



State of the Urban Forest Report

September 2023

City of Vaughan



Project Team Acknowledgment

Diamond Head Consulting Ltd. (DHC) prepared this State of the Urban Forest Report for the City of Vaughan. DHC acknowledges the participation and support of City of Vaughan departments and staff in preparing this document.

Prepared by:



Date:

September 2023 (v.1.2)

Consultant Team:

Tyler Searls
Amelia Needoba
Marco Sanelli
Camille Lefrançois
Cindy Cheng
Nguyet-Anh Nguyen
Vlad Romanescu

Executive summary

This is Vaughan’s first State of the Urban Forest Report. This document contains information, analysis, and benchmarking that the City of Vaughan will use to plan for the sustainable management of its urban forest. Additionally, the analysis serves as a reference point for assessing change in the urban forest, supporting comparison against evolving urban forest conditions.

The urban forest is made up of every tree and forest ecosystem contained within the Vaughan’s boundary. Urban trees provide a wide range of benefits to visitors and residents of Vaughan. These benefits, often referred to as ecosystem services, include improved physical and mental health, urban habitat, clean air and water, carbon storage, stormwater interception, and relief from the urban heat island effect, to name just a few.

The City of Vaughan is in the process of developing its first Urban Forest Management Plan. This State of the Urban Forest Report contains analysis that will be used to inform the actions put forward through that document.

This Report’s central analysis is detailed in [Part 2](#), which contains analyses of the city’s tree canopy (2019) using remote sensing datasets, and of the city’s inventory of 130,000 street trees. The Report also briefly outlines the legislative and regulatory framework influencing tree management in Vaughan.

As of 2019, Vaughan’s city-wide canopy cover was 20 percent. Two-thirds of the canopy area is contained to Vaughan’s urban area, and the remainder to the rural area. The City is responsible for the management of 880 ha of tree canopy, constituting about 16 percent of all canopy in the city. Lands under the ownership and management of the Toronto and Region Conservation Authority contain 24 percent of the city’s canopy area in woodland and natural ecosystems. **The City manages 130,000 street trees** and is responsible for the management of more than 180 ha of city-owned woodland.

In 2022, Vaughan’s Forestry Group operated on a total operating budget of just over \$1.7 million dollars. This represents a lower operating budget compared to some nearby peer communities on a per capita basis. This level of operational investment means that the Forestry Group maintains its street tree population reactively (responding to more than 5,000 service requests per year), rather than proactively, and that virtually no maintenance occurs within woodland areas.

When assessed against a set of criteria and indicators for sustainable urban forest programs, **the City’s program scored “Fair” in 2023**, indicating core elements of an urban forest program are in place, but opportunities to achieve a healthier, more sustainable urban forest exist. The full criteria and indicator assessment is provided through [Appendix A](#).



Quick Facts

- 20 percent city-wide canopy cover in 2019
- 16 percent of Vaughan's total canopy is on City-owned land, 24 percent is on Toronto and Region Conservation Authority owned-land, and the remaining 60 percent is on private or other ownership
- ±130,000 street trees
- 25 percent of street trees are maple (*Acer*), 10 percent are Norway maple (*Acer platanoides*)
- Estimated street tree structural replacement value of \$110 million

Table of Contents

Part 1. Introduction 1

- 1.1 What is the Urban Forest and Who Manages it?
- 1.2 What are the Benefits?
- 1.3 How do we Measure Urban Forest Values?

Part 2. The Urban Forest 6

- 2.1 Tree Canopy
- 2.2 Street Tree Inventory
- 2.3 Woodland Ecosystems

Part 3. Vaughan’s Urban Forestry Program 22

- 3.1 Staff
- 3.2 Key Service Areas
- 3.3 Service Requests
- 3.4 Budget
- 3.5 Key Challenges

Part 4. Regulatory Context 30

Part 5. Peer City Comparison 35

Part 6. Program Report Card 37

Part 7. References 38

Part 8. Appendices 39

- Appendix A: Urban Forestry ‘Report Card’
- Appendix B: Woodlot Height-Area Frequency Plots
- Appendix C: Version History

Glossary of key terms

- Biodiversity*** Biodiversity encompasses all living species on Earth and their relationships to each other. This includes the differences in genes, species and ecosystems.
- Canopy cover*** A measure of the extent of the urban forest based on the amount of ground covered by the foliage of trees when viewed from above.
- Ecosystem services*** The many and varied benefits to humans provided by the natural environment and from healthy ecosystems. Recreation potential, shade, water filtration, and pollination are all examples of ecosystem services associated with the urban forest.
- Green infrastructure*** Natural and human-made community assets that support ecological and hydrological functions and processes.
- Tree equity*** When all people experience the benefit of trees and the urban forest in proportion to their needs.
- Urban forest*** All trees and their ecosystems within the City of Vaughan, including trees in private yards, public parks, conservation areas, environmental buffers, open spaces as well as those along boulevards and roadways, and in wetlands, natural areas, and the city’s vast woodland communities.
- Urban forest program*** A set of activities performed by the City and community partners to plan, grow, manage, protect, and steward the urban forest, as well as all related policies, equipment, resources and knowledge.
- Woodland*** Groupings of trees consistent with the definitions put forward under the *Forestry Act*, *Municipal Act*, and *City of Vaughan Official Plan*; meeting a minimum area of 0.2 ha.
- Woodlot*** The City of Vaughan is home to 25 community woodlots, supporting a range of management values and more than 180 ha of combined woodland area.

Part 1. Introduction

The City of Vaughan is a vibrant and diverse metropolitan area, covering more than 270 km² in the heart of south-central Ontario. The city is comprised of a mosaic of urban, suburban, rural, and naturalized landscapes, supporting a broad range of land uses. The city is now home to more than 320,000 people¹, and welcomes millions of visitors each year.

Vaughan's urban forest includes more than 5,400 ha of tree and forest canopy, and provides the community with considerable value, supporting rich recreation and leisure opportunities, and contributing to the community's urban character and quality of life.

This State of the Urban Forest Report provides a snapshot of Vaughan's urban forest, consisting of a summary of its current extent, composition and value, existing management practices, as well as the key challenges it faces.

The 2023 State of the Urban Forest report is organized into the following sections:

Introduction: provides an overview of why we need the urban forest and how it benefits the community of Vaughan.

The Urban Forest: highlights findings about the current status of Vaughan's urban forest in terms of its distribution, condition, and importance to our community.

Vaughan's Urban Forestry Program: summarizes Vaughan's Forestry program and available Forestry resources.

Regulatory Context: describes the legislative, regulatory, and policy frameworks that inform urban forest management within the city.

Peer City Comparison: compares Vaughan's urban forest and management program with that of a set of peer communities.

Program Report Card: provides a "report card" scoring of Vaughan's urban forest management program based on a series of established criteria and indicators.



1.1 What is the Urban Forest and Who Manages it?

Vaughan’s urban forest includes all trees and their ecosystems within the city’s municipal area. This includes trees in private yards, public parks, and in conservation areas, as well as those along boulevards and roadways, and in wetlands, natural areas, and the city’s woodland communities. The urban forest also includes the soils, plant and animal communities that co-exist with trees and tree canopy in urban environments.

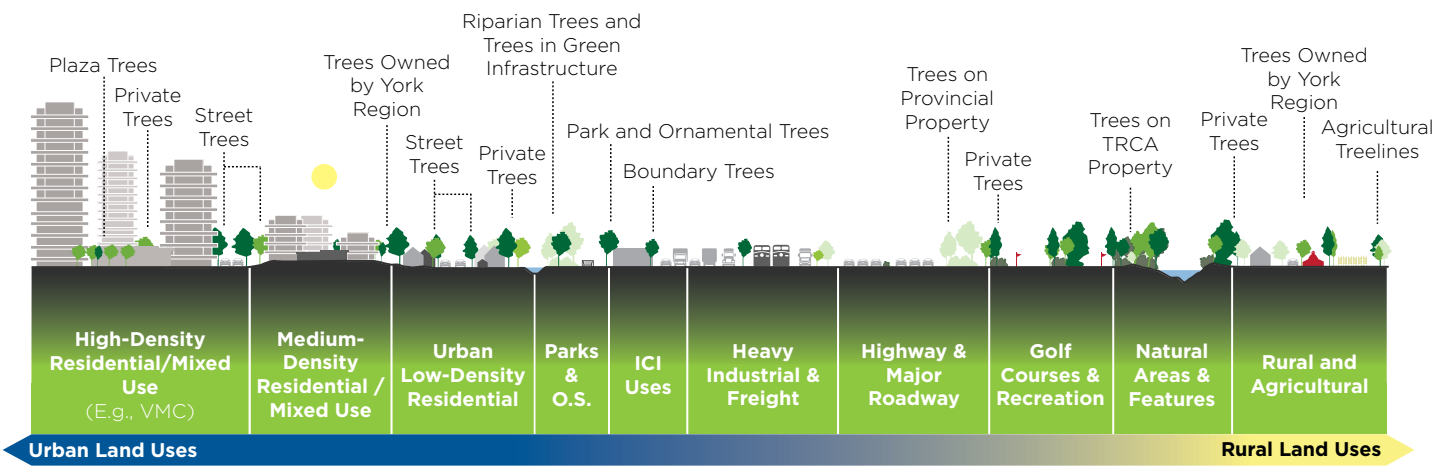
Urban forests are dynamic, living systems. The current composition, health and extent of Vaughan’s urban forest is the product of past management and events that have impacted the urban forest to this point.

The urban forest is part of Vaughan’s **green infrastructure**, supporting much of the city’s biodiversity, cleaning air and water, and improving the quality and livability of the city’s diverse neighbourhoods (Figure 1-1).

Vaughan’s urban forest spans both public and private land and, as a result, its management is a shared responsibility.

The City manages trees on City-owned lands, such as those growing in parks and open space, in woodlands, and along roadways. On non-City lands, trees are managed by property owners and other land managers. The City does regulate some activities affecting private trees through the Tree Protection By-law and through development processes, but management of private tree canopy is largely out of the City’s jurisdiction.

Figure 1-1. While Vaughan’s urban forest spans a range of land uses, this document is scoped around the city’s forested parks and intensively managed street trees.



1.2 What are the Benefits?

The urban forest provides important benefits for the health and livability of the community. Those benefits, sometimes called **ecosystem services**, have been widely studied, and include providing habitat for wildlife², stabilizing steep slopes, storing and sequestering carbon³, and urban cooling⁴, to name a few. Ecosystem services are often classified into four main classes:

Cultural – describing the values held by people related to beautification, sense of place, mental and physical health, spirituality, recreation, and tourism.

Regulating – describing services which regulate the environment such as pollination, air and water quality, storm water interception, and urban cooling.

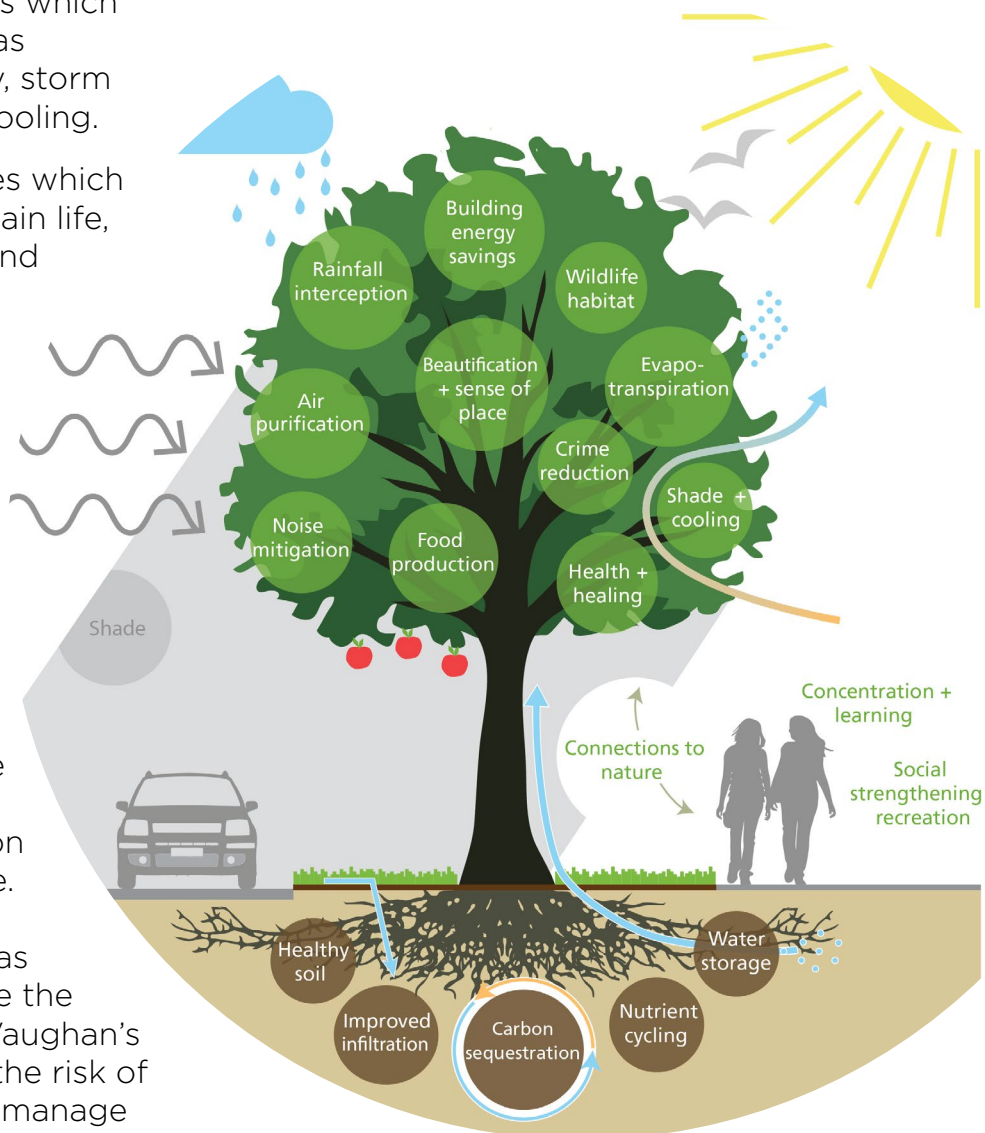
Supporting – describing services which support the conditions to maintain life, including habitat, biodiversity, and enabling natural processes.

Provisioning – describing the tangible products of trees and forest products such as medicines, fruits, and nuts (and could include sawlogs/pulpwood).

The urban forest is a crucial community asset, just like engineered infrastructure assets such as roadways, pipes, and sewers. Proper management of the urban forest can have several co-benefits that reduce the pressure on the City's engineered infrastructure. For instance, increasing tree cover and pervious surfaces in urban areas can reduce surface runoff, minimize the volume of water moving through Vaughan's stormwater system, and decrease the risk of localized flooding. It is essential to manage

and maintain the urban forest as a valuable community asset to realize these benefits fully. Neglecting the urban forest can result in several negative impacts, such as reduced biodiversity, compromised human health, and increased maintenance costs for the City's engineered infrastructure.

On June 4, 2019 the City of Vaughan joined a growing number of its peer communities in declaring a climate emergency.⁵ Urban trees and the services they provide are an important part of the City's response to climate change.



1.3 How do we Measure Urban Forest Values?

Measurement of the services generated by the urban forest and its associated value is not straight forward. Fortunately, readily available tools, such as the USDA's i-Tree suite of software, support some standard and quantifiable measures through which ecosystem services can be evaluated.

The USDA's i-Tree Eco software was used to estimate the ecosystem services generated by Vaughan's tree canopy, as well as its associated financial value. City-wide estimates of ecosystem services are estimated based on the composition of an inventory of 100 sample plots stratified to capture the broad range of urban forest conditions present within Vaughan (Table 1-1). Vaughan's street tree inventory was used to attain ecosystem service estimates

for the value of those trees, specifically (Table 1-2).

The results indicate that Vaughan's canopy stores nearly half a million tons of carbon (with an estimated value of \$103 million), and sequesters more than 14,200 additional tons of carbon every year (with an estimated value of \$2.7 million per year) (Table 1-1). Carbon pricing is based on the Canadian Beyond carbon storage and sequestration, Vaughan's urban forest provides more than \$3.2 million in air-quality-related services annually.

Vaughan's street tree inventory also provides significant benefits, although on a smaller scale. Vaughan's street trees store an estimated 24,000 tons of carbon (valued at \$5.6 million), and sequester an additional 750 tons every year (with an estimated value of \$180,000 per year) (Table 1-2). Additionally, the street trees

Table 1-1. *City of Vaughan ecosystem services generated by all canopy cover within Vaughan. (i-Tree Eco)*

i-Tree Eco Ecosystem Service Estimates (i.e., All Trees in the City)		
Ecosystem Service	Service Estimates	
	Carbon & Stormwater	
C Sequestered annually in trees (t)	14,200	\$2,682,000
C stored in trees (t)	542,000	\$102,291,000
Avoided runoff (L)	1,221,268,000	\$2,839,000
Air Quality		
CO removed annually (t)	5.4	\$8,000
NO ₂ removed annually (t)	19.7	\$14,500
O ₃ removed annually (t)	194.6	\$960,000
PM ₁₀ (t)	/	/
PM _{2.5} (t)	13	\$2,230,000
SO ₂ removed annually (t)	2	/
Total air pollution removed (t/year)	234.7	\$3,215,000
Total Annual Service Value		\$6,428,000
Total Stored Carbon Value		\$102,291,000

generate over \$300,000 in extra ecosystem services annually. i-Tree Eco estimated the structural value of the City’s tree inventory at \$110 million. Structural value is intended to capture the hypothetical cost to replace the entire inventory with trees of similar condition and size.

It is important to note that the i-Tree software only provides quantitative estimates for a limited set of ecosystem services, and there are many other cultural, regulating, provisioning, and supporting services provided by urban forests that cannot be easily valued. While the estimates in [Table 1-1](#) and [Table 1-2](#) provide a measurable estimate of some key services, the full range of services provided by Vaughan’s urban forest, and their associated financial value, is likely much higher than what is reported here.

