aims to reduce the spread of garlic mustard in the City's parks and natural areas through community stewardship. The program has been running since 2018 and was recently formalized. City staff provide training on identifying and removing garlic mustard, as well as reviewing procedures for working safely outdoors. Volunteers are provided with the necessary supplies and work independently at an approved park of their choosing throughout the summer. A volunteer management system is used so that volunteers can self-report their own hours, and report on the amount of garlic mustard removed.

In 2021, the GMTF was supported by 18 volunteers across 10 parks. Almost 200 hours were spent removing 260 garbage bags of Garlic Mustard. Approximately 40 hours of City staff time was spent on program administration and training. The number of volunteers participating in the GMTF as well as the hours spent removing garlic mustard more than doubled in the following year.

capacities. Numerous challenges in woodlands are directly human-caused or influenced by human actions. Effectively addressing issues like unauthorized dumping and encroachment involves a significant component of community education, and can influence the demand for woodland management services experienced by municipal staff. Educational initiatives and outreach efforts also help to generate community backing for the city's woodland

Case Study

Oakville's **Forest Health Ambassador** program utilizes involved residents to monitor street trees in neighborhoods for invasive insects, diseases, and other forest health concerns. This initiative operates during the summer months, allowing ambassadors the flexibility to survey as many or as few trees as they wish at their convenience.

management program. By fostering an understanding of the challenges associated with woodland management and showcasing the city's management efforts, Vaughan would support a beneficial awareness among members of the community.

Build Stewardship Capacity

The success of a woodland management program can be enhanced by the presence of dedicated community stewards. Activities within woodland management can directly contribute to expanding program capacities and can also generate community enthusiasm for sustainable woodland management practices.

1.9. Climate Change

The Impacts

Climate change is anticipated to have significant impacts on woodland ecosystems and their sustainable management. Climate projections for the region generally forecast warmer, wetter, and more unpredictable weather throughout the year. Rising summer temperatures may potentially lead to an extended growing season.[11,12,13] While precipitation predictions are often associated with lower confidence levels, predictions generally suggest an overall increase in annual precipitation, a decrease in summer precipitation, and an increase in winter precipitation.[14,15] Other climate models predict a more frequent and severe extreme weather events, including droughts, heatwaves, windstorms, thunderstorms, and ice storms.

These changes will trigger shifts in the distribution and abundance of tree biodiversity not only in Vaughan but globally.[16] In transitional forests in eastern Canada, such as those found in the Mixedwood Plains Ecozone and the Acadian Forest Region, advanced modelling has suggested that deciduous species adapted to warmer conditions may pose a threat to conifers adapted to colder climates as warm-adapted species migrate northward with the climate gradient.[16]

The increased severity and variability of weather patterns and storm events are anticipated to have an impact on the woodlands of the Mixedwood Plains Ecozone. One consequence of greater variability in spring temperatures is the occurrence of "winter browning" injury. This phenomenon occurs when abnormally warm spring temperatures deceive trees into coming out of dormancy while the ground is still frozen or otherwise returns to a frozen state. When this happens, conifers lose moisture from their needles more rapidly than it can be replenished, leading to browning and drying of the needles. Notable winter browning events were observed near Hearst, Kapuskasing, and Cochrane in 2007[17] and in the Thunder Bay area in 2012.[18] Other extreme weather events, including windthrow,[19] ice storm damage,[20] and drought[21] are known to affect tree species in the Mixedwood Plains Ecozone and may become more frequent and/or severe due to the direct influence of climate change.

Climate change not only affects abiotic disturbance regimes but also influences biotic sources of disturbance. Research indicates that the range and life cycles of both fauna and flora are likely to be impacted by climate change. This creates new opportunities for known invasive pests to establish themselves beyond historically observed ranges.[22] Further, climate-induced changes may affect the life cycles of invasive species within their existing range, influencing their efficacy, the historical risk associated with outbreaks, and the probability of continued spread. As temperatures rise across much of the country, many invasive species may find new invasive ranges, often extending northward from the regions where they have historically been active.[23]

Climate change has also been linked with potentially destructive shifts in the population dynamics of endemic forest pests. A well-known example is the mountain pine beetle (*Dendroctonus ponderosae*) in British Columbia.[24] The severe impacts of this beetle are believed to be, in part, a consequence of its range expanding due to climate-induced changes.[25] There is evidence suggesting that the

spruce budworm (*Choristoneura fumiferana*) may also shift towards the poles and higher elevations within its native range, with temperate regions like those found in the Mixedwood Plains Ecozone potentially facing significant consequences from these shifts. Other studies propose that the life cycles and ranges of other impending threats, such as oak wilt,[26] Asian long-horned beetle,[27] and spongy moth[28] may be influenced by climate change in the years to come. This has the potential to alter the level of threat they pose to the local environment.

In most cases climate change will, at the very least, serve as an underlying source of stress. Stress erodes a tree's resilience to additional sources of stress. This diminished resilience is commonly referred to as heightened forest vulnerability. While the extent of vulnerability may vary among different woodlands, it is reasonable to anticipate that a considerable portion of Vaughan's woodlot areas are susceptible to some level of vulnerability.

How the City Can Respond

Currently, the City has limited resources to facilitate a comprehensive woodland management effort, leaving minimal capacity to enhance forest resilience against the challenges presented by climate change. While the specific measures the City could implement to enhance the resilience of its woodlands vary depending on the specific concern, the most crucial action is to actively address pre-existing woodland health issues and ensure there are resources in place to support an adaptive management approach.

Section 2. Strategic Framework

Vaughan's Urban Forest Vision

Our vision is for a healthy, growing, and sustainable urban forest canopy that supports biodiversity, human health, recreation, and community climate resilience to provide a greener future for generations to come.

2.1. The Woodland Management Strategy

Vaughan's Woodland Management Strategy is to serve as the central document informing all woodland management decisions within the municipality. A review of progress in implementation is scheduled every five years, with an overarching strategy update planned every 10 years, in step with processes of review and update for the City's Urban Forest Management Plan (UFMP).

Section 2 offers the strategic framework for this WMS. Here program-level directions, actions, and management decisions are identified. **Section 3** and **Section 4** outline a framework and set of guidelines for the management of individual woodlots the City owns and manages.

Management Goals

Program recommendations have been categorized into five goal areas, each consisting of several strategies. Each strategy is supported by specific program actions, along with an associated indicator and target where applicable. The identification of indicators and targets aims to support monitoring WMS implementation. Vaughan's five woodland management goals are:

Goal 1: Prioritize good program governance
Goal 2: Maintain healthy and safe urban woodlands
Goal 3: Expand the urban forest canopy and associated benefits
Goal 4: Protect trees and woodlands for future generations
Goal 5: Partner in woodland stewardship.

Strategic Framework

Goal 1: Prioritize good program governance

Strategy 1: Strengthen governance through compliance with third-party forest certification standards.

Strategy 2: Resource woodland management sufficiently to achieve formalized levels of service.

Strategy 3: Integrate woodlots and other woodlands on City property into the City's asset management program (AMP).

Goal 2: Maintain healthy and safe urban woodlands

Strategy 4: Reflect the growing threat posed by invasive plants, forest pests, and pathogens in woodland management activities.

Strategy 5: Monitor woodlands and maintain inventories to support the ongoing implementation of this Strategy.

Strategy 6: Assess and manage tree-related risks in woodland areas proactively.

Goal 3: Expand the urban forest canopy and associated benefits

Strategy 7: Utilize woodland acquisition and afforestation as tools toward achieving the City's canopy and woodland target.

Goal 4: Protect trees and woodlands for future generations

Strategy 8: Prioritize the protection of Vaughan's woodland areas.

Goal 5: Partner in woodland stewardship

Strategy 9: Encourage community investment into and stewardship of Vaughan's woodlots.

Strategy 10: Continue to support outreach, education, and equity in woodland management programming.

Goal 1: Prioritize good program governance

Encourage and support procedures, relationships, systems and capacities that support Sustainable Urban Forest Management in Vaughan.

Strategy 1: Strengthen governance through compliance with a third-party forest certification standard.

Indicator: SFI Urban and Community Forest Sustainability Standard compliance.

Target: SFI certification for Vaughan's woodland management activities is achieved by 2034 and maintained on an ongoing basis.

Action 1. Pursue SFI certification for Vaughan's woodland management activities as part of its overall urban forest management program.

Action 2. Develop strategic partnerships that will support the implementation of this Strategy.

Action 3. Support staff training, industry outreach, and professional development within the discipline of woodland management.

Strategy 2: Resource woodland management sufficiently to achieve formalized levels of service.

Indicator: Funding $ per ha of woodland.

Target: $1,300 per ha, per year (2023 dollars)

Action 4. Examine staffing levels and consider hiring new role(s) within the Forestry group to support implementation of the WMS and WMPs.

Strategy 3: Integrate woodlots and other woodlands on City property into the City's asset management program (AMP).

Indicator: Integration of woodland assets into the City's AMP.

Target: Full integration, including condition ratings and woodland management levels of service.

Action 5. Formalize and document woodland management levels of service and performance measures.

Action 6. Integrate woodlots into the City's asset management program as a formal asset class.

Action 7. Prepare woodlot management plans (WMPs) for the 26 woodlots which do not yet have a plan.

Action 8. Develop research partnerships to explore nuanced woodland appraisal methods that fully reflect the range of human and ecological values supported by woodlot assets.

Goal 2: Maintain healthy and safe urban woodlands

Leverage woodland monitoring and sustainable management procedures supported by industry best practices and third-party certification standards.

Strategy 4: Reflect the growing threat posed by invasive plants, forest pests, and pathogens in woodland management activities.

Indicator: Invasive species Woodlot Management Plan indicator scores.

Target: All woodlots score "good" (i.e., 4) or better.

Action 9. Formalize the City's pest management program in a corporate integrated pest management (IPM) policy.

Action 10. Formalize the City's invasive species management program in a corporate invasive species management policy.

Strategy 5: Monitor woodlands and maintain inventories to support the ongoing implementation of this Strategy.

Indicator: Woodland inventory re-measurement cycles.

Target: Plot and interface edge inventoried on a standard five-year cycle.

Action 11. Develop the City's library of data available to provide new insights and enhance woodland management objectives and activities.

Action 12. Adopt monitoring and reporting measures which support sustainable woodland management.

Strategy 6: Assess and manage tree-related risks in woodland areas proactively.

Indicator: Risk management Woodlot Management Plan indicator scores.

Target: All woodlots score "good" (i.e., 4) or better.

Action 13. In consultation with the City's legal and risk management teams, develop and implement an approved tree risk management policy encompassing risk management in woodland areas.

Goal 3: Expand the urban forest canopy and associated benefits

Grow Vaughan's woodland areas toward achievement of 25% tree canopy cover by 2051 and an aspirational target of 14% woodland cover over that same period.

Strategy 7: Utilize woodland acquisition and afforestation as tools toward achieving the City's canopy and woodland target.

Indicator: Woodland canopy area.

Target: 14% by 2051.

Action 14. Prepare a city-wide Biodiversity Plan to guide restoration and inform land acquisitions supporting woodland health and expansion or broader ecosystem connectivity.

Action 15. Broaden the utility of the City's Tree Planting Reserve (i.e., the Tree Protection By-law cash-in-lieu fund) to enable funds to also be applied to a greater range of planting and maintenance expenses than is permitted at present.

Action 16. Identify pilot sites to trial Miyawaki afforestation methods.

Action 17. Seek funding, such as that provided by the federal Two Billion Trees program, to support woodland reforestation and restoration programs.

Action 18. Formalize mapping of priority areas to inform woodland acquisition and afforestation.

Goal 4: Protect trees and woodlands for future generations

Ensure tree protection requirements and processes within the City are lending to the right balance between regulation and supporting continued community growth.

Strategy 8: Prioritize the protection of Vaughan's woodland areas.

Indicator: Unauthorized encroachment Woodlot Management Plan indicator scores.

Target: All woodlot score "good" (i.e., 4) or better.

Action 19. Develop operational standards for woodland trail development, decommissioning and maintenance.

Action 20. Undertake ecosystem restoration consistent with the findings and prescriptions of the City's Woodland Management Strategy and accompanying Woodlot Management Plans.

Action 21. Work with research partners to develop climate-based seed transfer trials for woodland species.

Action 22. Ensure all woodland restoration and planting activities within Vaughan comply with Section 4 of this Strategy.

Action 23. Require tree protection hold-backs for contractors working around or within woodlots as part of design and construction projects.

Action 24. Establish an approach for managing encroachment issues within woodland areas.

Action 25. Pursue stronger interdepartmental relationships in the interest of multi-use trail management.

Goal 5: Partner in woodland stewardship

Spread awareness, support urban forestry education, and leverage community capacities and partnerships in implementing this Urban Forest Management Plan and the City's Woodland Management Strategy.

Strategy 9: Encourage community investment into and stewardship of Vaughan's woodlots.

Indicator: Volunteer hours committed through woodland management programming.

Target: 4,500 volunteer hours annually.

Action 26. Establish and administer a forest steward program, designed to appoint community members with a lead role in the stewardship of each of the City's 27 woodlots.

Action 27. Support a range of community stewardship opportunities for interested members of the public.

Action 28. Ensure woodland interests are well represented through the composition of any new Community Tree Board.

Action 29. Utilize on-site signage to advertise when and why site works will be occurring/has occurred. Use the opportunity to educate the public on woodland management processes.

Strategy 10: Continue to support outreach, education, and equity in woodland management programming.

Indicator: Community members engaged through outreach per year.

Target: 2,500 community members engaged annually.

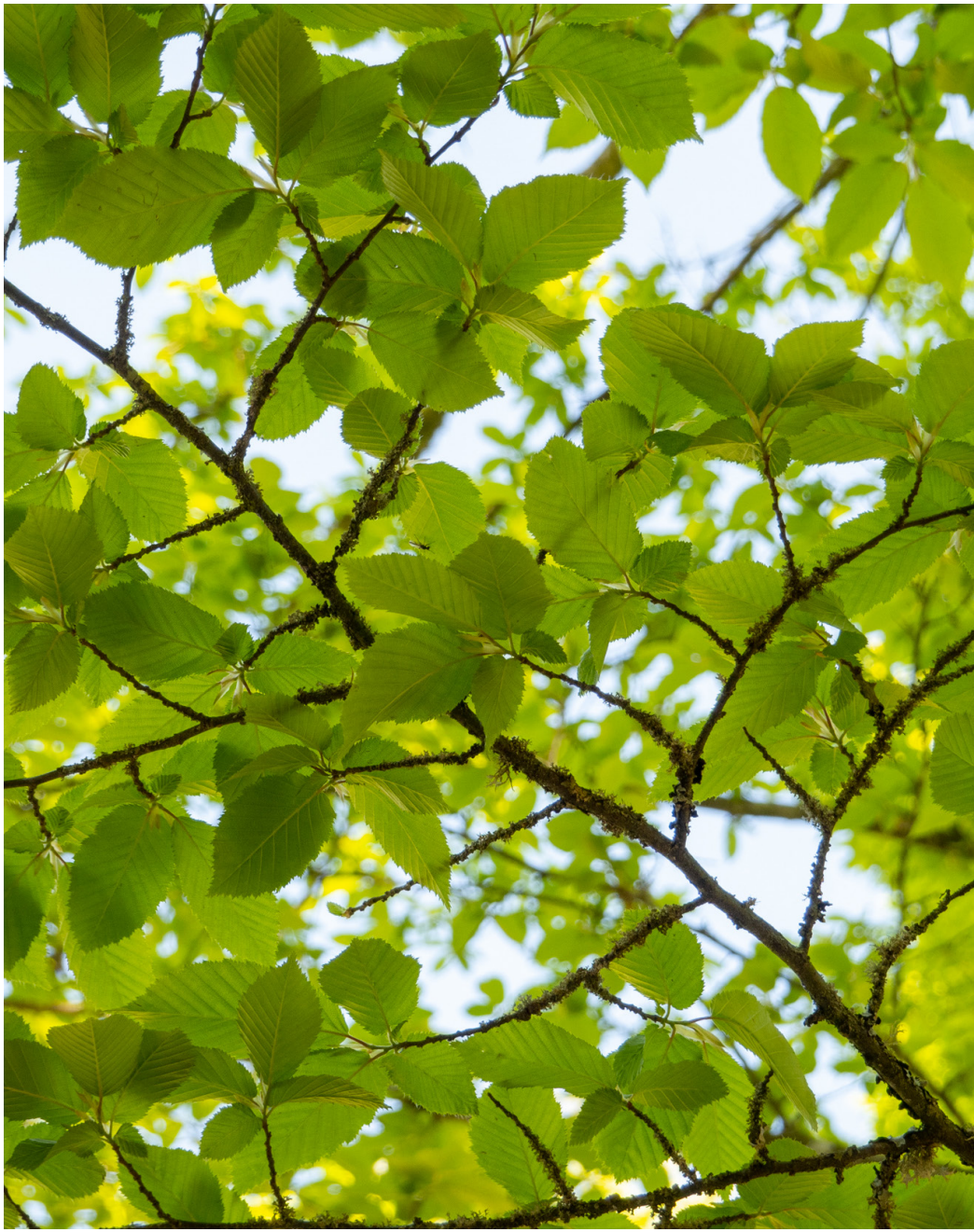
Action 30. Work together with Indigenous peoples to identify and support culturally sensitive urban forest and woodland management practices.

Action 31. Pilot the concept of food forests in partnership with the TRCA and community partners, supporting both equity outcomes and broader community engagement, education, and outreach.

Action 32. Ensure the design of urban forestry programming and engagement is considered through an equity lens.

Action 33. Utilize pop-up events to spread messaging on urban forestry topics and programming.

Action 34. Initiate a quarterly woodland walk to spread awareness of the challenges facing woodland management in the City, and to showcase activities such as restoration and invasive species removal.



2.2. The Action Plan

The following pages contain the full action plan for the City of Vaughan's Woodland Management Strategy. Specific actions are itemized and the departments with a vested interest in each action are identified. In addition, a timeframe to implementation has been identified, as well as an estimated financial commitment, a type, and a priority level. The following is a full summary of values contained to each of those fields:

Vested Interest

PFHO	Parks, Forestry, and Horticulture Operations
PIPD	Parks Infrastructure Planning and Development
DENG	Development Engineering
REST	Real Estate Services
PPLN	Policy Planning and Special Programs
LEGL	Legal Services
IPAM	Infrastructure Planning and Corporate Asset Management
FINS	Financial Services
CMSR	Community Services
OCIO	Office of the Chief Information Officer
CME	Communications, Marketing and Engagement
ECDV	Economic Development
BYLW	By-law and Compliance, Licensing, and Permit Services
TRCA	Toronto and Region Conservation Authority (External)
YORK	York Region (External)

Timeframe

SHORT	1 - 5 years
MID	6 - 10 years
LONG	10 - 15 years

Financial Commitment

$	Staff time or otherwise < $10,000
$$	$10,000 - $50,000
$$$	$50,000 - $150,000
$$$$	Needs an estimate or otherwise > $150,000

Type

BLPL	Actions which involve the adoption of new or revised by-laws or policy.
MNTR	Actions which support ongoing monitoring or reporting on the City's urban forest or the implementation of this Plan.
PCDR	Actions which involve both formal and informal procedural outcomes.
PRGM	Actions which broadly relate to the City's urban forest management program.
RSRC	Actions which relate to the development of new or use of existing program resources.

SPEC	Actions which invoke technical requirements for different program elements.
STWD	Actions which propose the development of different stewardship or community outreach outlets.
STDY	Actions which invoke the development of supplemental studies, plans or strategies in support of the City's urban forest.
PTNR	External partnerships supporting urban forest management and the implementation of the UFMP.

Priority

	No priority ranking indicates that the action is not a priority over the first ten years of implementation and may be prioritized at a future date or otherwise implemented as capacities permit.
YES	Indicates that an action is a priority over the first ten years of the UFMP's implementation.
HIGH	Indicates an action is critical to UFMP implementation over the first ten years, and should be a forefront priority in financial and resource planning.