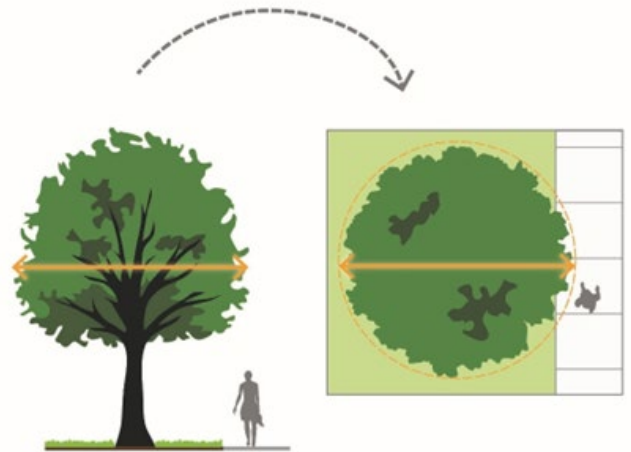


Table 1-2. City of Vaughan ecosystem services generated by the City’s tree inventory. (i-Tree Eco)

i-Tree Eco Ecosystem Service Estimates (i.e., Inventory Trees Only)		
Ecosystem Service	Service Estimates	Dollar Value (\$)
Carbon & Stormwater		
C Sequestered annually in trees (t)	750	\$179,000
C stored in trees (t)	24,000	\$5,670,000
Avoided runoff (L)	55,880,000	\$130,000
Air Quality		
CO removed annually (t)	0.4	Negligible
NO2 removed annually (t)	0.9	/
O3 removed annually (t)	9.5	\$53,000
PM10 (t)	/	/
PM2.5 (t)	0.4	\$81,000
SO2 removed annually (t)	0.1	/
Total air pollution removed (t/year)	11.3	\$135,000
	Total Annual Service Value	\$444,000
	Total Stored Carbon Value	\$5,670,000
	Total Structural Replacement Value	\$110,000,000

Part 2. The Urban Forest

Vaughan’s urban forest has undergone significant change over the last few centuries. The landscape once consisted of abundant stands of hardwoods, forb meadows, and mixed woodland communities. Today, isolated remnants of those native systems make up part of a larger mosaic of landscapes that, together with exotic species, constitute Vaughan’s urban forest. This section presents baseline metrics on Vaughan’s urban forest extent, composition, and structure.



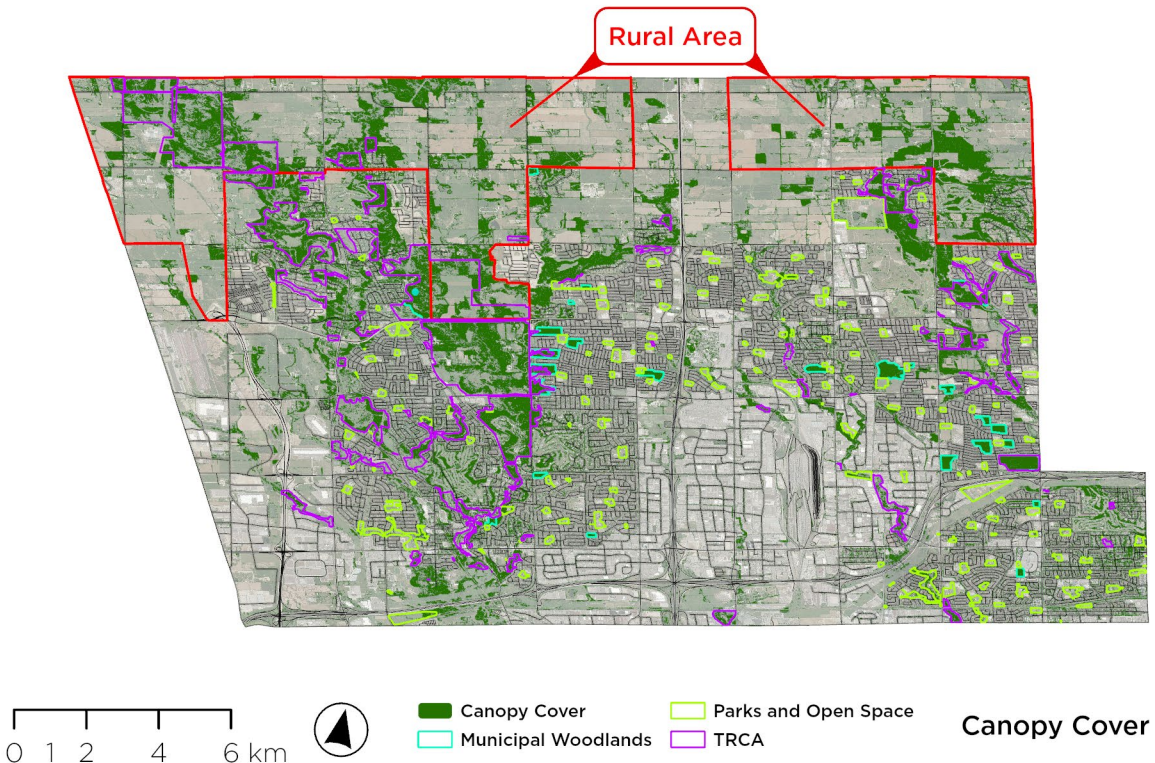
What is Tree ‘Canopy’?

A tree’s canopy refers to the leafed area sitting atop the trunk. Canopy area is often used to measure the area covered by a tree’s canopy as viewed from above, and is a common metric used in strategic initiatives such as this, as it is a relatively accessible indicator which generally corresponds to the scale, standards, and level of resources available to a management program.

2.1 Tree Canopy

Canopy cover is a common measure of the extent of an urban forest. Many jurisdictions track canopy cover over time to monitor change in the extent of their urban forest, and to inform management planning. As part of the analysis completed in support of this Report, Vaughan’s canopy cover was

Figure 2-1. City of Vaughan canopy cover mapping.



measured using a combination of LiDAR data and satellite imagery (both from 2019, [Figure 2-1](#)). In the future, LiDAR-supported canopy mapping can be repeated to measure canopy cover change over time.

Vaughan's Canopy

In 2019, Vaughan's city-wide canopy cover was estimated to be 20 percent, measuring more than 5,400 ha. Seventy-one percent of Vaughan's total canopy area is in the urban boundary and 29 percent is located within the rural area. Canopy cover over the urban and rural areas is estimated to be 18 percent and 26 percent, respectively. This Report has summarized canopy coverage by two-hectare grid ([Figure 2-3](#)), census dissemination area (DA) ([Figure 2-4](#)), neighbourhoods ([Figure 2-5](#)), by ward ([Table 2-2](#)), and by generalized land use ([Table 2-2](#)). The Region of York's 2021 State of the Forest report recommended a 25% to 35% target canopy cover target for the City of Vaughan, and a woodland cover of 14% to 17%.⁶

How Does Vaughan Measure Up?

Several of Vaughan's peer communities in south-central Ontario have also completed assessments of canopy cover using a range of methods ([Figure 2-2](#)). Municipal canopy cover amongst Vaughan's peer communities tends to range from 20 to 30 percent, averaging 24 percent. Communities with rural areas tend to have higher city-wide canopy coverage, where explicitly measured (e.g., Burlington has included rural canopy in their measurement, Hamilton has not). Rural areas tend to inflate community-wide canopy cover measures given the reduced intensity of urban land uses typical of rural landscapes. A more detailed peer city comparison is provided in [Part 5](#) of this Report.

Figure 2-2. A comparison of Vaughan's urban forest canopy and that of a selection of peer communities.

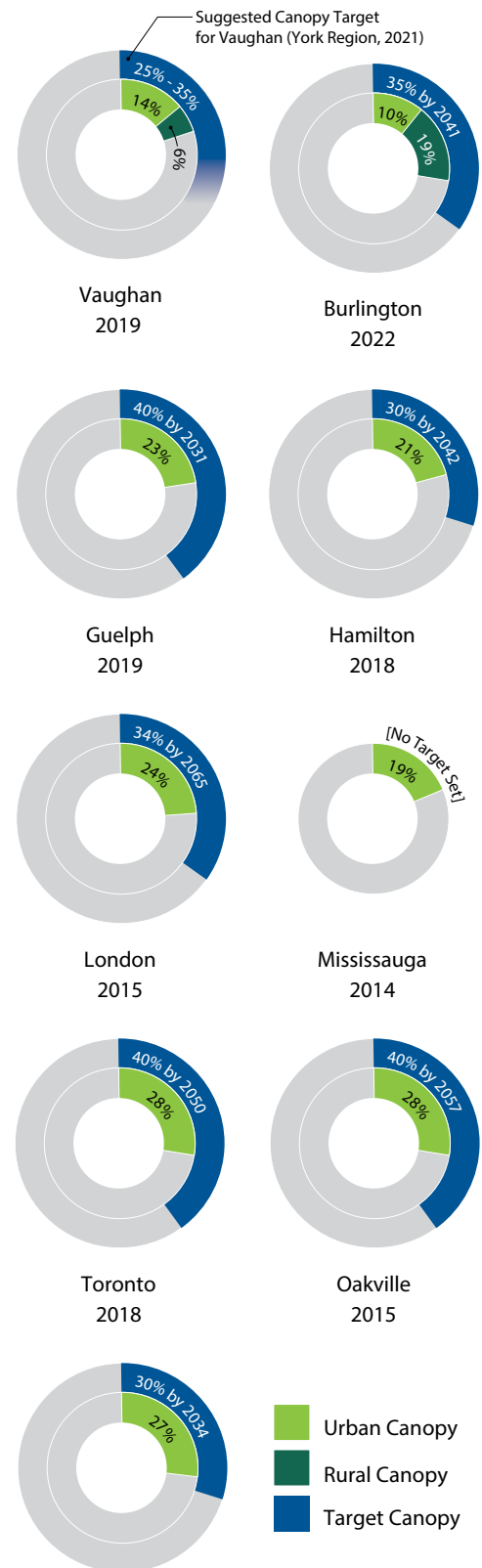


Figure 2-3. City of Vaughan canopy cover mapping by two-hectare grid.

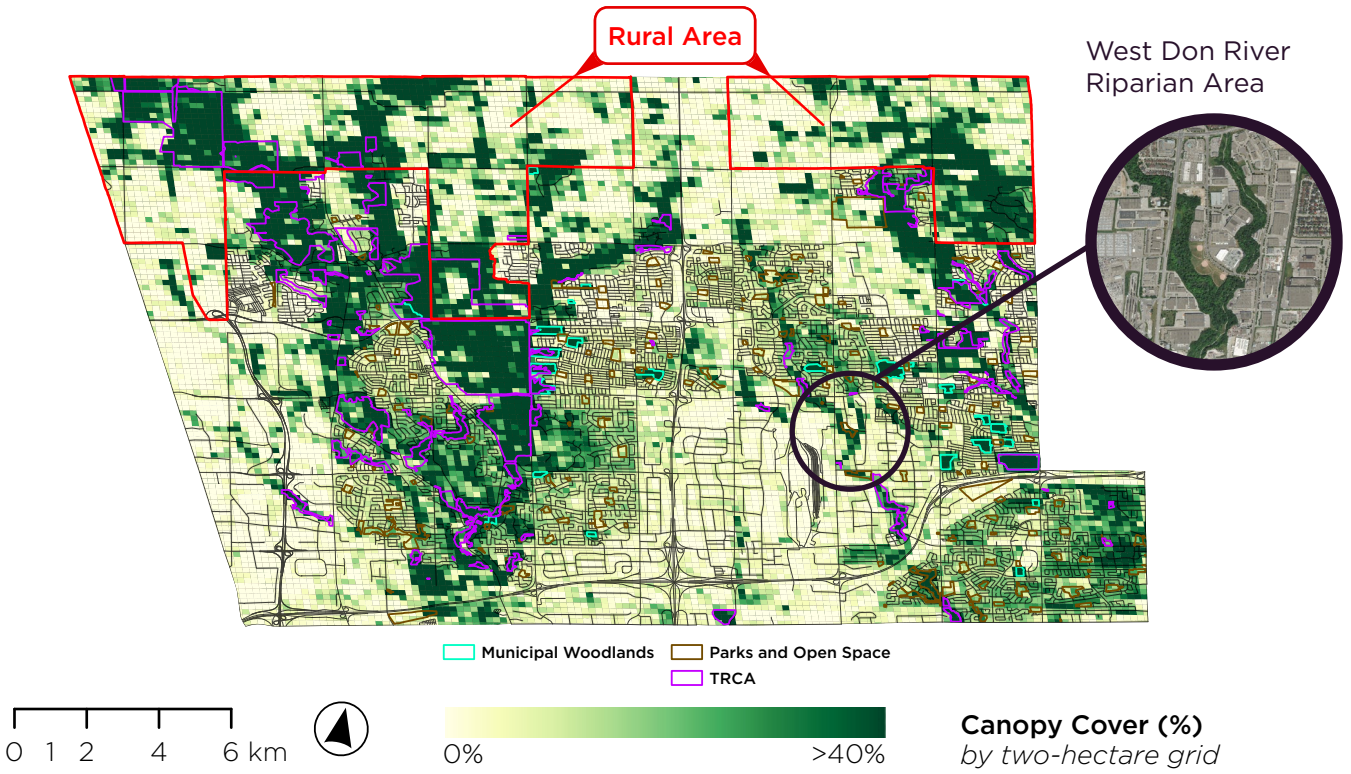
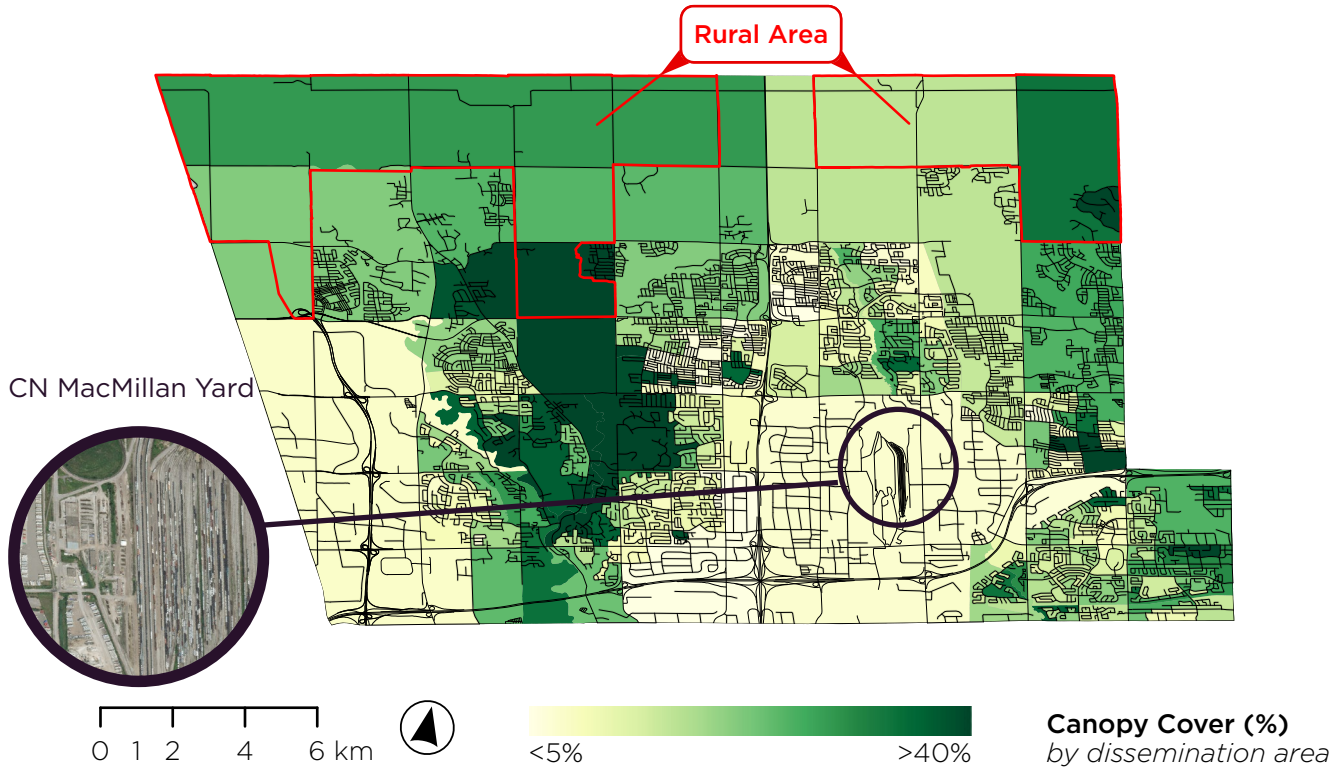


Figure 2-4. City of Vaughan canopy cover mapping by census DA.



Canopy Mapping

Figure 2-3 and Figure 2-4 depict canopy cover mapped by two-hectare grid and by census DA, respectively. Both give similar insight into the high-level distribution of canopy cover across Vaughan’s municipal area. Dissemination Areas (DA) are a spatial unit used by Statistics Canada and are typically drawn to capture between 400 to 700 residents.⁷ The boundaries are typically sensitive to natural, political, and human-constructed barriers (such as the road network). Both Figure 2-3 and Figure 2-4 illustrate that Vaughan’s canopy cover is concentrated in woodlands and river valley corridors; including features like the Don River, Humber River and Byod Conservation Park. Areas of low canopy cover are most identifiable in Vaughan’s industrial areas, and in particular those in and around the CN MacMillan Yard in the south-east of the city (Figure 2-4).

Neighbourhoods

Vaughan’s neighbourhoods with highest tree canopy cover are Woodbridge Centre (35 percent), Woodbridge South East (28 percent), Woodbridge North (27 percent), and Kleinburg (27 percent) (Figure 2-5). These neighbourhoods have a higher proportion of natural landcovers, including woodland areas. In contrast, the neighbourhoods of Woodbridge East, South of Maple, and Woodbridge West feature predominantly industrial and commercial type uses and each have canopy cover below 10 percent (Figure 2-5).

Figure 2-5. City of Vaughan canopy cover mapping by neighbourhood.