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Goal 1: Prioritize good program governance						
Action 1.	Pursue SFI certification for Vaughan's woodland management activities as part of its overall urban forest management program.	PGRM	PFHO	LONG		$$
		Why: SFI certification would commit the City to best practices for urban woodland management, with benefits for the local community, ecosystems, and the City's reputation.				
Action 2.	Develop strategic partnerships that will support the implementation of this Strategy.					
Action 2.1.	Work with the TRCA, York Region, the Ontario Woodlot Association, and the Eastern Ontario Model Forest to support and encourage private landowners in accessing resources to support afforestation and SFM efforts on private land.	PGRM	PFHO, TRCA, YORK	MID		$
		Why: Collaboration with other organizations could support efficiencies in resource use related to monitoring and advance knowledge sharing to enable adaptive management.				
Action 2.2.	Continue to work with the TRCA, York Region, and LEAF, toward restoration, afforestation, and clean-up events in woodland areas.	PGRM	PFHO, TRCA, YORK	MID		$$
		Why: Collaboration with other organizations could support efficiencies in resource use related to monitoring and advance knowledge sharing to enable adaptive management.				
Action 2.3.	Continue to work with research partners such as Vineland, universities, the Ministry of Natural Resources and Forestry, and Natural Resources Canada to trial innovative planting methods, climate-facing genotypes, and novel management practices and concepts.	PGRM	PFHO	MID		$$
		Why: Increasing cost of planting, and climate change, will challenge the adaptive capacity of the program. Innovation may provide creative solutions.				
Action 2.4.	Continue to coordinate woodland management programming and efforts with the TRCA.	PGRM	PFHO	SHORT		$
		Why: As the TRCA is Vaughan's largest landowner of woodlands, with specialized expertise in woodland management, continuing coordination helps provide a similar level of service for woodland management across the City.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 3.	Support staff training, industry outreach, and professional development within the discipline of woodland management.	PGRM	PFHO	SHORT		$
		Why: Ensuring City staff have access and exposure to the network of woodland management professionals in south-central Ontario supports a knowledge exchange that will significantly benefit to Vaughan's woodland management program.				
Action 4.	Examine staffing levels and consider hiring new role(s) within the Forestry group to support implementation of the WMS and WMPs.	RSRC	PFHO, FINS	SHORT	HIGH	$$$$
		Why: Vaughan's woodland management program has no dedicated resources. Dedicated departmental capacity will be required to implement this Management Strategy over any time horizon.				
Action 5.	Formalize and document woodland management levels of service and performance measures.	PGRM	PFHO, IPAM	SHORT	YES	$
		Why: Levels of service should reflect the full range of services Vaughan's Forestry Operations can provide, and reflect the recommended service levels in the Woodland Management Strategy, as well as best practices.				
Action 6.	Integrate woodlots into the City's asset management program as a formal asset class.	PGRM	IPAM, PFHO	SHORT	YES	$$
		Why: Vaughan's urban forest assets encompass more than the managed street tree population. Expanding the scope of asset management planning to include all urban forest asset classes supports planning asset maintenance and renewal.				
Action 7.	Prepare woodlot management plans (WMPs) for the 26 woodlots which do not yet have a plan.	STDY	PFHO	SHORT	HIGH	$$$$
		Why: Vaughan's woodlots are the focus of its woodland management and provide a high proportion of the urban forest canopy and related ecosystem services in some neighbourhoods. Their role as conserved forest ecosystems becomes more important as the City urbanizes; while challenges like climate change and increasing use demand more active management.				
Action 8.	Develop research partnerships to explore nuanced woodland appraisal methods that fully reflect the range of human and ecological values supported by woodlot assets.	STDY	PFHO	LONG		$$
		Why: Vaughan's woodland areas support a range of human and ecological values, many of which are difficult to assign a fiscal value to. Utilizing nuanced methods for valuating the City's woodland communities would better inform cost-benefit analyses and the merits treatments designed to improve asset condition.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Goal 2: Maintain healthy and safe urban woodlands						
Action 9.	Formalize the City's pest management program in a corporate integrated pest management (IPM) policy.	BLPL	PFHO	MID	**YES**	$
		Why: Pest management will continue to be a challenge in Vaughan's urban forest. Formalizing the City's pest management approach clarifies detection and response processes.				
Action 10.	Formalize the City's invasive species management program in a corporate invasive species management policy.	BLPL	PFHO	MID	**YES**	$$
		Why: Invasive species have and will continue to be a challenge in Vaughan's urban forest. Formalizing the City's invasive species management approach would help to strategize and clarify processes with respect to the decision-making surrounding treatments.				
Action 11.	Develop the City's library of data available to provide new insights and enhance woodland management objectives and activities.					
Action 11.1.	Undertake a soils survey (once) within woodland areas to better inform management and future restoration prescriptions.	MNTR	PFHO	LONG		$$$
		Why: Soils are a governing factor in woodland composition and structure. Certain prescriptions, such as those involving planting new trees, greatly benefit from an understanding of resident soil typologies.				
Action 11.2.	Record incidental observations of tree age to the City's tree inventory as well as date of observation.	MNTR	PFHO	MID		$
		Why: Tree ages provide insight into the age and development of the forest through time. Coring is not always necessary. Tree ages can be recorded opportunistically through ring counts as trees are felled within a woodland as part of other management initiatives (e.g., hazard abatement work).				
Action 11.3.	Record incidental observations of woodland encroachment, as well as date of observation.	MNTR	PFHO	MID		$
		Why: All instances of encroachment, whether in a plot or not, should be recorded to support future woodland management planning and reduce loss of woodland area.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 11.4.	Establish and maintain a woodland inventory in compliance with **Section 4** of this Strategy.	MNTR	PFHO, OCIO, IPCAM	MID	HIGH	$$
		Why: Current and complete woodland inventory information is foundational for integrating woodlands into the City's asset management program, and for supporting sustainable woodland management.				
Action 11.5.	Maintain access to an inventory of Species at Risk observations within woodlot assets. Ensure broad organizational access to support decision-making.	MNTR	PFHO, OCIO, IPCAM	MID		$
		Why: Supporting broad organizational awareness of species at risk presence in woodland areas ensures all staff have the best information available to ensure legislative obligations are complied with and can support enhanced management activities.				
Action 12.	Adopt monitoring and reporting measures which support sustainable woodland management.					
Action 12.1.	Update the City's Woodlot Management Plans on a five-year cycle, in-step with woodland inventory re-measurement.	MNTR	PFHO	MID	**Yes**	$$
		Why: Woodlot health assessments are an important mechanism both from a monitoring perspective and from an asset management perspective. The forest health assessments and short-term management prescriptions put forward in the WMPs should be kept current, to ensure prescribed management activities remain aligned with long-term management objectives..				
Action 12.2.	Review this document after ten years, and prepare a new Woodland Management Strategy at the end of this Strategy's 20-year life.	MNTR	PFHO	MID		$$
		Why: Urban forest management is an adaptive process requiring sensitivity to changing community contexts and conditions. Timely review of this strategy ensures recommendations are contributing to positive urban forest outcomes, as observed through monitoring initiatives, and ensures management practices are positively contributing toward Vaughan's vision for its woodlots.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 13.	In consultation with the City's Legal and Risk Management team, develop and implement an approved tree risk management policy, encompassing risk management in woodland areas.	PGRM	PFHO, LEGL	SHORT	HIGH	$$$
		Why: The City should formalize its approach to risk management, supporting the identification of processes (i.e., frequency, mitigation priority, mitigation timeframe, thresholds, qualifications and documentation) and resources required to manage tree-related risk at an acceptable level. Thresholds should be based on current industry risk assessment standards.				
Goal 3: Expand the urban forest canopy and associated benefits						
Action 14.	Prepare a city-wide Biodiversity or Green Space Plan to guide restoration and inform land acquisitions supporting woodland health and expansion or broader ecosystem connectivity.	STDY	PPLN, PIPD, PFHO	LONG	YES	$$$$
		Why: A municipal biodiversity or green space plan could identify good candidate areas for consideration as habitat connectivity and wildlife corridors (woodland linkages and buffers), candidate sites for afforestation, and could provide a high-level strategy for the management of local flora and fauna given the threats imposed by climate change.				
Action 15.	Broaden the utility of the City's Tree Planting Reserve (i.e., the Tree Protection By-law cash-in-lieu fund) to enable funds to also be applied to a greater range of planting expenses than is permitted at present.	RSRC	PFHO, FINS, LEGL	SHORT	YES	$
		Why: The intent of Tree Planting Reserve at present is to facilitate the transfer of trees removed from private property to public property. As a result, the current use of the Tree Planting Reserve is limited to the purchase of trees for planting in public spaces. Enabling the Tree Planting Reserve to be applied to costs incurred through restoration, afforestation, and reforestation projects would maintain the intent of the fund's use.				
Action 16.	Identify pilot sites to trial Miyawaki afforestation methods.	RSRC	PIPD, PFHO	MID		$$$
		Why: An increasing number of Canadian municipalities have found success in leveraging Miyawaki plantings.[29,30,31] The City of Vaughan could establish pilot sites to test the method and its efficacy themselves.				
Action 17.	Seek funding, such as that provided by the federal Two Billion Trees program, to support woodland reforestation and restoration programs.	RSRC	ECDV, PFHO	MID		$
		Why: Capitalizing on opportunities for subsidized tree planting will be key to reaching the City's aspirational target of 14% woodland cover.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 18.	Formalize mapping of priority areas for woodland afforestation and acquisition.	PCDR	PPLN, REST, LEGL, FINS, PFHO, IPCAM, PIPD	SHORT		$
		Why: Formalizing those locations in the City where new woodlot area should be prioritized better informs discussions which relate to woodland afforestation or acquisition. Ideally, formalized locations would consider the value of a prospective location/parcel relative to both human uses and the value it adds to the City's existing woodlands network.				
Goal 4: Protect trees and woodlands for future generations						
Action 19.	Develop operational standards for woodland trail development, decommissioning and maintenance.	PCDR	PIPD, PFHO	MID		$$
		Why: Existing trails and surface materials sometimes negatively impact tree health, and unsanctioned trails are extensive.				
Action 20.	Undertake ecosystem restoration consistent with the findings and prescriptions of the City's Woodland Management Strategy and accompanying Woodlot Management Plans.	PCDR	PFHO	MID	HIGH	$$$$
		Why: As is the case in many urban communities, decades of urban growth have impacted the health and extent of Vaughan's woodland ecosystems. The City's woodland management strategy and woodlot management planning framework provide a structure through which sustainable woodland management can be achieved within the City of Vaughan. The City needs to support the resourcing levels required to support implementation of both of those documents, as well as the restorative activities prescribed.				
Action 21.	Work with research partners to develop climate-based seed transfer trials for woodland species.	RSRC	PFHO	MID		$$
		Why: Some native species genotypes may become maladapted to the local area, and climate-based seed transfer can introduce more climate suitable individuals of native species.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 22.	Ensure all woodland restoration and planting activities within Vaughan comply with **Section 4** of this Strategy.	RSRC	PFHO	MID		$$
		Why: Consistently applying the principles of woodlot management from this WMS to all woodlots across the City will ensure a consistent quality of service for woodland management and improve transparency.				
Action 23.	Require tree protection hold-backs for contractors working around or within woodlots as part of design and construction projects.	PCDR	DENG, FINS	SHORT		$$
		Why: Hold-backs and securities are an effective compliance measure.				
Action 24.	Establish an approach for managing encroachment issues within woodland areas.					
Action 24.1.	Establish an approach for managing legacy issues of private yard encroachments into woodlot areas.	PCDR	PFHO, LEGL	MID		$$
		Why: Legacy issues of encroachment exist. Recognizing that some issues of encroachment are not necessarily the fault of the current owner of a property, the City could adopt a standard approach to fair and equitable resolutions.				
Action 24.2.	Formalize an approach and enforcement action for managing developing issues of encroachment.	PCDR	PFHO, LEGL	MID		$$$$
		Why: As the City of Vaughan continues to experience growth and development, encroachment into public lands, including woodlands, will be a persistent issue. The City should formalize the processes and enforcement measures at its disposal to consistently manage this issue.				
Action 25.	Pursue stronger interdepartmental and TRCA relationships in the interest of multi-use trail management.	Procedure	PRC, PFHO, PIPD, TRCA	MID		$$$
		Why: The issue of unauthorized trails will persist and grow with the City. Establishing procedures to gradually decommission trails will mitigate the probability of the issue becoming overwhelming in the future.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Goal 5: Partner in woodland stewardship						
Action 26.	Establish and administer a forest steward program, designed to appoint community members with a lead role in the stewardship of each of the City's 27 woodlots.	Stewardship	PFHO, BYLW	SHORT	**YES**	$$
		Why: A forest steward program offers an invaluable network and resource to the City of Vaughan. Forest stewards would be interested members of the public assigned a leading role in monitoring efforts and in the coordination of stewardship events in a specific woodlot. Forest stewards would also be an important resource in helping City staff understand the challenges facing specific woodlots.				
Action 27.	Support a range of community stewardship opportunities for interested members of the public.					
Action 27.1.	Support public planting initiatives to expand woodland areas where sites are suited.	Stewardship	PFHO	MID		$$
		Why: Bare root planting initiatives are an excellent way to build stewardship, expand the City's woodland system and canopy, and require minimal training in advance.				
Action 27.2.	Host community clean-up events to remove garbage from woodland and riparian sites.	STWD	PFHO, PPLN	SHORT		$$
		Why: Waste and litter removal from woodlots are excellent stewardship opportunities.				
Action 27.3.	Offer outlets for citizen-led monitoring initiatives within woodland areas.	STWD	PPLN, PFHO	SHORT		$$
		Why: Tools which support citizen monitoring capitalize on the public's value as a great asset in providing numerous eyes on the ground to support woodland management.				
Action 28.	Ensure woodland interests are well represented through the composition of any new Community Tree Board.	STWD	PFHO, PPLN	SHORT		$
		Why: A Community Tree Board (CTB) would provide a platform for community members to raise specific urban forestry concerns for the sharing of program specific information, and for coordination and administrative support for stewardship and engagement programming.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 29.	Utilize on-site signage to advertise when and why site works will be occurring/has occurred. Use the opportunity to educate the public on woodland management processes.	PCDR	CME, PFHO, PIPD	MID	**YES**	$$
		Why: Ensuring signage is present near or at the location of site works helps ensure the public is aware of why and when the work will be occurring, capitalizes on an important educational opportunity, and can enhance the success of plantings.				
Action 30.	Work together with Indigenous peoples to identify and support culturally sensitive urban forest and woodland management practices.	PTNR	CME, PFHO	SHORT	**YES**	$$$$
		Why: For thousands of years, Indigenous Peoples have served as stewards to the natural ecosystems that have existed within the lands now known as the City of Vaughan. Although the landscape has changed dramatically over the past few centuries, there may be significant opportunities for meaningful knowledge exchange between the City and Indigenous Peoples on urban forest management, including the identification of culturally-sensitive management practices or supporting reconciliation through urban forestry programs and initiatives.				
Action 30.1.	Consult with local Indigenous Peoples and Communities toward integrating traditional ecological knowledge into woodland management activities.	STWD	CME, PFHO	SHORT	**YES**	$$
		Why: Traditional Ecological Knowledge is often defined as the cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment, encompassing language, naming and classification systems, resource use practices, rituals, spirituality and world-view. Indigenous Peoples have lived in and cared for the trees and woodlands in what is now known as Southern Ontario for thousands of years before the arrival of settlers. Having long occupied the lands sustainably, there may be opportunities to share how these lands and forests can be sustainably managed.				
Action 30.2.	Utilize place-making and other cultural tools toward integrating Indigenous Peoples, perspectives, and values into woodland areas.	STWD	PPLN, CME, PFHO, PIPD	SHORT	**YES**	$$
		Why: There are several examples of new parks and public amenities taking on Indigenous names in recognition of the histories of the lands they now exist within. In July 2021, Vaughan City Council unanimously supported the renaming of Ryerson Park to Sweetgrass Park in consultation with local Indigenous leaders.				

Action		Type	Responsibility	Timeframe	Priority	Ant. Cost
Action 31.	Pilot the concept of food forests in partnership with the TRCA and community partners, supporting both equity outcomes and broader community engagement, education, and outreach	PTNR	PFHO, PPLN, TRCA	MID		$$
		Why: Food forests are a diverse arrangement of primarily edible plants that attempt to mimic the ecosystems and patterns found in the natural world. Food forests tend to be low-maintenance once established, and can produce a reasonable crop toward food security outcomes.				
Action 32.	Ensure the design of urban forestry programming and engagement is considered through an equity lens.	PGRM	PPLN, CME, PFHO	MID		$
		Why: Making sure that urban forestry programs and engagement efforts consider the diverse socioeconomic and cultural profiles in the city helps create outcomes that benefit everyone.				
Action 33.	Utilize pop-up events to spread messaging on urban forestry topics and programming.	STWD	CME, PPLN, PFHO	SHORT		$
		Why: Pop-up events can be an effective means of engaging with community members.				
Action 34.	Initiate a quarterly woodland walk to spread awareness of the challenges facing woodland management in the City, and to showcase activities such as restoration and invasive species removal.	Education	PFHO, CME, PPLN	SHORT		$
		Why: Woodland walks are a great way to get residents out and talking about the challenges facing the City's woodlands. Showcasing issues, successes or ongoing restoration efforts is an effective way for the City to demonstrate what it's doing to supporting woodland areas.				

Section 3.Woodlot Management Planning

3.1. Basis

Woodlot management planning plays a crucial role in ensuring sustainable forest management. Although the Strategic Framework in **Section 2** outlines broad program actions, it lacks the specificity necessary to provide guidance for the management of specific woodlot assets. **Section 3** outlines the woodlot management planning framework presented in this document, and has had its inaugural application to the Sugar Baker Bush Woodlot Management Plan (WMP). One of the cornerstone actions put forward through **Section 2** of this plan is to prepare WMPs for Vaughan's 26 remaining woodlots.

The framework for Vaughan's WMPs supports the monitoring and sustainable management of the City's woodlots over a ten year period. The WMP framework incorporates a blend of stand-level analyses, the application of a common criteria and indicators framework, clearly defined long-term management objectives, and short-term management prescriptions. This section elucidates the purpose, intent, and structure of the WMPs, and a diagram illustrating the framework of the WMPs is presented in the following page.

3.2. Woodlots

Vaughan is home to 27 community "woodlots". Although the term is sometimes associated with timber harvest, Vaughan's woodlots are managed primarily for recreational and ecological values. Harvest is not a program priority given the woodlots the City currently manages.

3.3. Woodlot Management Values

The first component of Vaughan's Woodlot Management Planning Framework consists of two overarching values that is to guide the management of all woodlots within the city:

1. Biodiversity Conservation
   Management values that give priority to ecological function, biodiversity, species habitat, and environmental quality.

2. Safe and Enjoyable Human Use
   Management values that prioritize recreational opportunities, ensure the safe use of woodlot settings, and leverage environmental services that support human land use.

Every woodlot in the city is managed to achieve balance between these two overarching values. Each Woodlot Management Plan (WMP) includes an aggregate score for both values. These scores are derived from a distinct set of criteria and indicators for each value. The aggregate scores help to inform asset management and life cycle planning within each woodlot, and support the assessment of progress towards of long-term management objectives.

Vaughan's Woodlot Management Planning Framework

27 Woodlots in Vaughan managed to achieve a balance of

2 Core Forest Management Values

1) Biodiversity Conservation
2) Safe and Enjoyable Human Use

The weighting of the criteria and indicators varies among woodlot types, reflecting the differing significance of indicators to the long-term management goals of each type of woodlot.

4 Woodlot Types

1 
Recreational Woodlot

2 
Lowland/ Riparian Woodlot

3 
Upland Woodlot

4 
Remnant Woodlot

Criteria and indicators are employed to generate scores for the City's two core management values. These scores serve as a condition assessment for each woodlot.

Long-term Management Objectives

Issues raised through criteria & indicator assessment inform short-term management prescriptions.

16 Criteria and Indicators

Used to assess long-term woodlot management objectives.

13 for Biodiversity Conservation

- Invasive Species
- Unauthorized Encroachment
- Regeneration
- Supercanopy Trees
- Coarse Woody Debris
- Snags
- Uncommon Trees & Rare Woodlands Communities
- Mast Trees
- Woodland Connectivity
- Woodland Size
- Species at Risk
- Relative Biodiversity
- Interior Forest Habitat

3 for Safe and Enjoyable Human Use

- Recreation Quality
- Risk Management
- Surface Water Drainage

Short-term Management Prescriptions

Shortcomings raised through the criteria & indicator assessment are used to craft short-term management prescriptions. These prescriptions are aligned with long-term management objectives.

3.4. Woodlot Types and Long-Term Management Objectives

To establish a long-term management direction, each of Vaughan's 27 woodlots will be assigned one of four broad types, determined by patterns of prevailing human use and ecological qualities. This typology does not imply exclusive management for a single use. Instead, all woodlots are managed to strike a balance between the two core values described in **Subsection 3.3**. The types identify the predominant use of the woodlot, thereby informing suitable long-term management. Each woodlot type supports up to three long-term management priorities, intended to align with the city's aspirations for woodlot assets of the same type.

Recreational Woodlots

Recreational woodlots are managed primarily to provide access for residents and varied recreational uses. These assets often include organized trail systems, signage, and parking facilities. There may be potential for designating off-leash dog areas where this does not detract from the experience of other users or create concerns for biodiversity conservation. The management of these forests generally aims to strike a balance between preserving ecological integrity and ensuring public enjoyment.

The long-term management goals are:

1. Managing risk at an acceptable level.
2. Supporting a range of recreational opportunities suitable for all ages and abilities.
3. To support healthy, biodiverse, and native ecosystems.

Lowland/Riparian Forests

Lowland and riparian forests contain creeks, rivers, or other watercourses. Forefront objectives in this asset class include risk management, supporting broader stormwater management function, and habitat connectivity within the Natural Heritage System (NHS). Human activities are usually considered as secondary priorities.

The long-term management goals are:

1. Managing risk at an acceptable level.
2. To support healthy, biodiverse, and native ecosystems.
3. To serve as a critical support in managing stormwater and runoff within the City of Vaughan.

Upland Forests

The main purpose of managing upland forests is to create habitats for wildlife, promote ecosystem health, and contribute to the preservation of native biodiversity. While these forests may have some walking trails, recreation is not generally a primary focus.

The long-term management goals are:

1. Managing risk at an acceptable level.
2. To support healthy, biodiverse, and native ecosystems.
3. To support a range of habitats for wildlife, including by connecting between other forest types.

Remnant Forests

Remnant forests are typically small, often less than 1 hectare in size, or have elongated shapes that make effective management for public use or biodiversity preservation challenging. In such cases, these parcels may be managed primarily for risk, with secondary objectives pursued only opportunistically.

The long-term management goals are:

1. Managing risk at an acceptable level.
2. To support a range of habitats for wildlife, including by connecting between other forest types.
3. To support urban reforestation.

3.5. Criteria and Indicators

A standardized set of 16 indicators serves as the backbone of Vaughan's woodlot management planning framework. Some indicators have the support of two or more sub-indicators. Each indicator is given a score of 1 to 5, where 1 is "very poor" performance and 5 is "very good" performance. To calculate the Biodiversity Conservation and Safe and Enjoyable Human Use scores, the scores across the relevant indicators are averaged to arrive at overall ratings for each core value. The score for Safe and Enjoyable Human Use is influenced by three indicators, while 13 indicators inform the Biodiversity Conservation score.

The goal of woodlot management is not to achieve a "very good" score (i.e., 5) for both woodlot management values. Rather, woodlot management activities should be guided by cost-benefit analyses, aiming to fulfill predetermined service levels for Vaughan's woodlot assets through strategic interventions. Sustainable forest management seeks to strike a balance among public investment, public safety, and public benefits.

Monitoring criteria and indicators allows the City to track variations in woodland health and woodland services, over time. Additionally, monitoring enables an evaluation of the effectiveness of management actions. A reassessment of the criteria and indicators should occur every five years, accompanied by updates to short-term management prescriptions.

Indicators

Vaughan's Woodlot Management Plans (WMPs) incorporate 16 indicators, with three dedicated to assessing the Safe and Enjoyable Human Use value and 13 assessing the Biodiversity Conservation value. An overview of the criteria scoring is available in **Table 3-1**. A brief summary of the indicators and their method of assessment is outlined below:

Safe and Enjoyable Human Use Indicators

Recreation Management: The recreation management indicator offers a qualitative evaluation of the extent to which trail infrastructure improvements and/or renewal are expected to impact a public woodlot over the next 10 years (e.g., necessitating tree removal).

Risk Management: The risk management indicator serves as a quantitative screening measure assessing the potential risk posed by trees in the woodlot, taking into account the presence of interface environments (i.e., length of edge) and/or the existence of dead or dying trees (dead/dying trees per hectare). It's important to recognize that this indicator does not rely on any formal tree risk assessment. Low scores do not conclusively indicate that a hazard is present in the woodlot. Instead, the risk management indicator has been prepared to support prioritizing future risk management monitoring and abatement efforts.

Stormwater Management: The stormwater management indicator is a qualitative measure of the extent to which capital stormwater management and drainage projects taking place in resident creeks are anticipated to require tree removal.

Biodiversity Conservation Indicators

Unauthorized Encroachment: The unauthorized encroachment indicator gauges the severity of encroachment issues within a woodlot. Encroachment into woodland areas can result in the introduction of invasive species, displacement of native flora, and disruption of wildlife shelters, food sources, and overwintering habitats. In certain instances, encroachment may also conflict with human uses of a forest. The indicator is established through a count of incidental observations, with lesser weight assigned to more easily addressed encroachment issues (e.g., dumping) and greater weight assigned to more challenging-to-resolve matters (e.g., yard encroachments, encampment, or unauthorized trails).

Supercanopy Trees (SCT): The SCT indicator offers a quantitative assessment of the abundance of large trees (> 50 cm dbh) within a woodlot (i.e., SCT per hectare). Supercanopy Trees emerge above the primary canopy of a stand, introducing vertical structural diversity that serves as lookouts, refuges, perches, and landmarks for wildlife.

Coarse Woody Debris (CWD): The CWD indicator assesses the abundance of Coarse Woody Debris within a woodlot. CWD includes dead logs and large

dead branches on the forest floor, providing a feeding environment for woodpeckers, nesting opportunities for snakes, and serving as shelter for salamanders. Additionally, CWD offers a growth medium for fungi, mosses, and lichens. Deadwood pieces exceeding the minimum size criteria for a **log** can be counted as multiple **logs**. Presently, the City lacks the necessary data to score this indicator within woodlots. However, future inventory work will be undertaken to develop this dataset.

Regeneration: The regeneration indicator offers a quantitative assessment of the proportion of understory species that are native and have the potential to become overstory trees if released from the understory. Stem counts in the understory, specifically the proportions of "quality" species, form the basis of this indicator.

Invasive Plants: The invasive species indicator provides quantitative measures of the relative abundance of both woody and non-woody invasive species within a woodlot. Invasive plants possess traits that confer a competitive advantage over native species when new growing space becomes available in woodlands. The indicator comprises two sub-indicators: woody invasives, determined by the abundance of mature invasive trees in the overstory (i.e., stems per hectare), and non-woody invasives, based on the area affected by non-woody invasive species (i.e., a percentage of total woodlot area). Sub-indicators carry equal weight in determining the overall score for the indicator.

Snags: The snags indicator offers a quantitative assessment of the relative abundance of snags in a woodlot (i.e., snags per hectare). Snags are standing dead trees that offer opportunities for feeding, nesting, and

perching for birds such as woodpeckers and hawks, as well as mammals such as squirrels and raccoons.

Interior Habitat: The interior forest habitat indicator provides a quantitative measure of the relative abundance of interior habitat within a woodlot (i.e., gross area of interior habitat). Interior habitat was defined as woodland habitat setback 100 metres or more from any edge environment. Interior habitat often provides different functions than edge environments, such as protection from nest predators like raccoons and blue jays, which tend to be more prevalent in edge habitats.

Mast Trees: The mast trees indicator offers a quantitative assessment of the relative abundance of mature mast trees in a woodlot (i.e., stems per hectare). Mast trees produce edible fruits that serve as crucial sources of food for wildlife.

Uncommon Trees: The uncommon trees indicator presents a quantitative measure of the relative abundance of uncommon tree species (as defined) in a woodlot (i.e., uncommon trees per hectare). It's important to distinguish this indicator from the SAR indicator, which encompasses species identified under Ontario Regulation 230/08. Uncommon trees are not necessarily endangered or threatened, although they often are. Instead, they are species that have become less prevalent in Vaughan's native ecosystems due to urban and agricultural growth over the past two centuries.

Forest Connectivity: The forest connectivity indicator offers a quantitative measure of the relative connectedness (external connections) and fragmentation (internal connections) of a woodlot. Forest connectivity is crucial for the long-term persistence of species dependent on forested environments. The indicator comprises two sub-indicators: forest connectivity, which assesses the number of connections between the woodlot and other nearby woodlots, and fragmentation, which evaluates the number of discrete woodlot areas within the woodlot. Both measures use linkages as the basis for criteria scoring, with linkages representing the shortest path between a woodland patch and each of its neighbours. It's important to note that barriers and the cost of movement were not considered in this analysis. The methods used to evaluate fragmentation and connectivity are simplified and can be refined in future Forest Management Plan updates as new analyses and datasets become available. Sub-indicators carry equal weight in determining the overall indicator score.

Forest Size: The forest size indicator offers a quantitative measure of the gross size of the forest area, calculated by considering all constituent woodlots. Forest size serves as an important indicator because the total size of a forest can significantly impact its suitability for supporting habitat and various types of use or management practices.