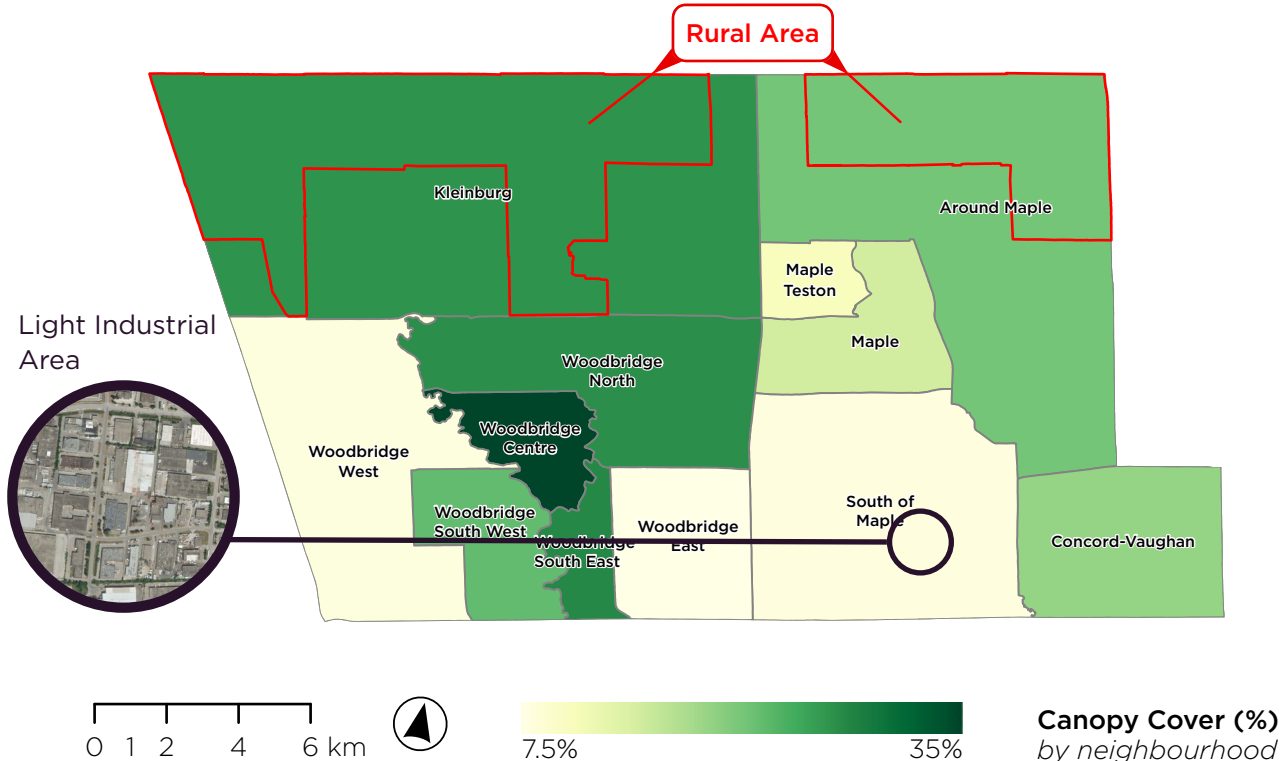
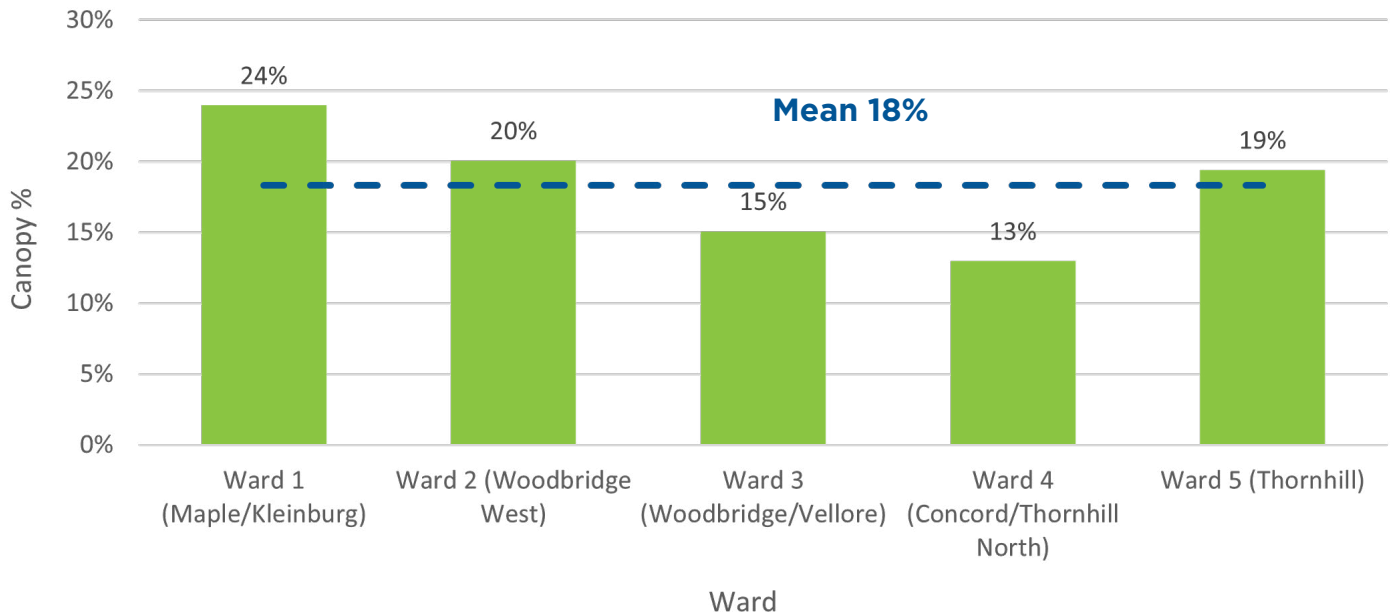


Figure 2-6. *City of Vaughan canopy cover by ward.*

Ward

By municipal electoral Ward, Vaughan's Ward 1 has the highest canopy cover (24 percent) in the city, given it largely corresponds to Vaughan's rural area (Figure 2-6). In terms of Vaughan's urban wards, Ward two sits at 20 percent canopy cover, benefiting from the contributions of woodland features such as Boyd Conservation Park and the Humber River Valley. Ward 5 has 19 percent canopy cover, Ward 3 has 15 percent, and Ward 4 has 13 percent. Mean canopy cover by Ward is 18 percent (Figure 2-6).

Ownership

By ownership, 16 percent of Vaughan's total canopy area is on City-owned land, 24 percent is on Toronto and Region Conservation Authority-owned land, and the remaining 60 percent falls into private or other ownership classes (Table 2-1). Most tree canopy on TRCA lands is woodland canopy (more under Section 2.3).

Table 2-1. *City of Vaughan canopy area by ownership.*

Ownership	Land Area (ha.)	Canopy Area (ha.)	Canopy Coverage (%)	Proportion of Total Vaughan Canopy Area (%)
City	3,829	884	23%	16%
TRCA	2,091	1,291	62%	24%
Other (Incl. Private)	21,537	3,260	15%	60%
Total	27,435	5,435	100%	100%

Consolidated Land Use

To identify relationships between built form and tree canopy, a consolidated land use layer was created based on the City’s Official Plan⁸.

The largest land use in Vaughan is low-rise residential, which covers more than 4,800 ha but has an average canopy coverage of only 12 percent, bringing down the city-wide canopy cover average (Table 2-2). More than 60 percent of Vaughan’s canopy is located within the Natural Area land use, which prioritizes conservation and protection of woodlands and other natural ecosystems.

Canopy cover in the rural area is 26 percent, higher than the urban area, which averages 18 percent.

Canopy Composition

Vaughan’s canopy cover was classified as either coniferous or deciduous tree types using a machine learning classifier. The results of this analysis found 81 percent of the city’s canopy was deciduous and 19 percent coniferous (Figure 2-7). Vaughan’s coniferous trees are concentrated along riparian corridors and in river valleys (e.g., East and West Humber River).

Table 2-2. City of Vaughan canopy area and coverage by consolidated land use.

Consolidated Land Use	Area (ha)	Overstorey Count (est.)	Canopy Area (ha)	Canopy Cover (%)	Crown Density (tree/ha)
Urban Area					
Low-Rise Residential	4,854	253,822	579	12%	52
Natural Area	3,989	394,787	2,208	55%	99
Public Roads	3,715	199,499	407	11%	54
Employment	3,055	45,774	96	3%	15
Secondary Plans	2,744	52,408	222	8%	52
Commercial Plaza (+ Theme Park)	886	21,744	53	6%	25
Infrastructure and Utilities	761	23,716	68	9%	31
Parks and Open Space	558	31,095	109	20%	56
Private Open Spaces	463	15,273	61	13%	33
High-Rise	108	3,693	12	11%	34
Institutional	53	1,052	3	6%	20
Sub-total	21,349	1,047,693	3,834	18%	43
Rural Area					
Rural/Agricultural	3,570	90,374	390	11%	25
Natural Area	2,069	197,885	1,102	53%	96
Infrastructure and Utilities	199	9,021	42	21%	45
Public Roads	183	13,840	38	21%	75
Low-Rise Residential	32	1,723	6	19%	53
Secondary Plans	32	3,670	23	70%	114
Sub-total	6,086	316,513	1,601	26%	68
Total	27,435	1,364,206	5,435	20%	52

Figure 2-7. City of Vaughan deciduous and coniferous tree mapping.

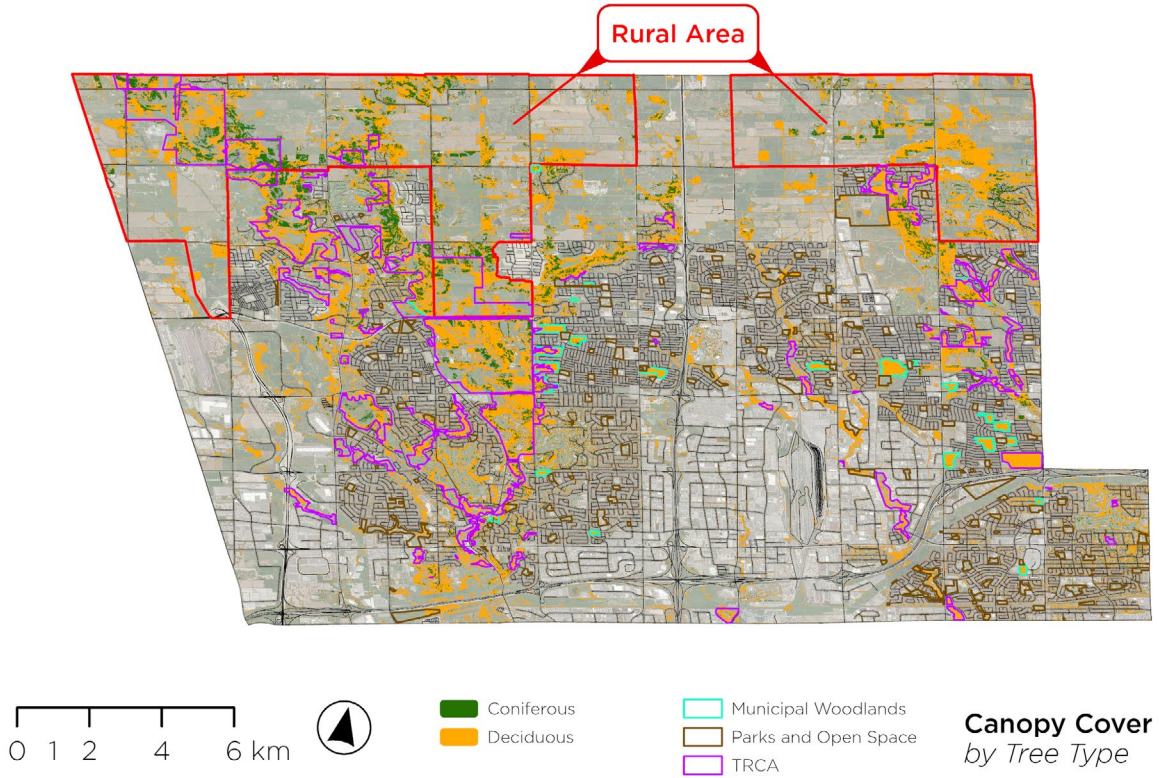
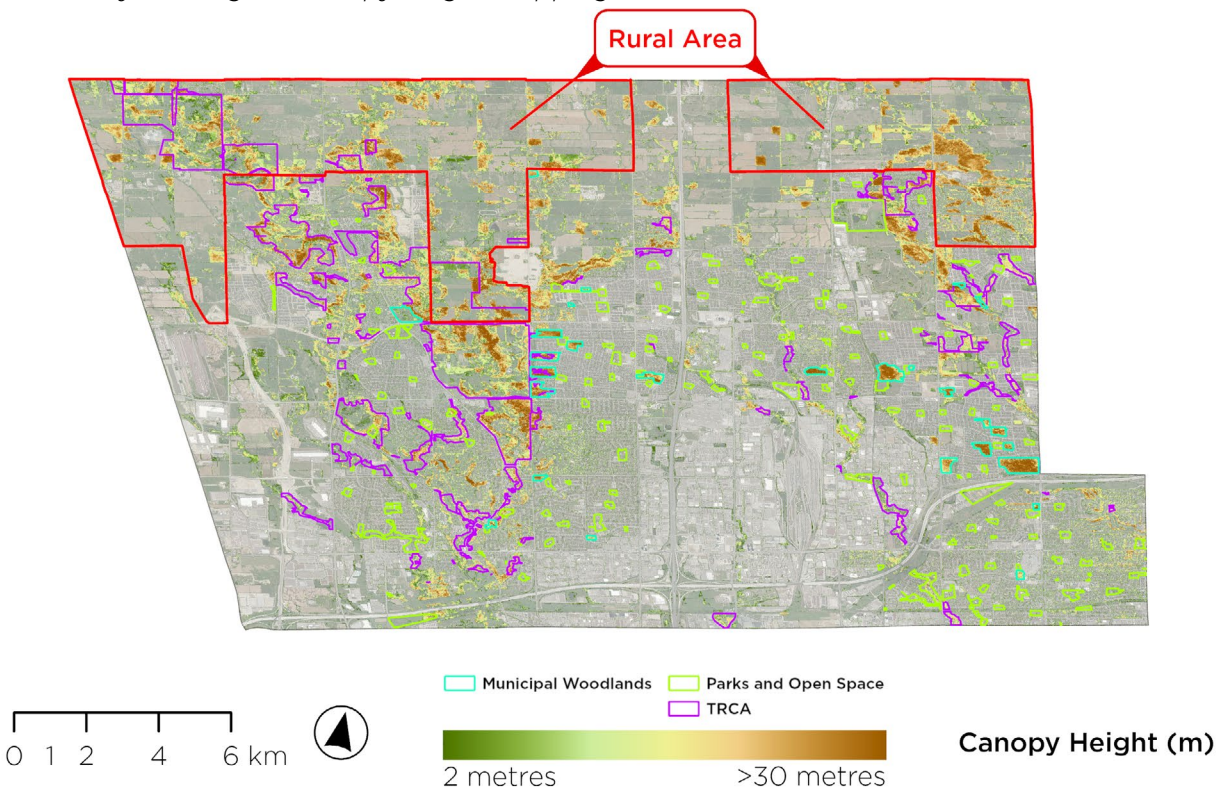


Figure 2-8. City of Vaughan canopy height mapping.



Canopy Height

The average tree height across all trees in Vaughan is 13 meters. [Figure 2-8](#) shows the tallest trees in Vaughan identified from LiDAR data, with a maximum height of approximately 43 meters. These tall trees are primarily located within the city’s woodlands and riparian corridors throughout the city.

Land Surface Temperature

The cooling effect of trees on urban environments has been well documented by the scientific literature. In Vaughan, the warmest temperatures recorded on June 16, 2021 were found in areas with low tree canopy and high impervious cover, such as industrial areas. Conversely, forested areas along river valleys and within city woodlands were observed to be up to 14°C cooler compared to highly impervious areas with mostly buildings and roads, as illustrated in [Figure 2-9](#).

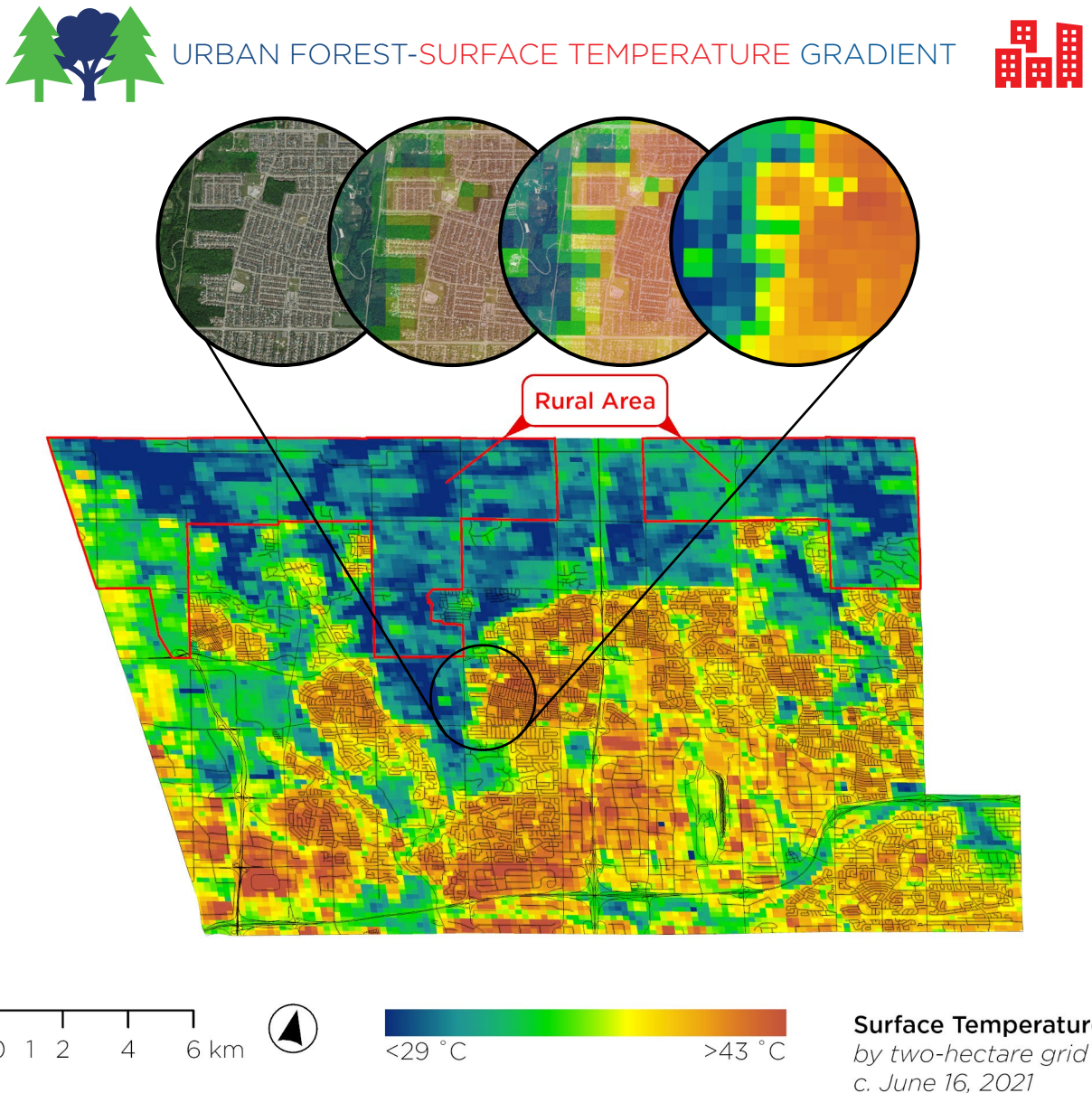


Figure 2-9. Mean maximum recorded surface temperature on June 16, 2021.