Species at Risk (SAR): The SAR indicator offers a quantitative measure of the relative abundance of Species at Risk (as defined under Ontario Regulation 230/08) or candidate habitat for these species. The indicator comprises two sub-indicators: the first involves actual observations of SAR, determined by their frequency in the woodlot (i.e., SAR observations per hectare), and the second entails observations of candidate SAR habitat (i.e., different types of candidate SAR habitat per hectare). Sub-indicators carry equal weight in determining the overall indicator score.

Relative Biodiversity: The species richness indicator provides a quantitative measure of the relative abundance of unique flora and fauna species within a woodlot. This indicator consists of two sub-indicators: richness of woody native species, determined by a simple count of unique species of native flora (i.e., species per hectare), and unique species of fauna (i.e., species per hectare). Both sub-indicators are constrained by the currently available data; the flora sub-indicator does not encompass the full spectrum of native flora within the forest, and the fauna sub-indicator is limited to avian species. Thresholds for criteria should be adjusted for this indicator as inventory data is enriched over time. Sub-indicators carry equal weight in determining the overall indicator score.

Table 3-1. *Woodlot criteria and indicators scheme.*

Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
VALUE: Safe and Enjoyable Human Use						
Recreation Management 	*Gaps exist in the provision of quality trail infrastructure within the forest. Planned network upgrades and/ or maintenance activities will likely necessitate significant tree removal.*	*Some gaps exist in the provision of quality trail infrastructure within the forest. Planned network upgrades and/ or maintenance activities will likely necessitate some tree removal.*	*Isolated gaps exist in the provision of quality trail infrastructure within the forest. Planned network upgrades and/ or maintenance activities could necessitate some tree removal.*	*Trails infrastructure in the forest is sufficient in meeting forecasted demand. Trail renewal activities could impact isolated trees.*	*Trails infrastructure in forest sufficient in meeting forecasted demand. Trail renewal activities unlikely, but could impact isolated trees.*	**Recreation: 2** **Upland: 1** **Lowland: 1** **Remnant: 0**
Risk Management 	> 1,000 m edge/ha AND > 5 dead or dying trees/ha. *Concentration of dead and/or declining trees and extensive edge environments are present in the forest.*	> 0 m edge/ha AND > 5 dead or dying trees/ha. *Concentration of dead and/or declining trees and some edge environments are present in the forest.*	> 0 m edge/ha AND < 5 dead or dying trees/ha. *Some dead and/ or declining trees and some edge environments are present in the forest.*	> 0 m edge/ ha AND 0 dead or dying trees/ ha BUT one or more forest health factor(s) present. *No dead or declining trees were observed within the forest, but some interface settings exist. Forest health concerns are present, or may be expected in the future.*	0 m edge/ha AND 0 dead or high-risk trees/ha AND no significant forest health factors present. *No dead or declining trees within the forest, and no or very limited interface settings exist. No current forest health issues present or anticipated in the future.*	**Recreation: 2** **Upland: 2** **Lowland: 2** **Remnant: 2**

Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
Stormwater Drainage 	*0.2 ha or more woodland canopy per year are removed to support stormwater management or drainage works. Some or all areas of affected woodland cover will be permanently converted to non-woodland cover.*	*Less than 0.2 ha of woodland canopy per year are removed to support stormwater management projects. Some areas of affected woodland cover will be permanently converted to non-woodland cover.*	*Less than 0.2 ha of woodland canopy per year are removed to support stormwater management projects. Restorative planting will take place in all areas affected following the end of construction.*	*Less than 10 tree removals per year occur to support stormwater management projects. Restorative planting will take place in all areas affected following the end of site alteration.*	*No tree removal is anticipated within the woodlot in support of stormwater management projects.*	**Recreation: 2** **Upland: 0** **Lowland: 2** **Remnant: 0**
VALUE: Biodiversity Conservation						
Invasive Plants 	4+ woody invasive trees/ha. *Woody invasive trees pervasive in the forest and a significant ecological concern.*	1-4 woody invasive trees/ha. *Presence of woody invasive trees common and an ecological concern in the forest.*	1-1.5 woody invasive trees/ha. *Some woody invasive trees in the forest.*	<1 woody invasive trees per ha. *Few woody invasive trees in the forest.*	No presence of woody invasive trees in the forest.	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
	Non-woody invasive cover present in more than 2% of the forest. *Non-woody invasive plants pervasive in the forest and a significant ecological concern.*	Non-woody invasive cover present in between 1 and 2% of the forest. *Presence of non-woody invasive plants common and an ecological concern in the forest.*	Non-woody invasive cover present in between 1 and 0.5% of the forest. *Some non-woody invasive plants in the forest.*	Non-woody invasive cover present in between 0.5 and 0.1% of the forest. *Few non-woody invasive plants in the forest.*	No notable areas of Non-woody invasive cover present.	

Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
Unauthorized Encroachment 	*Very frequent instances of encroachment of multiple types in the forest. Issues often involve varieties of encroachment that are more challenging or costly to resolve (e.g., rear yard encroachment, unauthorized trails).*	*Frequent instances of encroachment of multiple types in the forest. Issues occasionally involve varieties of encroachment that are more challenging or costly to resolve (e.g., rear yard encroachment, unauthorized trails).*	*Some instances of human encroachment in the forest. Issues are typically less difficult to resolve (e.g., dumping).*	*Very isolated instances of encroachment in the forest. Issues only involve varieties of encroachment that are more readily resolved (e.g., dumping)..*	*No known issues of unauthorized encroachment in the forest.*	**Recreation: 2** **Upland: 2** **Lowland: 2** **Remnant: 0**
Regeneration 	No high-quality tree regeneration present. *Regeneration exclusively invasive or otherwise consisting of species which may not achieve maturity.*	0-60% quality regeneration present. *Few suitable native recruits present in regeneration.*	60-80% quality regeneration present. *Some suitable native recruits present in regeneration.*	80-95% quality regeneration present. *Regeneration consisting primarily of suitable native recruits.*	>95% quality regeneration present. *Regeneration consisting only of suitable native recruits.*	**Recreation: 2** **Upland: 2** **Lowland: 2** **Remnant: 0**
Supercanopy Trees (SCT) 	No SCT present.	1 SCT per 16-32 ha *SCT limited in the forest.*	1 SCT per 8-16 ha *Some SCT present in the forest.*	1 SCT per 4-8 ha *SCT are a common occurrence in forest.*	1 or more SCT per 4 ha or less[1] *SCT abundant in the forest.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**

Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
Coarse Woody Debris (CWD) 	Very limited or no CWD present in forest.	<5 logs/ha *CWD limited in the forest.*	5-10 logs/ha *Some CWD present in the forest.*	10-20 logs/ha *CWD a common occurrence in forest.*	>20 logs/ha[1] *CWD abundant in the forest.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
Snags 	Very few or no snags present in forest.	1-2 snags/ha *Few snag trees present in the forest.*	2-3 snags/ha *Some snag trees present in the forest.*	3-5 snags/ha *Snag trees a common occurrence in the forest.*	>5 snags/ha[1] *Snag trees abundant in the forest.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
Interior Forest Habitat 	No interior habitat in forest.	<1 ha interior habitat. *Few interior habitat present in forest.*	1-2 ha interior habitat *Some interior habitat present in forest.*	2-4 ha interior habitat *Interior habitat a common occurrence in forest.*	>4 ha interior habitat[1] *Interior habitat abundant in the forest.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
Mast Trees 	Very few or no mast trees present in forest.	1-2 mast trees/ha *Few mast trees present in the forest*	3-5 mast trees/ha *Some mast trees present in the forest*	5-8 mast trees/ha *Mast trees a common occurrence in the forest*	>8 mast trees/ha[1] *Mast trees abundant in the forest.*	**Recreation: 1** **Upland: 1** **Lowland: 1** **Remnant: 0**

Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
Uncommon Trees 	Very few or no uncommon trees observed in forest.	1 uncommon tree/2 ha or more *Few occurrences of uncommon trees in forest.*	1 uncommon tree/1-2 ha *Some uncommon trees present in forest.*	1-2 uncommon trees/ha *Uncommon trees a common occurrence in forest.*	>2 uncommon trees/ha *Uncommon trees abundant in forest.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
Forest connectivity 	>6 links within the forest. *Highly fragmented forest unit. Forest functionality as a single ecosystem is very limited.*	4 - 6 links within the forest *Fragmented forest unit.*	2 - 3 links within the forest *Some fragmentation exists within the forest.*	One link within the forest *Forest is largely intact.*	No links within the forest *Forest is one consolidated unit. Fragmentation and interconnectivity not a concern.*	**Recreation: 0** **Upland: 1** **Lowland: 1** **Remnant: 0**
	No external links to nearby forests. *Very isolated forest. Very limited to non-existent connections to the City's broader forest network.*	1 to <3 links at a 1 km max distance *Forest connectivity to the City's broader forest network is limited.*	3 links at a 1 km max distance *Some connections exist between the forest and the City's broader forest network.*	4 links at a 1 km max distance *Forest is reasonably well connected to the City's broader forest network.*	>= 5 links at a 1.5 km max distance *Forest is very well connected to the City's broader forest network. Numerous connections to other forest features exist.*	

Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
Forest size 	< 0.5 ha of the forest under City ownership or management AND the larger contiguous forest is < 0.5 ha in total size *Very small remnant forest left over from development activity with little opportunity to support meaningful ecological or environmental management outcomes in light of constraints imposed by its size.*	< 0.5 ha of the forest under City ownership or management AND the larger contiguous forest is > 0.5 ha in total size *Small remnant forest parcel left over from a past subdivision process. However, opportunities may be present to manage the broader contiguous forest in collaboration with neighbouring landowners.*	0.5 - 1 ha of the forest under City ownership or management *Moderately sized forest capable of supporting ecological or biodiversity outcomes.*	1 - 8 ha of the forest under City ownership or management *Large forest are capable of supporting important ecological and biodiversity outcomes.*	>8 ha of the forest is under City ownership or management *Very large forest capable of supporting a broad range of important ecological and biodiversity outcomes.*	**Recreation: 0** **Upland: 1** **Lowland: 1** **Remnant: 0**