2.2 Street Tree Inventory

Vaughan’s Parks, Forestry and Horticulture Operations Department maintains an inventory of more than 130,000 trees as of January 2023 (Figure 2-10). These trees are primarily located along streets, not including regional roads. The inventory was established in 2015 and has not been updated since that time.

There are limitations to analyses completed using the inventory due to the inventory’s age and lack of regular maintenance. Tree condition or other inventory values may not be current. Similarly, age, diameter and tree condition are likely to be out of date.

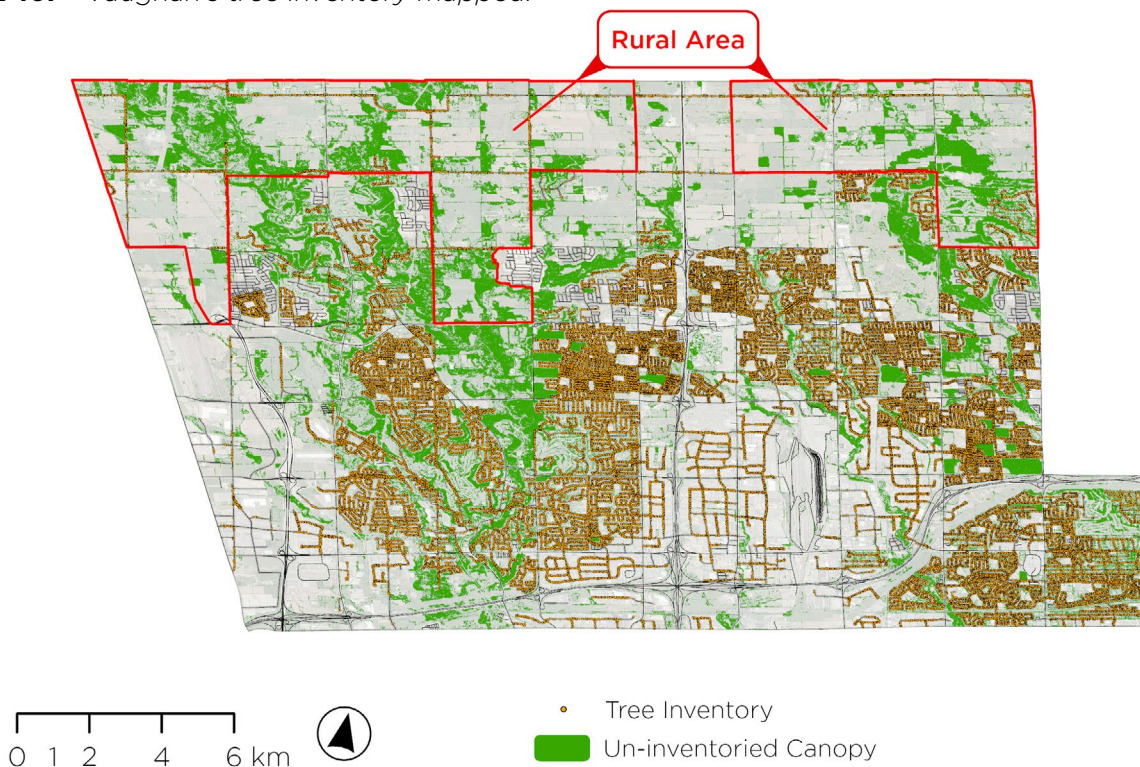
Tree Condition

The accuracy of condition ratings in Vaughan’s inventory is presently uncertain. Ninety-one percent of Vaughan’s inventoried trees have a condition rating of either “good” or “fair” at present, and six percent “excellent” (Figure 2-11). All large municipal tree inventories contain some trees in “poor” or worse condition. This finding is likely an indicator that Vaughan’s street tree condition values are not accurate. Updated information is needed to quantify the condition of trees in Vaughan’s inventory.

Age and Size Diversity

The inventory of Vaughan’s street trees does not include specific age measurements, but the diameter at breast height (DBH) can provide a rough estimate of age. While

Figure 2-10. *Vaughan’s tree inventory mapped.*



the relationship between tree diameter and age varies across species and sites, understanding the size and approximate age distribution still provides insights for management.

Figure 2-11 shows that most trees in Vaughan are small or young. In fact, more than 80 percent of street trees in Vaughan have a diameter of less than 30 cm. About four percent of the tree inventory does not have a measured DBH.

This size information, combined with the composition of the inventory (which includes many medium-to-large stature species), indicates a young tree population. Tree planting with development in recent decades is likely the driver of this trend.

While having a high proportion of young trees can support a stable urban forest population over time, an excessively high percentage could signal challenges in

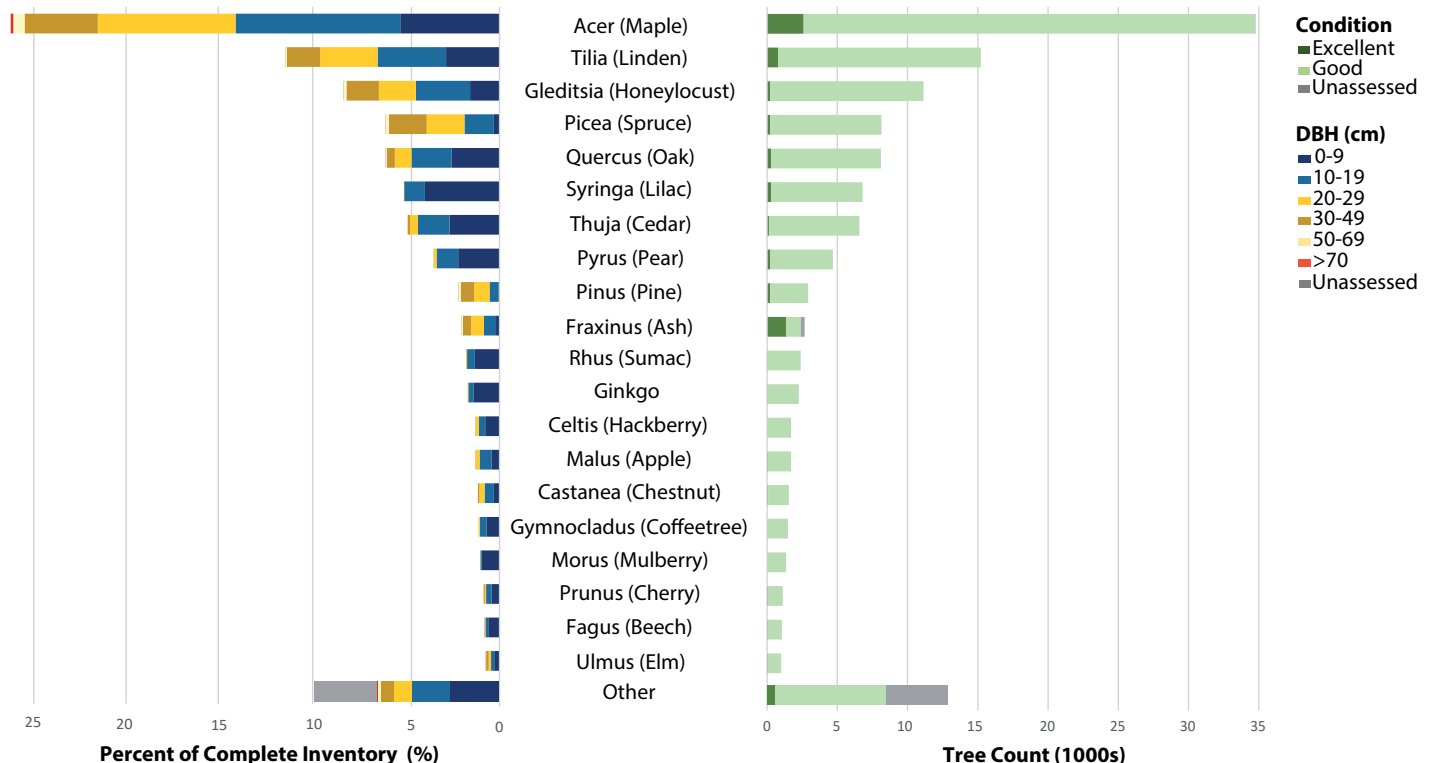
managing the urban forest, including in retaining large, mature trees in the city.

Species Diversity

Nearly 70 percent of Vaughan’s trees belong to the seven most populous genera (Figure 2-11). Maple (*Acer*) alone represents more than 26 percent of the city’s tree inventory, followed by linden (*Tilia*, 12 percent) and honeylocust (*Gleditsia triacanthos*, 9 percent). Norway maple (*Acer platanoides*) constitutes more than 10 percent of Vaughan’s street trees; ivory silk lilac (*Syringa reticulata*) and little-leaf linden (*Tilia cordata*) both exceed five percent.

Figure 2-12 displays Vaughan’s street tree diversity using an adaptation of the ‘Shannon-Wiener index’⁹ to measure of relative species abundance within the tree population. Areas of dark purple correspond to high relative species diversity while lighter areas indicate the opposite.

Figure 2-11. Vaughan’s tree inventory by proportion and count of species, diameter classes, and tree condition.

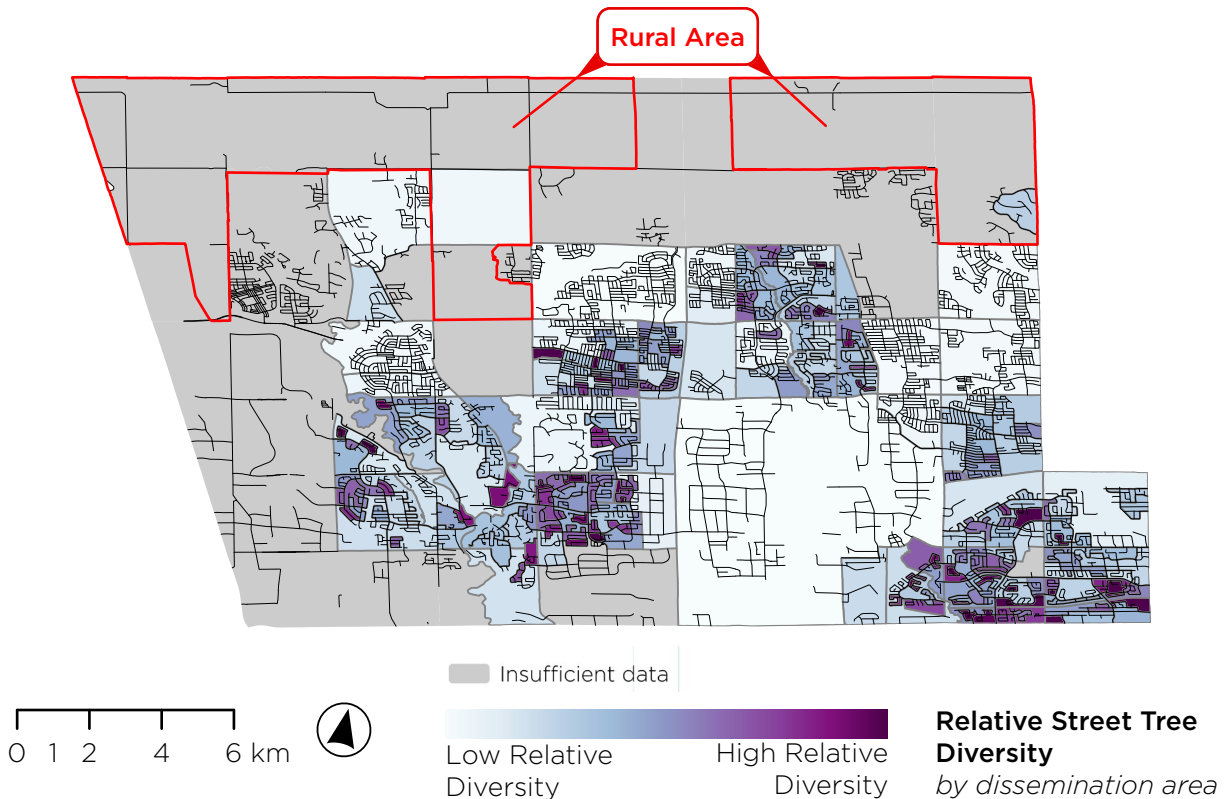


High relative diversity areas tend to be in older subdivisions, where the original trees have been retained and new species have been added over time. In contrast, newer subdivisions and industrial areas tend to have relatively low diversity.

infestation of cherry trees has also been prevalent, resulting in the removal of cherry trees on the list of tree planting species in 2012.

Maintaining urban tree diversity is important as it helps to ensure the resilience of the urban forest against pests and pathogens that target specific tree species. Ontario has experienced several devastating invasive pests and diseases, such as chestnut blight, Dutch elm disease, and Emerald Ash Borer. These experiences underscore the significance of maintaining diversity in urban trees. Asian long-horned beetle is a pest of concern, which attacks various host plants but primarily targets species in the maple genus, which make up over a quarter of Vaughan’s tree population. Black knot

Figure 2-12. Vaughan’s relative street tree diversity mapping by census DA.



Street Tree Density

Figure 2-13 maps the density of street trees in Vaughan by census DA. Street tree density in Vaughan ranges from less than ten trees per kilometre to more than 200. The city’s residential neighbourhoods stand out as having relatively high street tree densities as compared to its commercial and industrial uses.

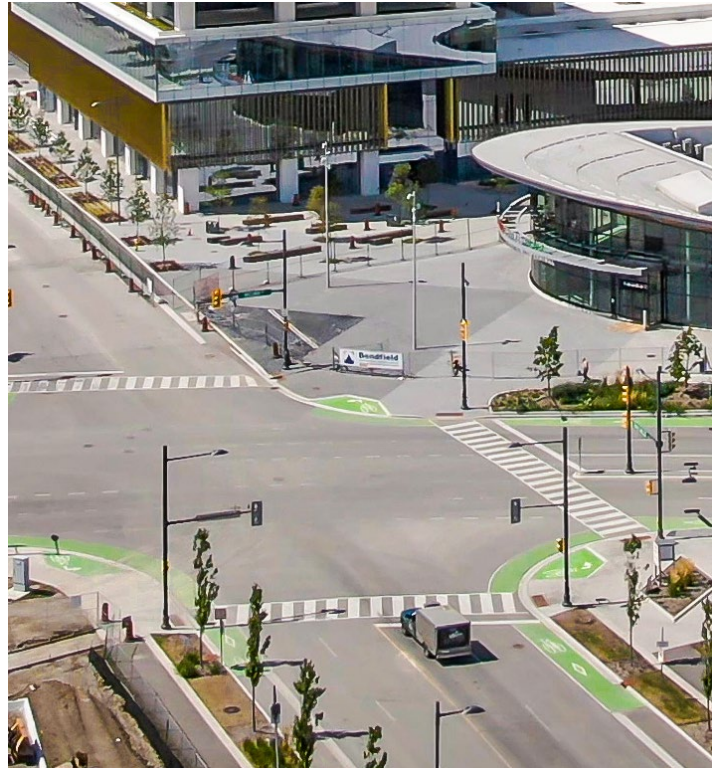
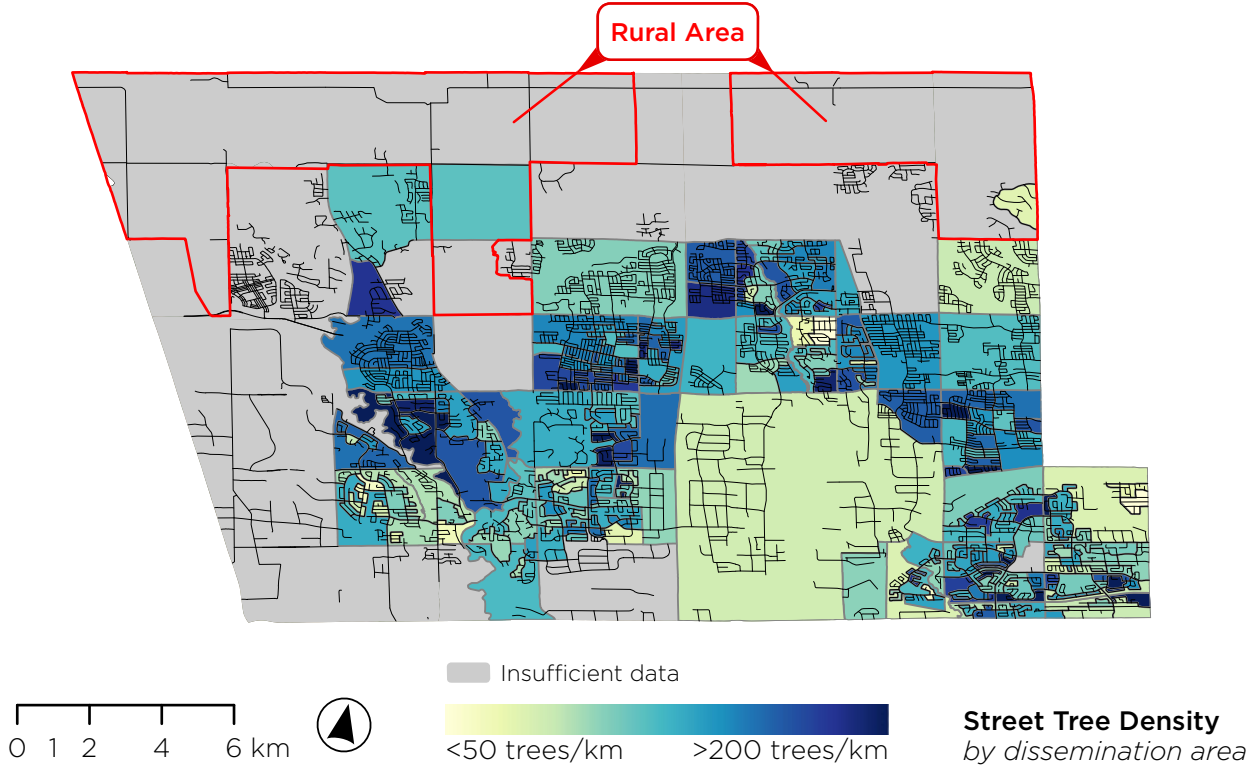


Figure 2-13. Vaughan’s street tree density mapping by census DA.