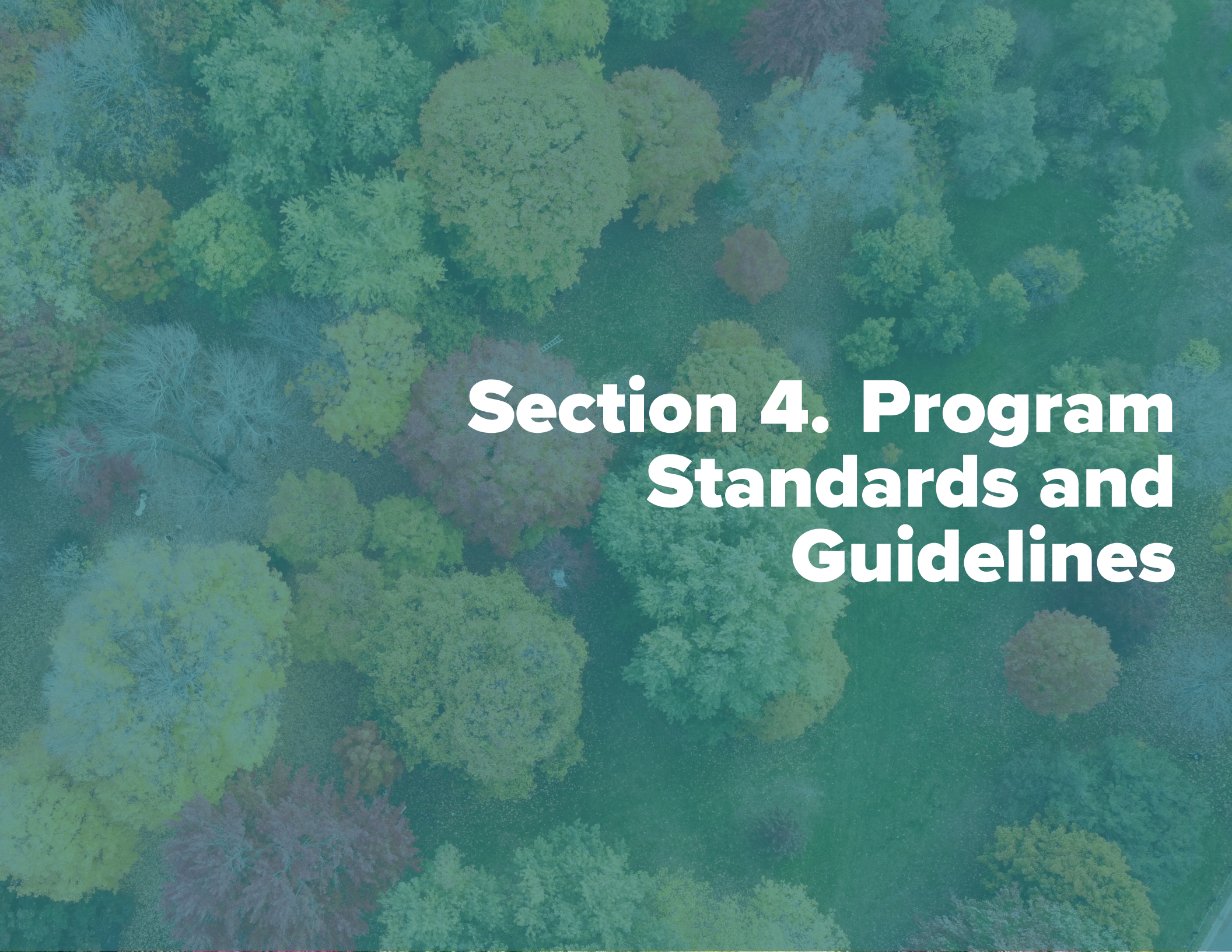
Objective	Very poor *Unfit for Purpose* 1	Poor *At Risk* 2	Fair *Requires Attention* 3	Good *Adequate for Now* 4	Very Good *Fit for Future* 5	Indicator Weighting by Forest Type
Species at Risk (SAR) 	No observations of species at risk in forest	Observations of SAR at a rate of 1 species/10 ha *Very limited SAR observations in forest.*	Observations of SAR at a rate of 1 species/2 ha *Few SAR observations in forest.*	Observations of SAR at a rate of 1 species/ha *SAR observations in forest.*	Observations of SAR exceeding a rate of 1 species/ha *Abundant SAR observations in forest.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
	No candidate SAR habitat observed in forest	Observations of candidate SAR habitat at a rate of no more than 1 species/2 ha *Very limited candidate SAR habitat in forest.*	Observations of candidate SAR habitat at a rate of up to 2 species/ha *Few candidate SAR habitat observations in forest.*	Observations of candidate SAR habitat at a rate of up to 5 species/ha *Candidate SAR habitat observations in forest.*	Observations of candidate SAR habitat exceeding a rate of 5 species/ha *Abundant candidate SAR habitat observations in forest.*	
Relative Biodiversity 	Unique woody overstory species occur at a rate of less than 1 species/ha *Very limited native woody biodiversity.*	Unique woody overstory species occur at a rate of up to 2 species/ha *Limited native woody biodiversity.*	Unique woody overstory species occur at a rate of up to 3 species/ha *Fair native woody biodiversity.*	Unique woody overstory species occur at a rate of up to 4 species/ha *Considerable native woody biodiversity.*	Unique woody overstory species occur at a rate exceeding 4 species/ha *Rich native woody biodiversity.*	**Recreation: 1** **Upland: 2** **Lowland: 2** **Remnant: 0**
	No bird observations recorded within the forest *Very limited avian biodiversity.*	Bird observations at a rate of <2 records/ha in the forest *Limited avian biodiversity.*	Bird observations at a rate of up to 4 records/ha in the forest *Fair avian biodiversity.*	Bird observations at a rate of up to 8 records/ha in the forest *Considerable native avian biodiversity.*	Bird observations exceeding a rate of 8 records/ha in the forest *Rich avian biodiversity.*	

3.6. Short-Term Management Prescriptions

Short-term management prescriptions identify critical woodlot management activities and their planned timing. Informed by the woodlot criteria and indicators and steered by long-term management objectives, short-term prescriptions reflect the activities that should occur within the woodland toward better alignment with the objectives for its management.

The purpose of short-term management prescriptions is therefore to improve the position of key low-scoring criteria and indicators, which in turn will move the woodlot toward the relevant long-term management vision while also enhancing asset value and the range of services provided by the woodland asset.

In the context of Vaughan's WMPs, short-term prescriptions have been prepared up to 2034 (i.e., a 10-year timeframe). While a formal process for prioritizing limited resources to support prescriptions was not applied, the short-term prescriptions generally gave precedence to higher-priority actions and sought to optimize resource utilization by sequencing prescriptions to achieve efficiencies.



Section 4. Program Standards and Guidelines

4.1. Specifications Supporting Site Works

Vaughan's WMPs generally advocate for the creation of a 'specification' at the time when restoration and/or planting works are scheduled to take place. While the data utilized in preparing the WMPs is sufficient for guiding broad short-term prescriptions within individual woodland communities, it lacks the specificity required to prescribe the exact locations and methods for implementing these prescriptions on the ground. This level of direction is instead postponed to the development of a specification.

Specifications should encompass the information essential to facilitate the organized execution of site works and must be formulated shortly before the commencement of site work. Generally, specifications should include:

- specific spatial location(s) of site activities as part of prescribed works,
- stocking specifications across different areas and planting typologies contained to a site,
- treatment and specific location(s) of woody invasives and/or downed woody material as part of any restorative works,
- treatment and specific location(s) of non-woody invasives as part of any restorative works,
- treatment of downed woody material and large stems slated for removal (e.g., leave downed logs, girdle large invasives),
- requirements and location(s) for fencing, scarification of compacted soils, mowing, or other site preparatory site works.

Specifications should be crafted by a suitably qualified individual. While this section includes standards that can offer guidance for specifications, it is the intent of the specification to establish the nuanced direction required to inform coordinated planting and/or restoration activities on the ground.

Not all management activities within woodlot areas will be governed by specifications. Smaller-scale processes, such as the removal of hazardous trees or fallen trees over trails, will not be guided by specifications. Instead, the City will broadly adhere to the guidance provided in this Section when undertaking such activities.

4.2. Invasive Species Management Standards

The *Ontario Pesticides Act* and Ontario Regulation 63/09 include a natural resources exception that permits the application of chemical controls for managing pests and invasive species. This exception allows the use of prohibited pesticides to manage, protect, establish, or restore a natural resource. Municipalities have the authority to apply or engage a licensed contractor to apply prohibited herbicides without requiring a written letter from the Ministry of Natural Resources and Forestry (MNRF). Herbicides may only be applied in strict accordance with all label directions. Individuals or entities working on behalf of the City are obligated to comply with all federal and provincial legislation when applying herbicides.

Data gathered from field inventories has identified the presence of invasive plants in at least some of Vaughan's woodlots. While the goal of completely removing all invasive species from Vaughan's woodlots may be idealistic, striving for the eradication of most established invasive species on a city-wide scale is not practical. The City's primary focus in managing invasive species, in most cases, should be to impede their spread and conserve native ecology, rather than pursuing complete eradication.

Future efforts toward an Invasive Species Management Plan should establish a formal decision-making process for management interventions (i.e., implementing Action 10 of this WMS).

Treatment

The seed bank for some of the invasives can persist in the soil and remain viable for as long as a decade. All site works involving the removal of invasive plants should be accompanied by a monitoring budget to facilitate spot treatments within the treatment area for a period ranging between three and five years. In many cases, residual invasive pressures from surrounding land uses will endure, necessitating ongoing control efforts as part of routine woodland management to prevent re-infestation.

Whenever feasible, treatments for invasive species should be carried out simultaneously. However, the use of different herbicides and control methods for different species may hinder simultaneous treatment. Removal efforts should consistently adhere to best management practices for dealing with invasive species in the natural landscape. Generally, removal will entail a combination of chemical and mechanical controls, and the approach may be guided by the thresholds and directives outlined in an invasive species management plan, when one becomes available.

In general, specifications facilitating the removal of any existing invasive species should be implemented before

initiating any new planting on a site. On sites where native biodiversity is restricted, planting should take place shortly after the removal of invasive species. Reintroducing appropriate native species into the site following invasive removal enhances restoration outcomes. Similarly, planting native species after creating large or frequent openings in the woodland canopy (e.g., through the removal of hazard trees) can help counteract the introduction and spread of invasive species into the understory layer, especially where invasives are already present within a woodland.

Invasive Fauna and Disease Controls

A variety of invasive pests and diseases pose a threat to Vaughan's urban woodlands. Monitoring is the primary method by which the City can stay vigilant against forest health threats. Action 9 of this WMS recommends the City formalize an approach to pest management, such as through the creation of an Integrated Pest Management Policy. This document defers all pest management processes, standards, and thresholds to that document.

Notwithstanding the above, the City typically does not typically undertake treatment for health concerns deemed to be cosmetic in nature. The City does, however, monitor egg masses for spongy moth in collaboration with its organizational partners and may, at its discretion, opt to prescribe treatment where mast thresholds are deemed to warrant the prescribed activity.

Spongy moth (*Lymantria dispar dispar*).

Tree guards and rodent/rabbit fencing adjacent a recent planting site.

4.3. Planting Standards

Where prescribed through a WMP, the following minimum standards should be adhered to when developing a specification involving tree planting within a woodland area.

Site Preparation

Prescriptions for invasive plant removal will be completed prior to the commencement of planting activities at a given location.

In anticipation of fall planting, the designated planting sites undergo mowing in spring to minimize ground cover and mitigate competition.

The decision to implement exclusion fencing should be made before initiating the mowing process. Installation of exclusion fencing and/or tree guards will be required where there is a potential risk of browse damage by deer, rodents, or rabbits. In locations with high levels of pedestrian activity and trails, particular attention should be given to deer exclusion measures to reduce the risk of damage or trampling by pets. The overall specifications for fencing and guards are outlined as follows:

Deer fencing:

- Minimum 3 m tall.
- Composed of knotted-joint style woven wire with 15 cm vertical wire spacing. The bottom 1 m must have openings small enough to prevent the passage of fawns.
- Setback at least 20 cm from any enclosed tree.
- Wood battens or other materials attached to the woven wire to increase fence visibility in areas of concern.

- Pressure treated line post spacing at 4.5-6 m.
- Deer fencing need not enclose coniferous groupings.

Rabbit fencing:

- Barriers be installed around each seedling, or exclusion fencing be employed around the entire site.
- Barriers should be no shorter than 30 cm.
- The barrier should extend no less than 15 cm below grade, and should be set at 90° at maximum depth to prevent lift.
- No single opening greater than 2.5 cm x 2.5 cm.
- More than 20 cm setback from any enclosed tree.
- Use a metal mesh, rather than fibreglass or plastic which can be gnawed through.

Tree guards:

- Individual tree guards are often most effective where rabbit or rodent damage is concerned.
- Tree guards can be made from 10-20 mm square wire screen, biodegradable plastic mesh tubing, or solid plastic sleeves.
- Guards should be set 7.5-10 cm into the ground and braced away from the base of the tree.
- Guards to be installed to a height of 50 cm above the anticipated snow line.

Fencing/guards may meet other standards towards the same end, as prescribed through the relevant specification(s) for work.

Planting

- Selection of planting stock will generally align with **Table 4-1** based on the forest cover type present in the woodland. Stock may vary across the site and should be identified in the planting specification accordingly (**Section 4.1**).
- Seedlings should generally originate from Ontario seed zone 34 or seed zones directly south.
- Seedlings will generally be planted at a density of 1500 to 2400 units per ha, spaced at no less than 2 m on centre.
- Seedlings will be planted without pattern. Clustering may be employed dependent on the objectives of the site work. Use of clustering should be identified through the planting specification (**Section 4.1**).
- Approximately 10% of total plantings for a site will generally consist of an appropriate selection of shrubs, as specified by the qualified person authoring the specification.
- Dominant species will generally constitute more than half of all plantings for a site (**Table 4-1**).
- No one associate species will generally constitute more than 10% of all plantings for a site (**Table 4-1**).
- Seedlings will generally be bare root or container grown stock.
- Seedlings will not be planted within 1.5 meters of a tree greater than 5 centimetres dbh.
- Inclusion of any "trial" stock or stock not otherwise identified through **Table 4-1** (e.g., endangered trees, DED-resistant elm) will generally make up no more than 10% of all plantings for a site.
- Coniferous trees would ideally be planted in clusters where included in a planting specification.