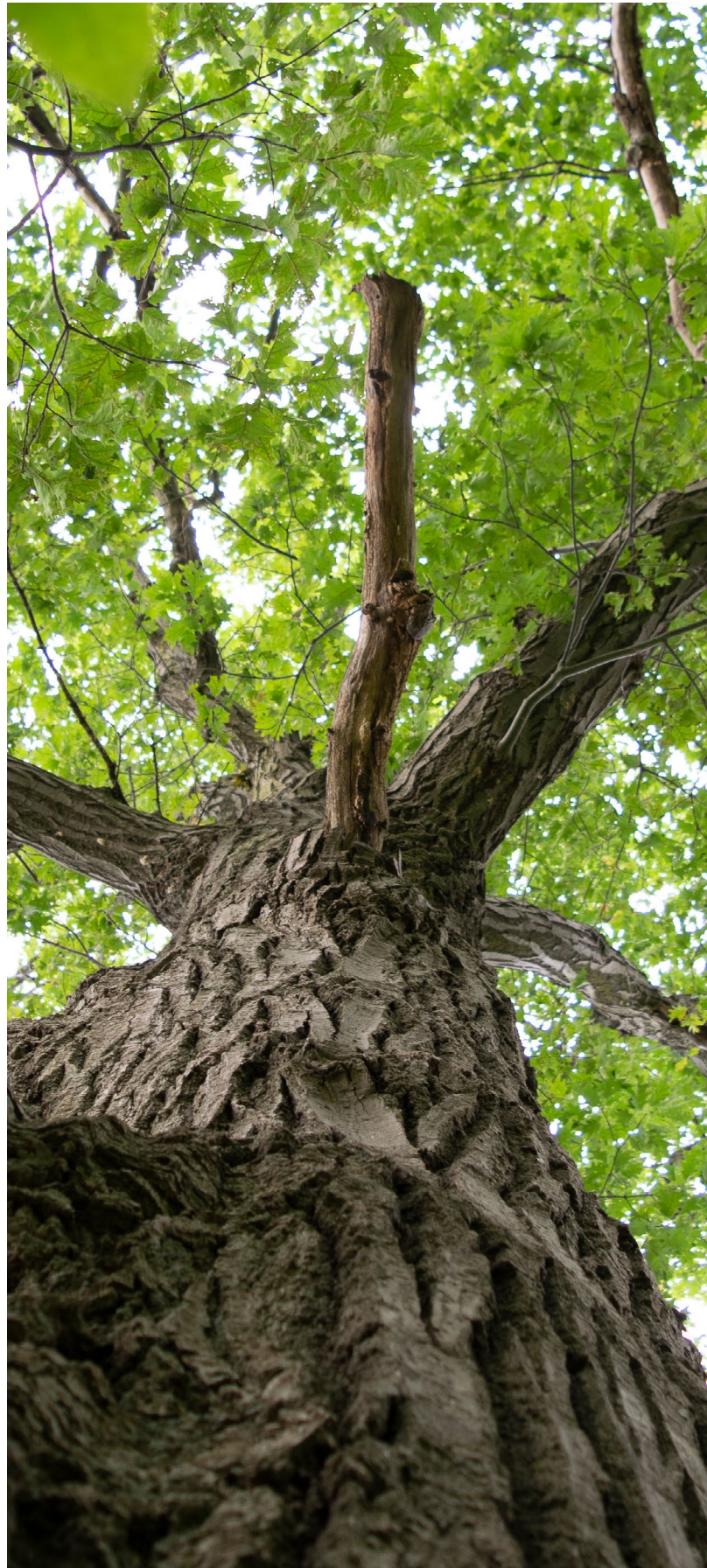
2.3 Woodland Ecosystems

The City of Vaughan is located in Ontario's Mixedwood Plains ecozone, consisting of the Lake Erie-Lake Ontario ecoregion in the southwestern corner of the province (known as the Carolinian ecoregion) and the transitional Lake Simcoe-Rideau ecoregion between the deciduous Carolinian ecoregion of the south and the coniferous boreal shield ecoregions of the north.¹⁰

Local climate is characterized by an average daily mean summer temperature of 20°C and a winter temperature of -5°C. It experiences four distinct seasons, with annual precipitation averaging 800 mm, with higher precipitation during the spring, summer, and fall compared to winter.

The Mixedwood Plains ecozone is primarily composed of mixed and tolerant hardwood forests, which are some of the most biodiverse in Canada, despite being heavily impacted by human development and habitation. The Carolinian ecoregion, which is the most densely populated in Canada, has mostly second-growth forests that are fragmented by agricultural and urban uses; less than 13 percent of the land is covered by native deciduous woodlands. In contrast, the Lake Simcoe-Rideau ecoregion has deciduous, coniferous, and mixed forests covering 16 percent, 5 percent, and 9 percent of the land, respectively.

The Carolinian ecoregion is a predominantly deciduous forest, and is characterized by species such as sugar and red maple, yellow birch, beech, red oak, hawthorn, and basswood. Remnant Carolinian trees can also be found in isolated pockets, such as butternut, blue ash, sycamore, Shumard Oak, Pawpaw, and cucumber tree.



The Lake Simcoe-Rideau forest is home to transitional forests and communities, containing both character conifers, such as eastern white pine, red pine, white cedar, black spruce, tamarack, and eastern hemlock, as well as hardy deciduous species shared with the Carolinian ecoregion to the south.

Although once abundant in the region, instances of healthy ash, elm, chestnut and butternut have each been significantly reduced over the last century, their scarcity a constant reminder of the challenges the region has faced with invasive forest pests and disease.

Grassland ecosystems occur only in isolated pockets, with species such as big bluestem, little bluestem, sundial lupine, and New Jersey tea. Characteristic fauna in the area include the green heron, eastern kingbird, white-tailed deer, Virginia opossum, Midland

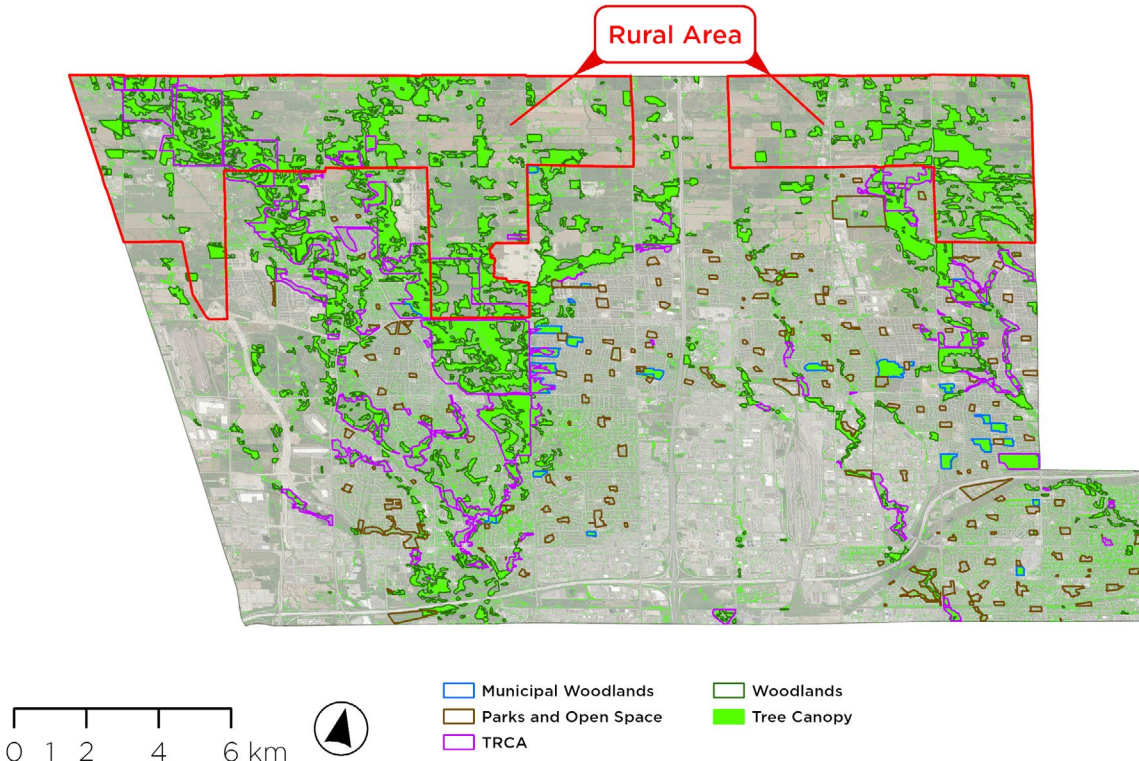
painted turtle, yellow perch, and banded killifish. Many of Ontario’s species at risk can be found in the Lake Erie-Lake Ontario ecoregion.

Vaughan’s Woodlands

The City of Vaughan has around 3,300 ha of woodland canopy, representing 60 percent of the city’s total canopy area (Figure 2-14). More than 85 percent of woodland canopy is protected through designations in the City’s Official Plan.

The Toronto and Region Conservation Authority currently manages nearly 2,100 ha of woodland within the City, currently sustaining more than 1,000 ha of woodland canopy (Figure 2-15). The top four forest communities make up more than 25 percent of the canopied landcover within the TRCA’s landholdings. However, the TRCA has identified some issues in their managed

Figure 2-14. Mapping of Vaughan’s woodland canopy and other canopy area.



ecosystems, such as the presence of exotics, unauthorized trails, and illegal dumping.

Vaughan’s Woodlots

Vaughan has 27 community “woodlots” that are managed by the City. The canopy height information for each woodlot was broken into four height classes, and the number of trees and woodlot canopy area belonging to each of the four canopy classes were plotted (Appendix B). These plots, coupled with historic imagery, provide insight into the structure and history of these woodlots.

The following page depicts the height distributions of four of Vaughan’s woodland areas, and historic imagery. The subsequent paragraphs explain how disturbances and management actions may have influenced

woodlot composition and structure through time. Field study would provide more insight into the age and history of these woodlots.

William T. Foster Woods

William T. Foster Woods was agricultural land until 1992 when it was established as a park and handed over to the TRCA for management. TRCA-led efforts have contributed to gradual canopy growth, and the park’s canopy-height distribution is consistent with young/pioneer forest growth.

Frank Robson Woodlot

Frank Robson Woodlot has persisted since at least 1954 and shows relatively old forest growth. The woodlot pre-dates the first residential subdivisions nearby.

Rutherford Woodlot

The Rutherford Woodlot has also persisted since at least 1954 and predates nearby residential subdivisions. Rutherford’s canopy contains a significant amount of coniferous cover, and has more trees in shorter height classes. A stream runs through the woodlot, which may explain the higher proportion of coniferous canopy versus other woodlots; conifers in the Mixedwood Plains are more common on fresh and moist sites.

Heintzman Woods

The Heintzman Woods have been returning to a secondary forest state since 1954, but show a more uneven stand structure due to repeated human disturbance within different areas of the woodlot.

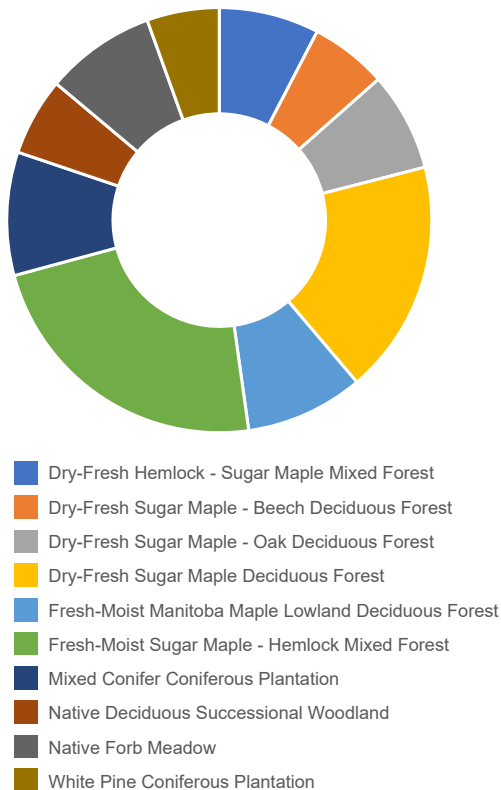
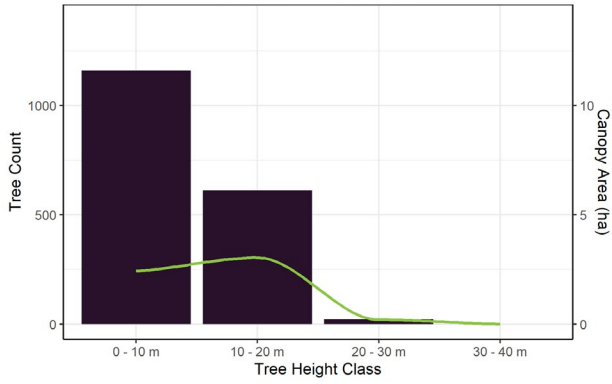
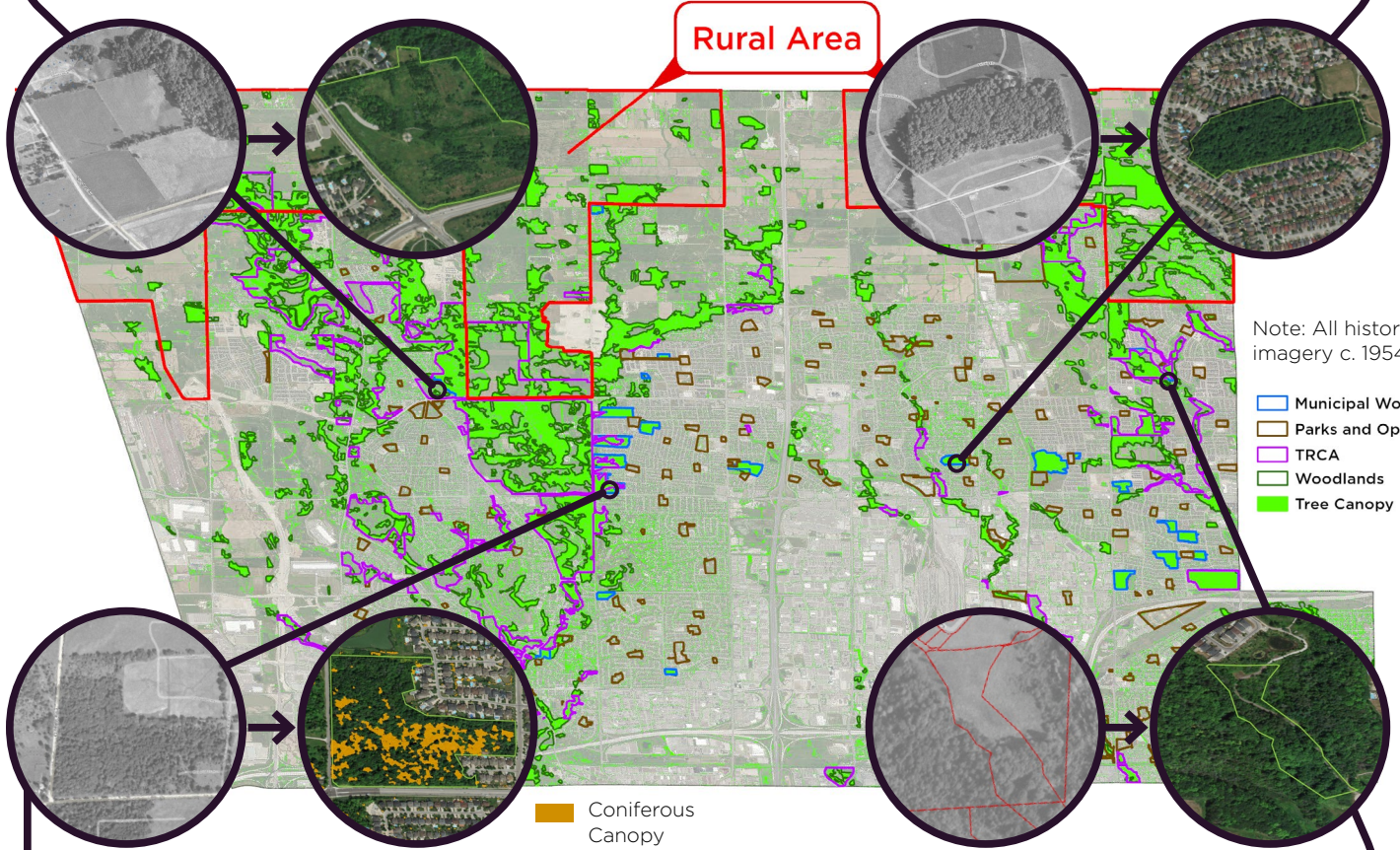
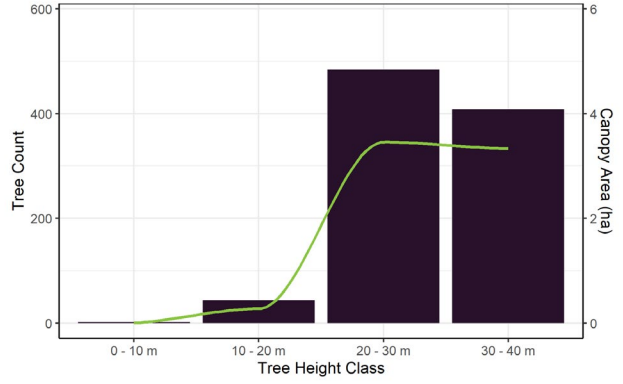


Figure 2-15. *Canopy under TRCA ownership by ecosystem type.*

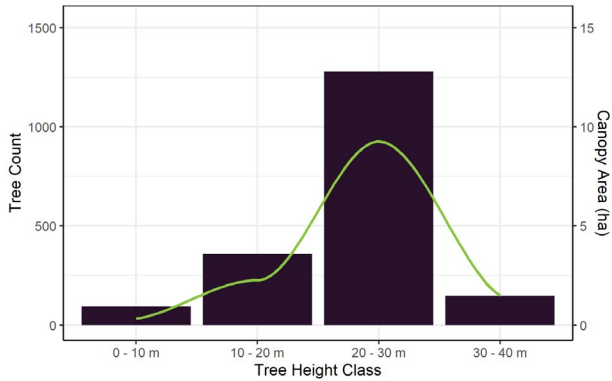
William T. Foster Woods



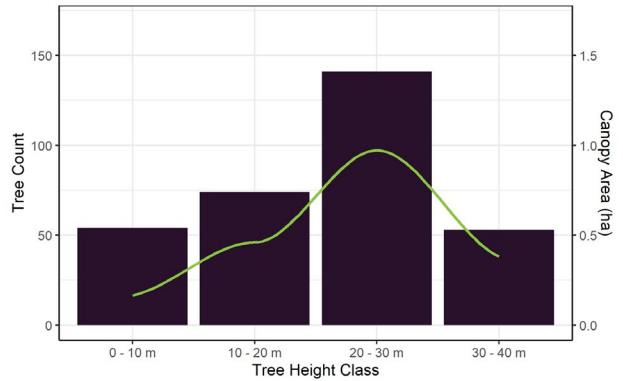
Frank Robson Woodlot



Rutherford Woodlot



Heintzman Woods



Part 3. Vaughan’s Urban Forestry Program

3.1 Staff

Vaughan’s Urban Forestry Group has a compliment of 14 full-time staff (14 FTE) and two part-time workers (1 FTE), including:

One Manager of Urban Forestry, who manages the full range of urban forestry staff and the overall program.

Two Forestry Inspectors who undertake tree inspections, customer service, and development application review.

Three Forestry Coordinators who coordinate staff and aspects of the program.

Six Arborists who undertake scheduled and responsive tree maintenance activities.

Three Forestry Labourers who provide additional labour capacity where arboricultural expertise is not needed.

In 2022, staff time was supplemented by approximately 2,500 contract crew hours. The City is dependent on contract crews in meeting its base service request volumes.

3.2 Key Service Areas

Vaughan’s management program encompasses several key service areas:

Tree Pruning, being the removal of tree limbs from public trees for reasons ranging from hazard abatement to sight-line conflicts and clearance issues.

Forestry Permitting and Plan Review, being the review of 300-400 applications for tree removal a year, review of applications for minor variance, development applications, permits, curb cut applications, internal infrastructure

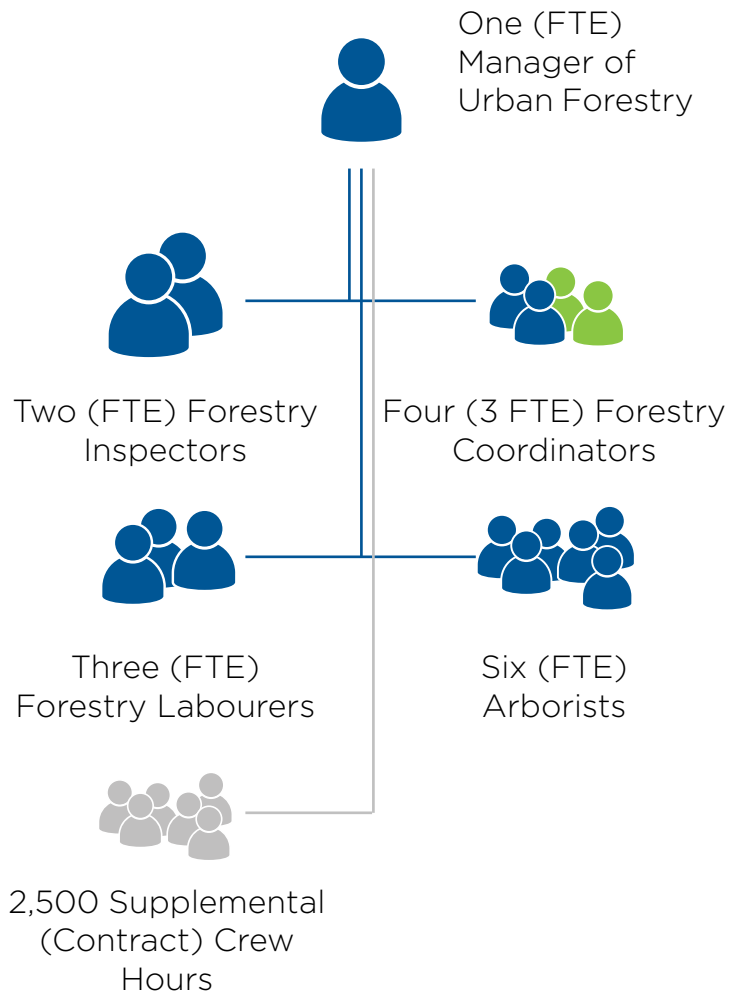


Figure 3-2. *Forestry Group organizational structure.*

delivery projects, and tree inspections of new subdivisions prior to municipal assumption.

Emergency and Storm Response, being the process of cleanup and hazard abatement following a major storm or weather event.

Tree Removal, being the removal of public trees for motivations ranging from end of life to infrastructure conflicts.

Tree Planting and Replacement, being the planting of new trees or replacement of trees that were previously removed.

Tree Risk Assessment, refers to the processes in place to monitor, respond to, and mitigate tree risk at an acceptable standard.

Gaps and Exclusions in Service Areas

TRCA Woodlands are managed by the Conservation Authority, and includes more than 2,000 ha of managed woodland area across within the city. It is often not obvious to the public if a woodland is managed by the City or Conservation Authority.

Woodland Inventory and Management is not currently budgeted for and the quality and condition of City-managed woodlands is largely not confirmed.

Regional Roads: Vaughan Forestry is not presently responsible for the management of any assets owned by the Region of York. This includes tree maintenance, planting, and removal along any of the regional roads within the municipality.

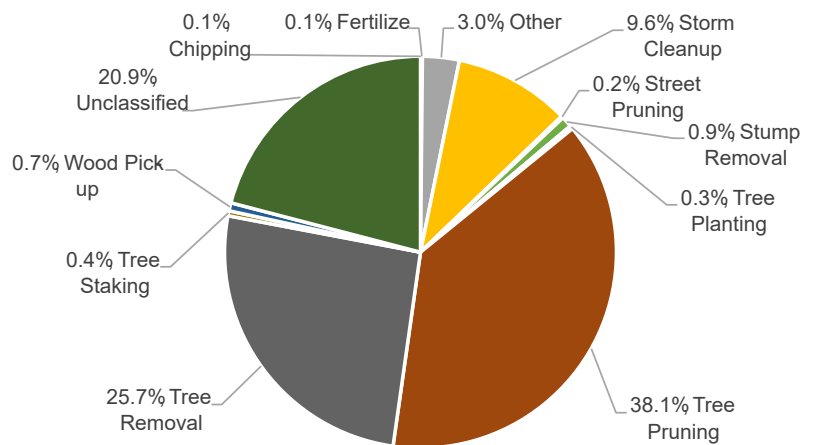
Inventory Management: While an operational aspect in many forest management programs, maintenance of the City’s tree inventory in Vaughan does not occur.

3.3 Service Requests

In 2022, Forestry received over 5,100 service requests, with the majority related to tree pruning (38 percent), tree removal (over 25 percent), and storm cleanup (10 percent). More than 20 percent of service requests were not assigned a service class (Figure 3-3).

At present, the City of Vaughan meets a lead time of approximately 24 weeks from the time of inspection to the resolution of the work order. Storm events, such as the May 2022 derecho, can contribute to a swell of service requests that further extends service lead times, often pushing request resolution as far as 30 weeks back, on average, from date of inspection.

Figure 3-3. Forestry work orders by classification.



3.4 Budget

In 2022, Vaughan’s Forestry Group operated on a total operating budget of just over \$1.7 million dollars. Expenses amounted to just under \$2.3 million, and revenues and transfers just over \$500,000 (Figure 3-4). Sixty-one percent of the City’s operating expenses were staff wages and labour costs. Twenty-three percent were paid out to contract crews and labour. Remaining expenses were associated with materials, supplies, and administrative expenditures.

Forestry is currently dependent on contract labour support to meet maintenance demands from service requests.

In terms of revenues and transfers in 2022, 34 percent were internal recoveries and transfers, and an additional 23 percent were capital fund transfers. Tree permit revenues made up approximately 15 percent of operating revenues, and associated cash-

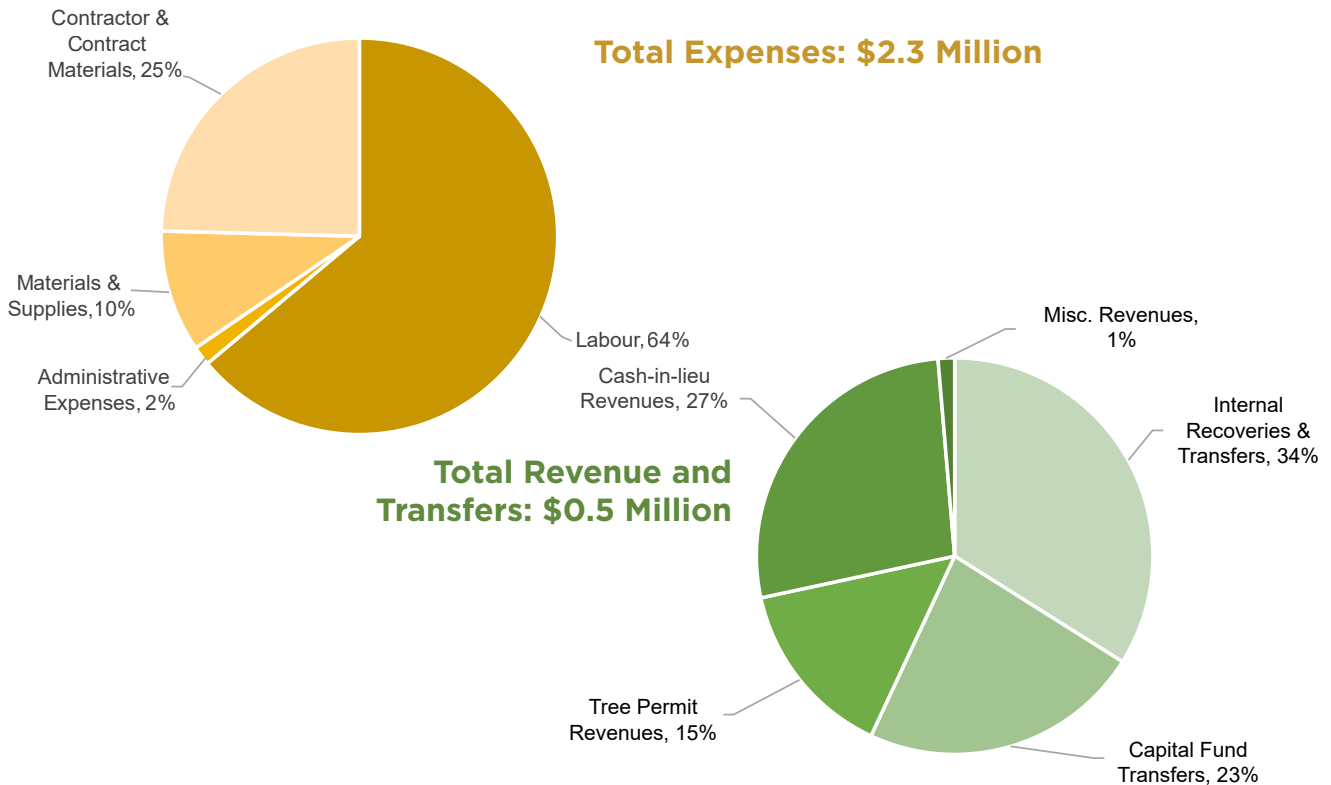
in-lieu proceeds made up an additional 27 percent.

3.5 Key Challenges

Resourcing

Program resourcing is the budget and staff resources available to support the maintenance, protection, management and growth of the city’s urban forest. An urban forest management program can only be as effective as capacity permits. Like all modern cities, Vaughan actively invests in its urban forest, and as such makes decisions on program elements which are supported, or which are not, based on the level of funding made available. Every decision to resource or not resource an aspect of an urban forest management program has impact on the City’s ability to optimize the management of the urban forest toward greater community benefit.

Figure 3-4. Forestry group expenditure, revenues and transfers.



At present, Vaughan's urban forest management program is almost exclusively reactive. Reactive programs tend to be less efficient in managing the urban forest because issues are only addressed when they become known to staff. Proactive programs, on the other hand, enhance urban forest outcomes by providing a regular maintenance regimen for all intensively managed trees, thereby reducing the frequency of preventable tree health issues and resolving problems before the trees reach a state of irreversible decline.

Pests, Disease and Invasives

In urban areas, insects, diseases, and invasive flora and fauna pose significant threats to the health of trees. Addressing these issues requires a considerable amount of the City's resources, including budgets and staff time. For instance, the Emerald Ash Borer (EAB) led to the removal of almost 9,000 public ash trees in Vaughan since its arrival in 2008, but Vaughan's EAB response has now officially ended. However, other pests and diseases continue to pose a threat to the urban forest.

Some of the current pest and disease threats to Vaughan's urban forest include the Asian long-horned beetle, oak wilt, spongy moth, hemlock woolly adelgid, and beech bark disease. Climate change has made the life cycles of insect pests faster, increasing their rate of development, reproduction, and overwinter survival. Moreover, environmental stressors can leave trees more vulnerable to pest infestations and diseases. For example, oak wilt is often transmitted through insect vectors that target stressed host plants.

Maintaining a diverse urban forest in terms of species composition is one of the most robust, passive forms of pest management. Forest pests and disease tend to have varied degrees of preference



Figure 3-5. *Small sampling of current exotic pests and disease of concern to Ontario. From left-to-right: EAB, hemlock woolly adelgid, Asian long-horned beetle (ALB), spongy moth (formerly gypsy moth), picnic beetle (not itself invasive, but a common vector for oak wilt), spotted lanternfly, and beech bark disease.*

toward specific species, genera, or families of plant. Higher urban forest diversity reduces the likelihood of a single pest negatively impacting large swaths of the city's trees, and can also work to reduce the spread of pests by making host plants less abundant in the urban landscape. However, diversification of Vaughan's urban forest is limited by the range of species that tolerate urban environments, and by the species that are commercially available for purchase. In woodlands, species diversity is also limited to ecologically appropriate native species.

Climate Change

A changing climate poses a significant risk to Vaughan's urban forest. Long-term changes in growing season temperature and precipitation may impact the range of species suitable for planting in the city, or could support conditions which could change the range or local life-cycle of forest pests and disease. Extreme weather will bring its own management challenges.

Significant storm events will introduce greater tree risk, and can result in months of clean up when they occur, draining program capacity. The May 21, 2022 derecho storm saw 1,000 service calls and cleanup required in 800 locations across Vaughan. Recurring and intense drought can contribute to tree stress and decline, and can make trees more susceptible to other sources of stress.

Proactive maintenance, including tree pruning and a structural young tree program can improve urban forest resilience to extreme weather, reducing the operational burden of response while promoting climate adaptation and mitigation. Healthy and well-managed trees will be stronger, less likely to be damaged by winds, less susceptible to secondary sources of stress, and provide essential benefits for public safety and climate adaptation.

The urban forest also itself provides adaptation and mitigation services^{11,12}. Services such as stormwater absorption and urban heat island reduction can help manage some of the more severe impacts of climate change, while services such as carbon sequestration and energy reduction actively reduce the emissions originating from the City of Vaughan and the activities taking place within it.

Data and Monitoring

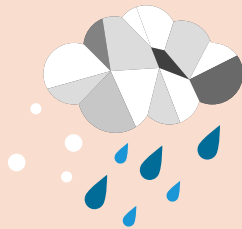
Vaughan is committed to maintaining high standards for public data, as evidenced by its recent receipt of three International Organization of Standardization (ISO) certifications from the World Council on City Data (WCCD). These certifications include a Platinum ISO 37120 certification for both 2020 and 2021, as well as the ISO 37122 Early Adopter Smart Cities certification. The WCCD is a global leader in standardized

FUTURE CLIMATE WILL BE...



WARMER

- Warmer average temperatures
- More hot days (above 30 °C)
- Milder winters
- More frequent and longer heat waves
- Longer, warmer growing seasons



WETTER

- Increased annual precipitation, especially in the winter
- Increased frequency of heavy precipitation events



WILDER

- Potential changes in frequency and intensity of extreme weather events
- More freezing rain, hail
- More high wind gusts

THIS IS LIKELY TO LEAD TO...



MORE ISSUES WITH PESTS AND INVASIVE SPECIES

Pests may reproduce more rapidly and more often.