Monitoring and Tending

Annual monitoring of the restoration process continues until the regeneration canopy is established, and the stand is deemed to have attained FTG status. Typically, FTG status is achieved between three and five years at the densities identified. Monitoring activities may encompass:

- Removal of any tree tags, tree guards, exclusion fencing, or other barriers.
- Treatment of invasive and undesired regenerative growth, as necessary.
- Subsequent ('infill') planting to maintain planting density where survivorship is below 75% across the entire planting site or in specific areas of the site which have seen increased mortality
- Watering; generally five times throughout the growing season the year after planting, four times the second year after planting, and twice the third year after planting.
- Installation of coco fibre mats following planting to suppress grasses and to retain moisture around plantings.
- Wrapping trunks of trees with burlap or sisal kraft paper (can prevent deer damage as well as protect plantings from sunscald). This will prevent deer from girdling the main trunk of the tree but will not prevent branch browsing.
- Where deer, rodent, or rabbit damage is particularly persistent, commercial repellents can be utilized to protect plantings. These can be applied to foliage or the base of the stem. Always follow the manufacturers application guidance.

4.4. Management of Deadwood

Coarse woody debris (see **Definitions**) and standing dead material play a crucial role in supporting various ecological functions. Although not always practical, it is advisable to take advantage of opportunities to incorporate woody material into the ecosystem. This may involve:

- Leaving standing dead and senescing trees standing.
- Leaving downed logs, whether sectioned or otherwise, at the felling/fall site.
- Leaving fine woody material at the felling/fall site.
- Leaving mitigated snags or "tall stumps" as part of hazard abatement activities.

Specifications for site works (**Section 4.1**) should prescribe the handling of stem removal and woody material.

4.5. Species at Risk

The City will make an effort to sustain an inventory of any locations within a woodlot area where species protected under Ontario Regulation 230/08 are identified. This database serves as the foundational information required to ensure that both on or off-site works, conducted by either the City or a third party, adhere to the regulations stipulated in the *Endangered Species Act*, 2007, S.O. 2007, c. 6.

The City will engage in management activities that contribute to the well-being of any SAR identified through the database. Additionally, the City may explore opportunities for financial support, potentially through initiatives like Ontario's Species at Risk Stewardship Program.

Table 4-1. *Planting pallet specifications.*

Species	ELC Forest Cover Type						Size	Mast	Site	Notes
	Hard	Oak	Low	Pine	Cedar	Hem				
Trees										
Aspen, largetooth		A	A						Moist to dry sites. Ideally full sun.	
Aspen, trembling		A	A						Moist to dry sites. Ideally full sun.	
Basswood	A		A	O				Y	Moist sites. Rich, well drained soils.	
Beech, American	D	O						Y	Moist sites. Preference to well-drained rich soils. Can grow in shade.	
Birch, yellow	A		D		A				Moist sites. Rich soils. Moderately shade tolerant.	
Birch, white	A	A	A	A	A				Adaptable plant. Needs full sun.	
Birch, gray									Adaptable plant. Needs full sun.	
Butternut	A		A					Y	Moist to moderately dry sites. Preference to well-drained rich soils. Good for slopes. Ideally full sun.	
Cedar, eastern white			A		D	A			Moist sites. Does not tolerate road salt. Tolerates some shade.	

Species	ELC Forest Cover Type						Size	Mast	Site	Notes
	Hard	Oak	Low	Pine	Cedar	Hem				
Cedar, eastern redcedar		A			D				Dry to average moisture. Preference to well-drained sites. Sandy or rocky soils with high pH.	
Cherry, black	D	O		O				Y	Adaptable plant. Full sun.	
Cottonwood, eastern									Moist sites. Rich and sandy soils. Full sun.	
Gum, black			I						Wet, slightly acidic sites. Ideally full sun.	Taproot- containerized stock only. Known adaptability to drier sites north and east of native range.
Hackberry	A		O						Adaptable plant. Full sun to partial shade.	Reasonable replacement for lost elm.
Hemlock, eastern	D			O		D			Moist sites. Very shade tolerant.	
Hickory, bitternut	A	O			A			Y	Very moist, rich sites. Full sun to partial shade.	
Hickory, pignut									Adaptable plant. Full sun to partial shade.	
Hickory, shagbark	A	O	A		A			Y	Moist sites with rich soils. Sun or partial shade.	
Hop tree									Moist to dry sites. Well drained, sand or loam soils. Full sun.	

Species	ELC Forest Cover Type						Size	Mast	Site	Notes
	Hard	Oak	Low	Pine	Cedar	Hem				
Ironwood	A			O	A			Y	Moist to dry, well-drained sites. Slightly acidic soils. Very shade tolerant, can tolerate full sun.	
Maple, black	A		A						Moist sites with rich soils. Shade tolerant.	
Maple, red	D	A		O		A			Adaptable plant. Tolerates some shade.	
Maple, silver			D						Moist sites with rich soils. Full sun.	
Maple, sugar	D	A	A	O		A			Moist sites with deep, rich, well-drained soils. Full sun.	
Oak, black		D		A	A				Moist to dry, adaptable to soils. Full sun.	Reduce use until the impacts of oak wilt are better understood.
Oak, bur	A	D	A	A					Adaptable plant. Full sun, tolerates moderate shade.	Reduce use until the impacts of oak wilt are better understood.
Oak, chinquapin		O		A					Adaptable plant. Full sun, intolerant of shade.	Reduce use until the impacts of oak wilt are better understood.
Oak, red	D	D	A	A	A			Y	Adaptable plant. Full sun, tolerates some shade.	No use until the impacts of oak wilt are better understood.
Oak, swamp white				A					Moist sites, rich slightly acidic soils. Full sun or partial shade.	Reduce use until the impacts of oak wilt are better understood.

Species	ELC Forest Cover Type						Size	Mast	Site	Notes
	Hard	Oak	Low	Pine	Cedar	Hem				
Oak, white	A	D	A	A	A			Y	Adaptable plant. Full sun.	Reduce use until the impacts of oak wilt are better understood.
Poplar, balsam			A		A				Moist sites, rich well-drained soils. Full sun.	
Pawpaw			I						Moist to wet sites, rich soils. Part to full shade.	Taproot- containerized stock only.
Pine, jack				D					Adaptable plant. Prefers dry sandy soils. Full sun.	
Pine, red				D	A				Adaptable plant. Tolerates poor, rocky and sandy soil. Full sun.	
Pine, white	A	A	A	D	A	A			Adaptable plant. Prefers sand or sandy loam. Tolerates partial shade when younger.	
Sassafras	O	O							Adaptable plant. Moist to dry sites preferred. Full shade or full sun.	
Spruce, white					A				Adaptable plant. Tolerates shade.	
Sycamore									Moist sites. Rich soils, tolerates heavy clay. Part shade or full sun.	
Tamarack									Adaptable plant. Full sun.	

Species	ELC Forest Cover Type						Size	Mast	Site	Notes
	Hard	Oak	Low	Pine	Cedar	Hem				
Tulip tree	O								Moist sites, sand and sandy loam. Full sun.	
Walnut, black								Y	Moist sites. Well-drained rich soils. Full sun.	

Acronym Key:

ELC Cover Type; Hard (upland tolerant hardwoods), Oak (upland oaks), Low (lowland hardwoods), Pine, Cedar (cedars and cedar swamps), Hem (hemlock). "D" indicates a dominant species in the cover type, "A" an associate species, "O" an occasional associate, and "I" and infrequent or rare associate.

Notes:

Certain species are present in the forest cover types identified but have been excluded from this table as they are not presently considered suitable planting stock.

Although "early successional hardwoods" is a discrete cover type identified through Ontario's Silvicultural Guide to Managing Southern Ontario Forests,[34] stock selection in stands currently meeting the definition of an early successional hardwood forest should instead utilize upland tolerant hardwood, upland oak, or lowland hardwood species (as is appropriate).

4.6. Woodland Acquisition

Formalizing priorities in woodland management can help to ensure new woodland acquisitions align with the City's long-term objectives for woodland management and its woodland network, as recommended by WMS Action 18. The decision to acquire new woodland areas through purchase agreements should be influenced, in part, by the proximity of the woodland parcel(s) to the City's current network. Priority should be given to purchasing woodland areas that meaningfully contribute to the City's existing woodland network, as determined by their connections to the established network. Woodland acquisitions could potentially be funded by an urban forest reserve fund (proposed by UFMP Action 2-4) or development contributions where appropriate. Potential acquisitions for woodland value should be reviewed against the Land Acquisition Study in each case.

Before the City proceeds with the purchase or dedication of a new woodland area, due diligence mechanisms will be requested and conducted prior to the transfer of land. This process involves:

- Surveys identifying the location(s) and severity of any resident populations of invasive species.
- Surveys identifying the location(s) and severity of any issues of encroachment.
- Surveys identifying the location(s) and severity of any hazardous trees.

Any issues identified during the due diligence process will ideally be addressed and resolved before transfer of ownership. Alternatively, if resolution is not possible before transfer, the fair market value of the woodland may be appropriately discounted to account for the costs associated with addressing those issues following the transfer of land.

4.7. Inventory and Monitoring Standards

Continuous inventory and monitoring processes are essential for the informed management of Vaughan's woodlots. The ongoing collection of forest inventory measurements is crucial for conducting analyses that form the basis of the WMPs outlines in **Section 3** of this Strategy. Moreover, up-to-date inventory records play a vital role in assessing the progress of WMS and WMPs implementation, facilitating the integration of the City's woodlands as a municipal asset. The following provide guidance for sampling methods and measures that support the collection of key woodland information.

Plot Sampling

Sampling programs can be employed to obtain critical insights into forest composition, structure, and health. Measurements easily collected through plot information is often challenging or impossible to acquire through remote sensing methods. The use of a variable-radius permanent sample plot inventory scheme allows for a quick collection of standard and repeated measurements of forest composition and structure over time.

In Vaughan's woodland communities, a cruising prism with a BAF of 2 is generally appropriate. For each tree identified as 'in-plot,' it is important to record species, diameter, condition, and height. Sample tree selection should be based on species and resident stratum, aiming to capture one sample measurement from each well-defined stratum in the plot, along with any noteworthy species diversity observed between strata.

Plot-level observations should include number of strata, slope, and groundcover. To assess understory composition and recruitment, surveys for regeneration and groundcover should be conducted. Regeneration data can be organized either as a stem count or as a proportion of new growth. Regardless of the format, the data should identify the species composition of recruits and understory plants. Soil samples (i.e., test pits) would ideally be taken once, at plot establishment (i.e., immediately outside plot), and paired with the plot record.

Observations of all snags, cavity trees, and coarse woody debris within the plot, including details about their size and level of decomposition should be recorded.

Sampling Density

Plots should be established with a target density of 2 plots per hectare and revisited at the same location in an iterative cycle, ideally aligning with WMP updates and SOUF reporting cycles. Revisiting the same plot is critical as it provides insights into the stands development over time. Sampling locations should be randomly selected, with a minimum buffer distance of 100 meters between them, and should be stratified by the communities and conditions present within the plot. This stratification aims to reflect the proportions of conditions such as interior forest, edge forest, and any ecosites.

Relevant Incidental Observations

Incidental observations, such as the presence of invasive species, encroachment, and erosion, whether within the plot or outside of it, should be spatially recorded, with the nature of the issue clearly identified. Ideally, the recording of incidental observations should be supported by preset standardized response fields, as outlined in Data Hygiene and Standardization.

Opportunistic observations of age (e.g., ring counts following tree felling) should be recorded to a standard dataset and the location of the observation geo-referenced.

Species at Risk

The City will make an effort to maintain an inventory of locations within woodlot areas where species protected under Ontario Regulation 230/08 are observed. This database will include information such as the location, date, and species observed, along with images where feasible. Accessibility to this database will be extended to all City

departments, recognizing that responsibilities for the protection of Species at Risk (SAR) may extend beyond the immediate site and can therefore influence various municipal operations and processes.

Forestry-related datasets

While not the primary responsibility of Vaughan's Forestry division, datasets related to stormwater asset condition and trail asset condition provide valuable information for asset maintenance activities. These datasets often contribute to woodland management prescriptions and should be utilized by Forestry as part of the criteria for the associated indicators.

Habitat/Breeding Bird Surveys

Breeding bird surveys, candidate SAR habitat, and SWH surveys were used as an input to the criteria and indicators outlined in **Section 3**. The City's inventory work should involve periodic updates to this inventory to monitor changes in populations, conducted on a 10-year basis. All observations, whether within the designated plot or not, should be spatially recorded, with the relevant species/habitat clearly identified in a designated field

Data Standardization

Defining precise specifications for data quality and cleanliness, both for internal use and as a requirement in tender documents, is crucial to ensure that new data seamlessly integrates with existing datasets and facilitates effective analysis. Inconsistent data formatting can lead to challenges in archiving and significantly hinder the analysis process.

Ensuring consistency in datasets is most effectively achieved during the data entry phase rather than through post-processing. Mitigating data entry issues can be accomplished through the use of field forms, which can be structured in different ways, including restricting data types at the time of entry (e.g., a numeric field) or providing a range of standardized options (e.g., a drop-down field). Certain GIS and software options also allow for remote monitoring of data entry in real-time, providing an additional means to detect and remedy issues before the entire dataset is collected.