MORE EXTREME WEATHER EVENTS

Heat, extreme precipitation, flooding, ice storms or other events may happen more often.

data that helps create smart, sustainable, resilient, and prosperous cities. Achieving Platinum certification is a significant accomplishment, as it represents the highest level of certification offered by the WCCD¹³.

Urban forest inventory datasets are crucial for evidence-based decision-making in urban forestry. A comprehensive street tree inventory is essential for scheduling proactive pruning, watering, and monitoring cycles, managing risk, and analyzing changes in the urban forest over time. Field plots in woodland areas provide valuable insights into long-term stand development, mortality, and recruitment, particularly given the effects of climate change.

Vaughan's street tree inventory last underwent a comprehensive update in 2016 and has not been maintained since. Additionally, the City does not have a formalized woodland monitoring program. Without current inventory and monitoring records to support proactive management and urban forest planning, the City cannot shift to a proactive management paradigm and will be unable to optimize the quality and life-cycles of its urban forest assets, nor to proactively manage tree risk.

Development Standards

In the 1970s, Vaughan was a community of only 15,000 people.¹⁴ However, over the past 50 years, the population has grown to over 320,000 residents, with millions of visitors each year. Most of this growth has been characterized by low-density, suburban built forms, similar to other Ontario communities that experienced a housing boom.

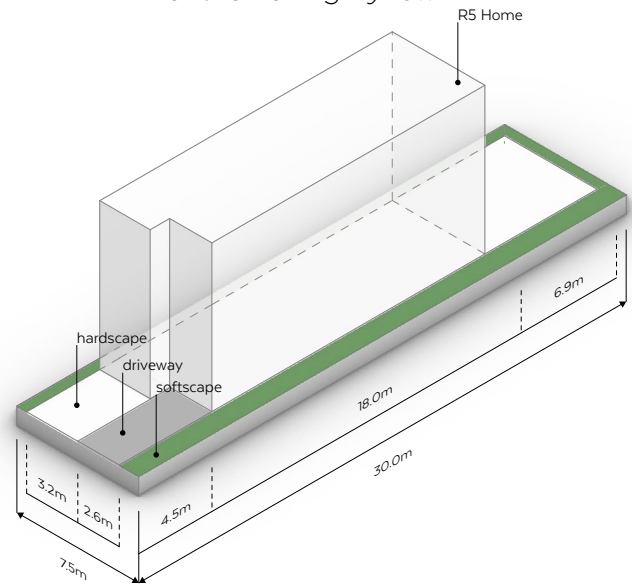
Moving forward, the development of intensification centres such as the Vaughan Metropolitan Centre (VMC) will consist of both intensification and greenfield development, both of which pose challenges for integrating the urban forest.



Intensification creates competition between trees and other critical infrastructure in limited public space, while greenfield development on small lots with minimal setbacks leaves little room for trees on both public and private property (Figure 3-1).

The core challenge in supporting continued growth is finding a balance between preserving or creating green space while accommodating higher-density development and affordable housing. While there is no single solution, the City must carefully consider the trade-offs in allowing developments that do not support the retention or replanting of trees that will be large at maturity. Once trees, or the space for them, are gone, it becomes expensive and difficult to reintroduce them.

Figure 3-1. Hypothetical built form of a low-density development within the City's R5 Zone aligned with the requirements of the Zoning By-law.



R5 Home

Hypothetical as-of-right built form.

- Driveway Area: 14.5m² // 6%
- Hardscape Area: 53.3m² // 24%
- Softscape Area: 57.4m² // 25%
- Building Footprint: 99.5m² // 45%



Encroachment and Enforcement

Vaughan's street trees and city-owned public woodlands are municipal assets. When private uses encroach upon city-owned land, it can threaten or complicate the maintenance of these assets. Typically, encroachment on public trees falls into one of two categories: encroachment into boulevards or encroachment into woodland areas.

In Vaughan, encroachment into woodland areas commonly takes the form of unauthorized trails or the unauthorized expansion of private uses, such as yards, into public woodlands. Encroachment into woodlands can harm the natural qualities of the ecosystem and reduce the community benefits that are generated by natural ecosystems. Additionally, it can set a negative precedent that neighbouring landowners may use to guide their own landscaping decisions.

Similar to other cities, Vaughan permits some types of encroachment into the boulevard space adjacent to private properties. However, according to the City's Encroachment By-law (034-2017), encroachment that interferes with City operations or modifies or interferes with City infrastructure, including trees, is prohibited.

Some types of boulevard alterations, such as excessive mulching, hardscaping, constructing deep planters, and using semi-permeable membranes over trees and roots, can harm tree health and reduce the lifespan of boulevard trees. Additionally, hardscaping can make it difficult for the City to replace trees without damaging the resident-installed hardscape.

The City has various mechanisms in place to address encroachment issues, depending on the specific circumstances. However, it is preferred that private landowners adhere

to the City's policies and regulations on authorized forms of encroachment.

If you are unsure of the legal limit of your property line, please contact the City before starting any work.



What Constitutes Encroachment?

Encroachment is any unauthorized incursion of private use into a public land or use. As it relates to the City's public trees and woodlands, encroachment most commonly takes place in boulevard spaces, and often takes the form of hardscaping and/or planters around trees, which can significantly reduce a tree's expected service life. ▼



Part 4. Regulatory Context

The City of Vaughan’s management of its urban forests is subject to a variety of legislation, regulations, policies, standards, and guidelines. (Figure 4-1). This section provides a primer on the legislative and regulatory materials that apply within the city.

Term of Council Service Excellence Strategic Plan (2022-2026)

The Strategic Plan outlines the City’s vision, mission, and values, as well as strategic key activities for the coming term of council. Environmental sustainability is a priority in

the current strategic plan, with an emphasis on improving the stewardship of green infrastructure, supporting sustainability initiatives, and investing in climate resilience.

Guiding Policy and Plans

Planning policy establishes the broad types of use and activities that can be governed through specific regulations and standards, such as by-laws. Ontario’s policy framework for urban development and intensification broadly allows for a growing population while protecting the province’s critical

Figure 4-1. While Vaughan’s urban forest spans a range of land uses, this document is scoped around the City’s forested parks and intensively managed street trees.



environmental features, rural landscapes, and agri-food networks.

High-level policy direction is provided by documents such as the Provincial Policy Statement, Growth Plan for the Greater Golden Horseshoe, Oak Ridges Moraine Conservation Plan, and Greenbelt Plan, which are built on by the York Regional Official Plan and the City of Vaughan Official Plan.

The **York Regional Official Plan** addresses important matters, including provincially mandated growth, regional priorities, key opportunities and challenges, and places particular emphasis on forest protection and enhancement. This includes:

- Increasing woodland cover to 25 percent of York Region's total land area (3.4.25), and canopy cover to 40 percent (3.4.26);
- Policy requiring local municipalities to develop an Urban Forest Management Plan, together with York Region, which may include additional local woodlands for protection (3.4.29);
- Policy requiring local municipal official plans to include appropriate policies to prepare and enact tree-cutting by-laws in accordance with provisions in the *Municipal Act* (3.4.34);
- Policies requiring the development of a woodland compensation plan for the removal of woodlands not deemed significant (3.4.32);
- Integration with provincial mapping and policy; (3.4.4) and
- Several other policy outcomes related to a sustainable natural environment.

The **City of Vaughan Official Plan** sets out the City's vision and growth direction

until 2031, with policies related to land use, transportation, infrastructure, environment, urban design, and community services. The urban forest's ecological, climate, and social values are recognized in the plan, with policies aimed at managing and enhancing this resource. Policies that are most relevant to urban forest management include:

- Requiring an urban forest inventory and forest management plan for forest resources in urban areas (3.3.3.5);
- Responding to climate change by growing the urban forest and undertaking carbon sequestration and storage audits to reduce "air emissions"/ greenhouse gas emissions (3.7.1.2);
- Improving the public realm through provision of street trees and landscaping (9.1.1.2);
- Providing a high-quality network of connected public green spaces, and a network of natural areas (9.1.1.7);
- Policies to establish urban greening targets (e.g., urban forest canopy) for Vaughan Metropolitan Centre and key development areas, streetscape improvement, and tree planting details in site plan control processes (10.1.1.4).

Associated Plans, Policies and Guidelines

The management of urban forests in the City of Vaughan is influenced by a substantial collection of plans, policies, and guidelines. These documents typically implement guiding policy documents like the Official Plan. Several of these documents and their relation to urban trees are outlined below.

The **Asset Management Plan (Urban Forestry)** aims to provide a financial and technical roadmap for managing the City's urban forest assets. This includes street

trees, park trees, woodlots, and open spaces. The recommendations cover tree/asset inventory, health condition assessments, maintenance approaches, levels of service frameworks, risk assessments, funding models, and training, communication, and knowledge sharing.

Green Directions Vaughan (GDV) was first approved by Council in 2009 as the City's community sustainability plan. It guides the community to a more sustainable future by addressing environmental, cultural, and economic values. In 2009, an updated GDV was adopted by Council and describes the City's environmental priorities and outlines a new set of sustainability actions. Actions specific to the urban forest and trees are focused on stormwater management (as part of infrastructure), provision of greenspace to support a growing population, and streetscape improvement. The City also approved a list of indicators to track progress on the implementation, which include greenspace and urban tree canopy.

The **York Region Climate Change Action Plan** charts a path for reduced emissions and prepares for York Region's future climate. The plan identifies goals and actions to achieve reduced emissions as well as to withstand and respond to current and future climate change impacts. Although the urban forest is not specifically mentioned, the Action Plan suggests actions to assess the vulnerability and ecosystem services of natural systems to inform adaptive planning.

Implementing By-laws and Policies

Several other implementing By-laws and standards influence urban forest management and are summarized below.

Zoning By-law: establishes minimum standards for landscape buffers, lot coverage, landscaped areas and building setbacks, which are major determinants of tree retention and replacement. Outstanding appeals mean the City is assessing new development applications on the basis of



conformity with two zoning By-laws (By-law 1-88, as amended and 001-2021, as amended).

City of Vaughan Tree Protection By-law (052-2018): applies to the City's urban area (with some exceptions) and includes provisions for public and private tree protection (>20 cm diameter breast height), replacement, and maintenance on public and private property. When a property owner wants to cut a tree, or a smaller-scale development is planned (e.g., building permits, pools, accessory buildings etc.) the private tree By-law applies, and a permit is required.

Site Plan Control By-law (123-2013): allows the City to evaluate the designs of buildings and sites, access, and landscaping (e.g., tree/vegetation size and type) prior

to development approval to ensure new development design is appropriate and safe. **Encroachment By-law (034-2017):** outlines rules to prevent any landscaping, vegetation, and natural or man-made objects from being located on the public boulevard or City parks or open spaces, prior to obtaining an encroachment permit. The By-law also applies to foliage extending into a Sight Triangle to be trimmed back to the property line, which may have implications to the planting and management decisions of private trees.

Tree Protection Protocol: identifies the procedure and standards required by the City to protect public and private trees through other development review processes, as enabled through provincial planning legislation. The protection protocol provides directions on evaluating



the impacts of development on trees, assessing tree permit applications, and tree preservation and management practices.

Sustainability Metrics Program: offers a set of tools to evaluate the sustainability performance of development proposals and encourage builders/developers to achieve a minimum level of performance. Metrics and requirements are set for urban tree canopy and shaded walkways/sidewalks, conservation of healthy mature trees on development sites, soil quantity and quality for new trees, and planting of native plants (trees, shrubs, etc.) to support pollinators.

York Region Forest Conservation By-law: generally requires a permit for tree removal in woodlands and woodlots throughout the Region. Some activities/removals are exempt. The By-law does provide criteria for the sizes and tree densities that constitute a woodland or woodlot as used in the By-law. The Forest Conservation By-law does not protect individual trees outside woodland or woodlot features.

York Region Construction Design

Guidelines and Standards: are a series of documents that provides guidance on street designs, including specific guidelines on street trees and horticultural design, such as tree species selection and soil requirement.

Ontario Regulation 166/06: enables the Toronto and Region Conservation Authority to regulate work within valley and stream corridors, wetlands and associated areas, and the Lake Ontario waterfront. Projects are required to obtain a permit prior to development and establish an inventory of tree species with over 10 cm DBH within the proposed development area.

Ontario Regulation 588/17: sets out requirements for municipal asset management planning to help municipalities better understand their infrastructure needs and inform infrastructure planning and investment decisions. In compliance with O.Reg 588/17, the City integrated some urban forest asset classes into its asset management planning process for the first time in 2023.

Recent Regulatory Changes of Note

Recent changes to the Planning Act and associated provincial policy, such as those under Bill 109, Bill 108, Bill 23, and more recently, Bill 97, have both significantly impacted planning and land use paradigms within the Province and have influenced the powers of municipalities, conservation authorities and upper-tier municipalities in regulating development processes. These changes have broadly impacted the amounts of land the City can require as parkland through new development, increased as-of-right density associated with certain types of use, have exempted some applications from the site plan approval processes and others from requirements for landscaping plans. Numerous significant changes to Provincial planning policy has have been brought into force; these are said to provide greater flexibility in the planning process at the local level. The implications of these moves to urban forest management are yet unclear. In response to the planning landscape in flux, the City will need new policies and regulations in place to continue to ensure the protection of and consideration for natural features in development processes.

Part 5. Peer City Comparison

Benchmarking Vaughan against other municipalities that share geographic, economic, social, and/or demographic similarities to the city helps to generate insights into how the City’s program compares to that of its peers. In [Table 5-1](#), Vaughan has been compared to six peer communities, five of which are located in south-central Ontario and share similarities to Vaughan in terms of: population, density, land area, and/or woodland communities.

The comparison is divided into four themes of urban forest management: planning, planting, management, and protection.

The information in [Table 5-1](#) was compiled through a review of publicly accessible materials from the six peer communities. These materials included urban forest management reports, tree policy documents, tree protection by-laws, corporate budgets and municipal websites.

Table 5-1. *City of Vaughan peer city comparison.*

	Vaughan	Surrey	Oakville	Hamilton	Brampton	Burlington	London
Population (2021)	323,103	568,322	213,759	569,353	656,480	186,948	422,324
Pop density (people per km ²)	1,186	1,798	1,538	509	2,469	1,004	1,004
Land area (km ²)	272	316	139	1,118	266	186	420
PLAN							
Canopy Cover (Year)	20% (2019)	32% (2014)	28% (2015)	21% (2018)	18% (2015)	30% (2018)	24% (2015)
No. Inventoried Public Trees	130,000	104,000	170,000	420,000	NA	71,000	135,000
ISA-Certified Arborists On Staff?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Operational Budget (\$ millions)	\$1.7	\$4.8	\$4.3	\$15.1 (Forestry & Hort.)	\$30.9 (Parks Maint. & Forestry)	\$3.7	\$15.8
Capital Tree Planting Budget (\$ 000's thousands)	\$1,000	Not reported	\$800	\$100	\$2,700	\$800	\$225
Approximate \$/resident toward operating budget	\$5.38	\$8.45	\$20.11	\$26.52	\$47.06	\$19.78	\$37.41
PLANTING							
Annual new public trees (Year)	2,000	4,475	Not reported	13,793 (2020)	±5,000-7,000 (Annually)	1,650 (2020)	±5,000 (Annually)
Regular woodland restoration/ planting events	No	Yes	Yes	No	No	No	Yes

	Vaughan	Surrey	Oakville	Hamilton	Brampton	Burlington	London
MANAGE							
Street Tree inventory Completeness	Out of Date	Current	Current	Current	Update Underway	Current	Current
Pruning Target	Reactive (22-Year)	5-Year	10-Year	7-Year	5 to 7-Year	7-Year	10-Year
Management Strategy/Plan	In Dev.	Yes	Yes	Yes	Yes	Yes	Yes
Formal Woodland Monitoring/ Management Program	No	No	Yes	No	No	No	Yes
PROTECT							
Public Tree By-law	Yes	Yes	Yes	Public Trees Only	Yes	Yes	Yes
Private Tree By-law	20cm DBH	20cm DBH	15cm DBH	None.	30cm DBH	20cm DBH	50cm DBH
Tree Protection Guidelines Document	Yes	No	No	Yes	No	No	No
Significant/ Heritage Tree clause	No	Yes	No		No	Yes	No
PARTNER							
Formalized urban forest stewardship program(s) backed by municipal resources	No	Yes	Yes	No	Yes	No	Yes
Opportunities for citizen science/ monitoring	No	Third-party	Yes	No	No	No	No
Reconciliation approach in parks and land management approach in parks and land management	Informal	Informal	Informal	Informal	Informal	Informal	Informal



Part 6. Program Report Card

Vaughan’s urban forestry program has been evaluated within an urban forest sustainability framework first proposed by Clark and Matheny (1998)¹⁵ and then updated by Leff in 2016.¹⁶ These frameworks define a set of performance indicators which work to establish the current and optimal

state of different element urban forest programs.

The criteria have been adapted to reflect local contexts. A full description of the criteria and indicators can be found under [Appendix A](#).

PLAN

Awareness of the urban forest as a community resource	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relative tree canopy cover	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clear and defensible urban forest canopy assessment and goals	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Interdepartmental and municipal agency cooperation in urban forest strategy implementation	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Municipality-wide urban forest management plan	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Municipal natural asset management	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Municipal biodiversity or woodland management strategy	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Municipal urban forestry program capacity	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Urban forest funding to implement a strategy	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

PARTNER

Citizen involvement and neighbourhood action	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Involvement of large private land and institutional land holders	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Urban forest research	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Regional collaboration	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

PROTECT

Policy/regulations regulating the protection and replacement of private and City trees	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Policy/regulations for sensitive ecosystems, soils, or permeability through private development	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internal protocols guide City tree or sensitive ecosystem protection	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Standards of tree protection/care observed during development or by arborists	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cooperation with utilities on protection (and pruning) of City trees	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

GROW

City tree planting and replacement program design, planning and implementation	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Development requirements to plant trees on private land	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Streetscape and servicing specifications and standards for planting trees	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equity in planting program delivery	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forest restoration and native species planting	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Selection and procurement of stock	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ecosystem services targeted in tree planting projects and landscaping	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

MANAGE

Tree inventory	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Natural areas inventory	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintenance of intensively managed trees	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Publicly owned tree species condition assessment	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tree risk management	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Emergency response planning	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pest and Disease management	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species diversity	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Age diversity (size class distribution)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Species suitability	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Waste biomass utilization	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of trees on private property	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Next Steps

The Urban Forest Report Card is a performance baseline that can be re-assessed each time a new State of the Urban Forest Report is prepared. Recommendations considered for the Vaughan's Urban Forest Management Plan will aim to shift the City's urban forest management program towards good and optimal ratings.