Spatial Datasets

Increasingly sophisticated and accessible remote sensing and spatial datasets offer a significant resource to woodland managers. Current spatial layers played a crucial role in identifying various metrics such as forest edge, trail length, canopy height, crown density, watercourse length, and area during the development of Vaughan's pilot WMP. While technologies like hyper-spectral imagery can accurately detect multiple tree species within Vaughan's woodlands,[32] their application remains relatively uncommon in operational settings to this point. Multi-spectral imagery, including the use of red-edge and near-infrared bands, can also be employed to identify tree stress, decline, and mortality in woodlands. Although methods exist to detect individual tree stems within woodland areas,[33] they have not been widely deployed in practice so far. Access to vital remotely-sensed datasets supporting these insights and analyses has expanded in recent years, with increasingly cost-effective, accurate, and timely UAV and satellite surveys becoming more available.

Hyper-spectral imagery contrasting live and dead or declining canopy in Vancouver's Stanley Park.

Several successive years of drought in combination with western hemlock looper led to an elevated rate of conifer mortality in one of the region's most treasured parks. In response, the Vancouver Board of Parks and Recreation acquired four-band orthoimagery which allowed managers to understand the extent and severity of the decline issue toward developing an appropriate course of management action.

In this image dead and declining coniferous canopy stands out in grey against healthy canopy in red.

Tree Risk Monitoring

Tree risk refers to the likelihood of property damage or personal injury resulting from a hazardous tree. In Vaughan's woodlots, there are trails and woodland edges that interface with public and/or private land uses.

The WMS has identified (i) the locations of interface edges and woodland trails within woodlots and (ii) the woodlands containing dead trees and ash. However, it did not conduct a formal risk assessment. As Vaughan's woodland management program matures, it is expected that formalized procedures for risk management will be established and integrated into other ongoing inventory and monitoring initiatives.

Future inventory updates should therefore incorporate a level one risk assessment of all interface edges within a resident woodlot. All edge and tree assessments should be recorded in a GIS and archived. Edge inspections can be conducted on an iterative schedule, synchronized with inventory re-measurement within a woodland.

4.8. Program Levels of Service and Asset Management

The integration of Vaughan's woodlands into the City's corporate asset management approach allows for the formal management of woodlands as a municipal asset. This integration supports the establishment of levels of service related to woodland maintenance. Clearly defined levels of service assist the City in identifying the necessary resources to maintain woodlands in accordance with community values. It also facilitates the support of ecosystem health and human-centered woodland management outcomes,

including proactive attention to aspects such as risk management.

Vaughan's Woodlot Management Plan (WMP) framework employs a customized criteria and indicators approach. This approach aims to establish two scores for each of the City's 27 woodlots: one for overall Safe and Enjoyable Human Use and the other for Biodiversity Conservation (refer to **Section 3** for more detailed information).

Distinguishing itself from nearly all other asset classes within the City, Vaughan's woodlands fulfill a diverse range of functions and generate various services, many of which are not directly oriented toward human benefits. The utilization of two scores in the woodland rating system recognizes those services and functions that directly affect human populations, as well as those that do not. This approach facilitates consideration for treatment activities supporting both human-related and non-human outcomes. The combined scores can be integrated into the City's asset management portfolio, employing the same five-tiered condition scheme applicable other classes of assets, and ranging from very poor to very good.

Asset values play a crucial role as they provide a reference point for the base value of a managed asset. This underlying value informs cost-benefit analyses, aiding decisions related to appropriate treatments, if any. Determining the underlying value of an asset is particularly challenging in woodland settings for two main reasons: (i) woodlands occur naturally and maintain themselves to some degree without human intervention, unlike conventional assets which do not, and (ii) the full spectrum of ecosystem services generated by urban woodlands is exceedingly difficult to quantify in fiscal terms (see **Section 1.3**). Still, some communities have made attempts to incorporate the value of woodlands into their corporate asset management policy through various methods of appraising woodland value. In the City of London's 2019 Corporate Asset Management Plan,[34] for instance, the City's woodlands were assigned a standard *replacement value* of $67,300 per hectare. This simplified method considers the hypothetical costs for 1:1 woodland replacement, taking into account planning, preparation, modest soil restoration, plant propagation, and planting costs.

The City of London's standard value has been applied to Vaughan's woodland areas, and taken a step further by adjusting the hypothetical replacement value based on the scores identified for the woodland through the relevant WMP. This adjustment is justified through assuming that successful restoration, replanting, and management would lead to an idealized forest state. In contrast, the current condition of all of Vaughan's woodlots would not reflect an idealized state. The practical implication of adjusting the value of woodlots is that for each woodland, there is a hypothetical asset value that would apply were the woodlot to achieve a 'pristine' condition (as assessed through the criteria and indicators approach), and a value reflecting the current state of the woodlot.

As methods for evaluating the full fiscal value (beyond timber) of woodlands continue to evolve, the City should consider incorporating more nuanced methods for woodlot appraisal in future updates to the WMPs and WMS. In addition, a suitable approach to managing woodlands does not necessarily strive for an idealized woodlot condition. Similar to other types of municipal asset, woodland treatments are subject to cost-benefit considerations, with the ultimate objective being to meet a defined level of service through treatment prescriptions. Sustainable woodland management, like urban forest management more broadly, aims to strike a balance between public investment, public safety, public benefit, and, in the case of woodlands, ecological benefit as well.

References

1 Hamill, S. (2001). *Biodiversity Indicators for Woodland Owners*. Canadian Biodiversity Institute & Eastern Ontario Model Forest. **https://www.eomf.on.ca/media/k2/attachments/Biodiversity_Indicators.pdf**

2 Nowak, David J., Eric J. Greenfield, Robert E. Hoehn, and Elizabeth Lapoint. (2023). *Carbon Storage and Sequestration by Trees in Urban and Community Areas of the United States*. Environmental Pollution: 229–36. **https://doi.org/10.1016/j.envpol.2013.03.019**

3 Kuehler, E., Hathaway, J., and Tirpak, A. (2017). *Quantifying the Benefits of Urban Forest Systems as a Component of the Green Infrastructure Stormwater Treatment Network*. Ecohydrology 10, no. 3: e1813.

4 Livesley, S. J., McPherson, E. G., and Calfapietra, C. (2016). *The Urban Forest and Ecosystem Services: Impacts on Urban Water, Heat, and Pollution Cycles at the Tree, Street, and City Scale*. Journal of Environmental Quality 45, no. 1: 119–24. **https://doi.org/10.2134/jeq2015.11.0567**

5 Statistics Canada. *Estimated population of Canada, 1605 to present.* Dataset. Ottawa, ON. 2007.

6 Aleksa, M. (2022). *The History of Deforestation in Southwestern Ontario and Methods Used in Afforestation of Old Agricultural Fields*. Undergraduate Thesis. Lakehead University.

7 Ontario Ministry of Natural Resources and Forestry. (2023). *Common buckthorn*. **ontario.ca/page/common-buckthorn**

8 Phytosanitary Alert System. (2023). *Report of oak wilt (Bretziella fagacearum) in Niagara Falls, Ontario, Canada*. North American Plant Protection Organization. **https://www.pestalerts.org/nappo/official-pest-reports/1053**

9 Crins, W.J., Gray, P.A., Uhlig, P.W.C., and Wester, M.C. (2009). *The Ecosystems of Ontario, Part 1: Ecozones and Ecoregions*. Technical Report SIB TER IMA TR-01. Ministry of Natural Resources, Science & Information Branch, Inventory, Monitoring and Assessment Section.

10 ibid.

11 Zhu, H. et al. (2020) *The Ontario Climate Data Portal, a user-friendly portal of Ontariospecific climate projections*. Sci. Data.

12 Zhang, L. et al. (2020) *Climate change projections of temperature and precipitation for the great lakes basin using the PRECIS regional climate model*.

13 D'Orgeville, M., Peltier, W. R., Erler, A. R. & Gula, J. (2014). *Climate change impacts on Great Lakes Basin precipitation extremes*. J. Geophys. Res. Atmospheres.

14 Taylor, A. R. et al. (2017). *Rapid 21st century climate change projected to shift composition and growth of Canada's Acadian Forest Region*. For. Ecol. Manag. 405, 284–294.

15 Esquivel-Muelbert, A. et al. (2019). *Compositional response of Amazon forests to climate change*. Glob. Change Biol. 25, 39–56.

16 Goldblum, D. & Rigg, L. S. (2005). *Tree growth response to climate change at the deciduous-boreal forest ecotone, Ontario, Canada*. Can. J. For. Res. 35, 2709–2718.

17 Man, R., Kayahara, G. J., Foley, S. & Wiseman, C. (2013). *Survival and growth of eastern larch, balsam fir, and black spruce six years after winter browning in northeastern Ontario, Canada*. For. Chron. 89, 777–782.

18 Man, R. et al. (2013). *A case of extensive conifer needle browning in northwestern Ontario in 2012: Winter drying or freezing damage?* For. Chron. 89, 675–680.

19 Anyomi, K., Mitchell, S., Perera, A. & Ruel, J.-C. (2017). *Windthrow Dynamics in Boreal Ontario: A Simulation of the Vulnerability of Several Stand Types across a Range of Wind Speeds*. Forests.

20 Olthof, I., King, D. J. & Lautenschlager, R. A. (2004). *Mapping deciduous forest ice storm damage using Landsat and environmental data*. Remote Sens. Environ. 89, 484–496.

21 Cooke, B. J. & Roland, J. (2007). *Trembling aspen responses to drought and defoliation by forest tent caterpillar and reconstruction of recent outbreaks in Ontario*. Can. J. For. Res. 37, 1586–1598.

22 Smith, A. L. et al. (2012). *Effects of climate change on the distribution of invasive alien species in Canada: a knowledge synthesis of range change projections in a warming world*. Environ. Rev. 20, 1–16.

23 Régnière, J., St-Amant, R. & Duval, P. (2012). *Predicting insect distributions under climate change from physiological responses: spruce budworm as an example*. Biol. Invasions 14, 1571–1586.

24 Kurz, W. A. et al. (2008). *Mountain pine beetle and forest carbon feedback to climate change*. Nature 452, 987–990.

25 Kurz, W. A. et al. (2008). *Mountain pine beetle and forest carbon feedback to climate change*. Nature 452, 987–990.

26 Pedlar, J. H., McKenney, D. W., Hope, E., Reed, S. & Sweeney, J. (2020). *Assessing the climate suitability and potential economic impacts of Oak wilt in Canada*. Sci. Rep. 10, 1939.

27 Pedlar, J. H., McKenney, D. W., Yemshanov, D. & Hope, E. S. (2020). *Potential Economic Impacts of the Asian Longhorned Beetle (Coleoptera: Cerambycidae) in Eastern Canada*. J. Econ. Entomol. 113, 839–850.

28 Liu, J. (2022). *Effects of Climate Change on Interactions between a Forest Pest and Its Natural Enemies*. Dissertation. University of Chicago.

29 Russell, N. (2023). *Charlottetown experiments with mini forests to speed up growth*. CBC News. **https://www.msn.com/en-ca/news/canada/charlottetown-experiments-with-mini-forests-to-speed-up-growth/ar-AA1i1WRa**

30 Helene Iardas. (2021). *Greening: Mini Forests*. The Ontario Association of Landscape Architects. **https://www.oala.ca/ground-57-greening-mini-forests**

31 Tori Fitzpatrick. (2023). *Network of Nature and Green Communities Canada launch National Mini Forest Pilot program in Richmond, B.C*. Canadian Geographic. **https://canadiangeographic.ca/articles/network-of-nature-launches-the-national-mini-forest-pilot-program-in-richmond-b-c/**

32 Modzelewska, A., Fassnacht, F. E., & Stereńczak, K. (2020). *Tree species identification within an extensive forest area with diverse management regimes using airborne hyperspectral data*. Int. J. of App. Earth Obs. and Geoinformation, 84, 101960. **https://doi.org/10.1016/j.jag.2019.101960**

33 Zhang, Y., Tan, Y., Onda, Y., Hashimoto, A., Gomi, T., Chiu, C., & Inokoshi, S. (2023). *A tree detection method based on trunk point cloud section in dense plantation forest using drone LiDAR data*. For. Eco., 10, 100088. **https://doi.org/10.1016/j.fecs.2023.100088**

34 City of London & GM BluePlan. (2019). *2019 Corporate Asset Management Plan*. City of London.

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