This Report comes at the end of the first round of engagement on the UFMP. A second round of engagement is set to take place in June 2023, and will provide an opportunity for residents and the public an additional opportunity to engage on the UFMP and WMS project. Visit haveyoursay.vaughan.ca/urbanforest for the latest information.



Part 7. References

- 1 Statistics Canada. 2023. (table). Census Profile. 2021 Census of Population. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Released March 29, 2023.
- 2 MacGregor-Fors, I., Escobar, F., Rueda-Hernández, R., Avendaño-Reyes, S., Baena, M. L., Bandala, V. M., Chacón-Zapata, S., Guillén-Servent, A., González-García, F., & Lorea-Hernández, F. (2016). City “green” contributions: The role of urban greenspaces as reservoirs for biodiversity. *Forests*, 7(7), 146.
- 3 Nowak, D. J., Greenfield, E. J., Hoehn, R. E., & Lapoint, E. (2013). Carbon storage and sequestration by trees in urban and community areas of the United States. *Environmental Pollution*, 178, 229–236. <https://doi.org/10.1016/j.envpol.2013.03.019>
- 4 Hamada, S., & Ohta, T. (2010). Seasonal variations in the cooling effect of urban green areas on surrounding urban areas. *Urban Forestry & Urban Greening*, 9(1), 15–24.
- 5 Mayor Bevilacqua & Members of Council. (2019). The City of Vaughan Climate Emergency Declaration (Council Communication No. 23; p. 2). City of Vaughan. <https://www.vaughan.ca/sites/default/files/COV%20Climate%20Emergency%20Declaration%20Jun-4-2019.pdf?file-verison=1682720718535>
- 6 York Region. (2021). State of the Forest May 2021 (p. 16) [Tech. Rep.]. Region of York.
- 7 Statistics Canada. (2016, November 16). 2016 Census of Population Dictionary: DA [Government]. Statistics Canada. <https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/geo021-eng.cfm>
- 8 City of Vaughan. (2020). City of Vaughan Official Plan (2010): Office of Consolidation (p. 334) [Official Plan]. City of Vaughan. <https://www.vaughan.ca/sites/default/files/VOP%20Volume%201%20-%20OPA%2015%20Correction%20%2528July%204%202022%2529.pdf?file-verison=1682621718783>
- 9 Shannon, C. E. (1948). A Mathematical Theory of Communication. *Bell System Technical Journal*, 27(3), 379–423. <https://doi.org/10.1002/j.1538-7305.1948.tb01338.x>
- 10 Wester M. C., Henson B. L., Crins W. J., Uhlig, P. W. C., Gray, P. A. The Ecosystems of Ontario, Part 2: Ecodistricts. Peterborough, ON: Ontario Ministry of Natural Resources and Forestry, Science and Research Branch; 2018 p. 474. Report No.: TR-26. Available from: <https://files.ontario.ca>.
- 11 Brandt, Leslie A., Gary R. Johnson, Eric A. North, Jack Faje, and Annamarie Rutledge. ‘Vulnerability of Street Trees in Upper Midwest Cities to Climate Change’. *Front. Ecol. Evol.* 9 (September 2021): 721831. <https://doi.org/10.3389/fevo.2021.721831>.
- 12 Nowak, D. J., Greenfield, E. J., Hoehn, R. E., and Lapoint, E. “Carbon Storage and Sequestration by Trees in Urban and Community Areas of the United States.” *Environmental Pollution* 178 (July 2013): 229–36. <https://doi.org/10.1016/j.envpol.2013.03.019>.
- 13 WCCD. ‘Vaughan Achieves Platinum and Smart Cities Early Adopter Certifications from the World Council on City Data’. World Council on City Data, September 2022. <https://news.dataforcities.org/2022/09/vaughan-achieves-platinum-and-smart.html>.
- 14 Statistics Canada. 2023. (table). Census Profile. 1971 Census of Population. Statistics Canada Catalogue no. CS92-706/1971-PDF. Ottawa. Released 1974.
- 15 Clark, J., & Matheny, N. (1998). A Model of Urban Forest Sustainability: Application to Cities in the United States. *Arboriculture & Urban Forestry*, 24(2), 112–120. <https://doi.org/10.48044/jauf.1998.014>
- 16 Leff, M. (2016). The sustainable urban forest: A step-by-step approach (p. 109) [Frwk]. U.S. Department of Agriculture, Forest Service, Northern Research Station, Philadelphia Urban Field Station.

40 Part 8. Appendices

Appendix A: Urban Forestry ‘Report Card’

The criteria and indicators table is based on the following sources:

- Davey Institute / USDA Forest Service: The Sustainable Urban Forest a Step-by-Step Approach (2016). Available online at www.itreetools.org/resources/content/Sustainable_Urban_Forest_Guide_14Nov2016.pdf
- Barron, S., Sheppard, S.R.J. and P.M. Condon: Urban Forest Indicators for Planning and Designing Future Forests (2016). Available online at: www.mdpi.com/1999-4907/7/9/208/htm
- Kenney, W.A., van Wassenauer, P.J.E. and A.L. Satel: Criteria and Indicators for Strategic Urban Forest Planning and Management (2011). Available online at: https://joa.isa-arbor.com/article_detail.asp?JournalID=1&VolumeID=37&IssueID=3&ArticleID=3192
- Clark, J.R., Matheny, N.P., Cross, G. and V. Wake: A model of Urban Forest Sustainability (1997). Available online at: fufc.org/soap/clark_sustainability_model.pdf

The Sustainable Forestry Initiative has released a draft of its upcoming certification standard for urban forests. Once adopted, this standard is expected to become widely adopted in North America and may be useful for future comparison or progress reporting:

- Sustainable Forestry Initiative: SFI Urban and Community Forest Sustainability Standard (2021). Available online at: <https://www.forests.org/wp-content/uploads/SFI-Urban-and-Community-Forest-Sustainability-Standard-%E2%80%93-November-1-2021.pdf>

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Clear and defensible urban forest canopy assessment and goals	Urban forest policy and practice is driven by comprehensive goals municipality-wide and at the neighbourhood or land use scale informed by accurate, high-resolution assessments of existing and potential canopy cover.	No assessment or goals.	Low-resolution and/or point-based sampling of canopy cover using aerial photographs or satellite imagery - and limited or no goal setting.	Complete, detailed, and spatially explicit, high-resolution Urban Tree Canopy (UTC) assessment based on enhanced data (such as LIDAR) - and limited or no goal setting.	The City has a complete, detailed, and spatially explicit high-resolution Urban Tree Canopy (UTC) assessment accompanied by a comprehensive set of goals, all utilized effectively to drive urban forest policy and practice municipality-wide and at neighbourhood or smaller management level.
Interdepartmental and municipal agency cooperation on urban forest strategy implementation	Ensure all relevant municipal departments and agencies cooperate to advance goals related to urban forest issues and opportunities.	Little cooperation and conflicting among departments and/or agencies often leading to poor outcomes for trees.	Common goals but limited cooperation among departments and/or agencies and mixed outcomes for trees.	Municipal departments, affected agencies and urban forest managers recognize potential conflicts and reach out to each other on an informal but regular basis.	Formal interdepartmental working agreements or protocols for all projects that could impact municipal trees.
Municipality-wide urban forest management plan	Develop and implement a comprehensive urban forest management plan for public and private property.	No plan.	Existing plan limited in scope and implementation.	Recent comprehensive plan developed and implemented for publicly owned forest resources, including trees managed intensively (or individually) and those managed extensively, as a population (e.g., trees in natural areas).	Strategic, multi-tiered plan with built-in adaptive management mechanisms developed and implemented for public and private resources.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Awareness of the urban forest as a community resource	The urban forest is recognized as vital to the community's environmental, social, and economic well-being.	General ambivalence or negative attitudes about trees, which are perceived as neutral at best or as the source of problems. Actions harmful to trees may be taken deliberately.	Trees are widely acknowledged as providing environmental, social, and economic services but are not widely integrated in corporate strategies and policies.	Trees are widely acknowledged as providing environmental, social, and economic services and urban forest objectives are integrated into other corporate strategies and policies.	Urban forest recognized as vital to the community's environmental, social, and economic well-being. Widespread public and political support and advocacy for trees, resulting in strong policies and plans that advance the viability and sustainability of the entire urban forest.
Relative tree canopy cover	Achieve desired degree of tree cover, based on potential or according to goals set for entire municipality and for each neighbourhood or land use.	The existing canopy cover for entire municipality is <50 percent of the desired canopy.	The existing canopy is 50 percent-75 percent of desired.	The existing canopy is > 75 percent-100 percent of desired.	The existing canopy is >75 percent-100 percent of desired - at the individual neighbourhood level as well as overall municipality.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
		Partner			
Citizen involvement and neighbourhood action	Citizens and groups participate and collaborate at the neighbourhood level with the municipality and/or its partnering NGOs in urban forest management activities to advance municipality-wide plans.	Little or no citizen involvement or neighborhood action.	Community groups are active and willing to partner in urban forest management, but involvement and opportunities are ad hoc.	Several active neighborhood groups engaged across the community, with actions coordinated or led by municipality and/or its partnering NGOs.	Proactive outreach and coordination efforts by the City and NGO partners result in widespread citizen involvement and collaboration among active neighbourhood groups engaged in urban forest management.
Involvement of large private land and institutional land holders (e.g., schools)	Large private landholders to embrace and advance city-wide urban forest goals and objectives by implementing specific resource management plans.	Large private landholders are generally uninformed about urban forest issues and opportunities.	Landholders manage their tree resource but are not engaged in meeting municipality-wide urban forest goals.	Landholders develop comprehensive tree management plans (including funding strategies) that advance municipality-wide urban forest goals.	As described in "Good" rating, plus active community engagement and access to the property's forest resource.
Urban forest research	Research is active and ongoing towards improving our understanding of the urban forest resource, the benefits it produces, and the impacts of planning, policy, design and management initiatives.	No urban forest research.	Isolated academic research occurs in the municipality's urban forest.	The municipality supports and has input on academic research occurring in its urban forest and knowledge transfer occurs.	The urban forest is a living laboratory - in collaboration with public, private, NGO and academic institutions - integrating research and innovation into managing urban forest health, distribution, and abundance.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Municipal infrastructure asset management	Integrate green infrastructure assets into the municipal asset management system to support valuing and accounting for natural assets in the City's financial planning to build climate resilient infrastructure.	No recognition of value of natural or human-made elements that provide ecological and hydrological functions (green infrastructure).	Local government recognizes the value of green infrastructure but does not yet have information to include them in an asset management system.	Green infrastructure assets have been partially or fully inventoried and some assets are included in an asset management system, with the intent to ultimately capture all assets in the consolidated financial statements of the municipality.	Green infrastructure assets are inventoried and included in an asset management system and on the consolidated financial statement of the municipality.
Municipal-wide biodiversity or woodland management strategy	Acquire and restore publicly-owned natural areas in pursuit of meeting municipal-wide biodiversity and woodland management goals.	No or very limited planning and stewardship of natural areas.	Area specific management plans focused on management, restoration, and protection of natural areas.	Municipal-wide urban forest, parks or natural areas strategy guiding management, restoration, and protection of the existing natural areas network.	Biodiversity strategy or equivalent in effect to manage, restore and existing and acquire future natural areas network throughout the municipality.
Municipal urban forestry program capacity	Maintain sufficient well-trained personnel and equipment - whether in-house or through contracted or volunteer services - to implement municipality-wide urban forest management plan.	Team severely limited by lack of personnel and/or access to adequate equipment. Unable to perform adequate maintenance, let alone implement new goals.	Team limited by lack of staff and/or access to adequate equipment to implement new goals.	Team able to implement many of the goals and objectives of the urban forest management plan.	Team able to implement all of the goals and objectives of the urban forest management plan.
Urban forest funding to implement a strategy	Maintain adequate funding to implement the urban forest strategy.	Little or no dedicated funding.	Dedicated funding but insufficient to implement the urban forest strategy or maintain new assets as they are added to the inventory.	Dedicated funding sufficient to partially implement the urban forest strategy and maintain new assets as they are added to the inventory.	Sustained funding to fully implement the urban forest strategy and maintain new assets as they are added to the inventory.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Internal protocols guide City tree or sensitive ecosystem protection	Ensure all relevant municipal departments follow consistent tree or ecosystem protection protocols for capital design and construction activities.	No protocols guiding City tree or ecosystem protection for capital design and construction activities.	Informal and inconsistent processes followed for City tree or ecosystem protection for capital design and construction activities.	Established protocols for City tree or ecosystem protection for capital design and construction activities but outcomes are inconsistent or sometimes unachievable.	Established protocols for City tree or ecosystem protection for capital design and construction activities are consistently followed and outcomes are successful.
Standards of tree protection and tree care observed during development or by local arborists and tree care companies	Consulting arborists and tree care companies understand city-wide urban forest goals and objectives and adhere to high professional standards.	Limited understanding or support for tree protection requirements.	General understanding or support for tree protection requirements but large variation in the quality of information and services provided.	General understanding or support for tree protection requirements and generally consistent quality of information and services provided.	Advocacy for tree protection requirements, engagement with City staff on improving processes and standards, and generally consistent quality of information and services provided to high professional standards.
Cooperation with utilities on protection (and pruning) of City trees	All 3rd party utilities employ best management practices and cooperate with the City to advance goals and objectives related to urban forest issues and opportunities.	Utilities take actions impacting urban forest with no municipal coordination or consideration of the urban forest resource.	Utilities inconsistently employ best management practices, rarely recognizing potential municipal conflicts or reaching out to urban forest managers and vice versa.	Utilities employ best management practices, recognize potential municipal conflicts, and reach out to urban forest managers on an ad hoc basis – and vice versa.	Utilities employ best management practices, recognize potential municipal conflicts, and consistently reach out to urban forest managers and vice versa.
Grow					

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Regional collaboration	There is cooperation and interaction on urban forest plans among neighbouring municipalities within the region, and/ or within regional agencies.	Municipalities have no interaction with each other or the broader region for planning or coordination on urban forestry.	Some neighboring municipalities and regional agencies share similar policies and plans related to trees and urban forest.	Some urban forest planning and cooperation across municipalities and regional agencies.	Widespread regional cooperation resulting in development and implementation of regional urban forest strategy.
Protect					
Policy or regulations regulating the protection and replacement of private and City trees	Secure the benefits derived from trees on public and private land by enforcement of municipality-wide policies and practices including tree protection.	No or very limited tree protection policy.	Policies in place to protect public trees and employ industry best management practice.	Policies in place to protect public and private trees with enforcement but lack integration with other municipal policy to enable effective tree retention.	Urban forest strategy and integrated municipal-wide policies that guide the protection of trees on public and private land; and ensure they are consistently applied and enforced.
Policy or regulations for conservation of sensitive ecosystems, soils, or permeability on private property through development	Secure the benefits derived from environmentally sensitive areas by enforcement of municipality-wide policies in pursuit of meeting biodiversity and connectivity goals.	No or very limited protection of natural features.	Policies in place to protect natural features and areas, whether privately or publicly owned, but no or otherwise very limited enforcement success.	Policies in place to protect natural features and areas, whether privately or publicly owned, and which have effective enforcement processes, but which lack integration with other municipal policies to enable effective tree retention.	Biodiversity strategy or equivalent integrated with the broad municipal policy direction(s) to guide natural features and areas protection and to ensure regulations are consistently applied.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Streetscape and servicing specifications and standards for planting trees	Ensure all publicly owned trees are planted into conditions that meet requirements for survival and maximize current and future tree benefits.	No or very few specifications and standards for growing sites.	Specifications and standards for growing sites exist but are inadequate to meet urban forest goals.	Specifications and standards exist and are adequate to meet urban forest goals but are not always achieved.	All trees planted are in sites with adequate soil quality and quantity, and with sufficient growing space to achieve their genetic potential and life expectancy, and thus provide maximum ecosystem services.
Equity in planting program delivery	Ensure that the benefits of urban forests are made available to all, especially to those in greatest need of tree benefits.	Tree planting and outreach are not determined equitably by canopy cover or need for benefits.	Planting and outreach includes attention to low canopy neighborhoods or areas.	Planting and outreach targets neighborhoods with low canopy and a high need for tree benefits.	Equitable planting and outreach at the neighbourhood level are guided by strong citizen engagement in identified low-canopy/high-need areas.
Forest restoration and native species planting	Encourage the appreciation of climate suitable native vegetation by the community and ensure native species are widely planted to enhance native biodiversity and connectivity.	Voluntary use of climate suitable native species on publicly and privately-owned lands.	The use of climate suitable native species is encouraged on a site-appropriate basis in public and private land development projects.	Policies require the use of climate suitable native species and management of invasive species on a site-appropriate basis in public and private land development projects but are not integrated across all policy or guided by a connectivity analysis.	Policies require the use of climate suitable native species and management of invasive species on a site-appropriate basis in public and private land development projects and through tree By-law.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
City tree planting and replacement program design, planning and implementation	Comprehensive and effective tree selection, planting and establishment program that is driven by canopy cover goals and other considerations according to the UFMP.	Tree replacement and establishment is ad hoc.	Some tree planting and replacement occurs, but with limited overall municipality-wide planning and insufficient to meet replacement requirements.	Tree replacement and establishment is directed by needs derived from an opportunities assessment and species selection is guided by site conditions, tree health and climate adaptation considerations.	Tree planting and replacement is guided by strategic priorities and is planned out to make progress towards targets set for canopy cover, diversity, tree health and climate adaptation within the timeframe of the strategy.
Development requirements to plant trees on private land	Ensure that new trees are required in landscaping for new development or, where space is lacking, there is an equivalent contribution to tree planting in the public realm.	Landscaping requirements do not address trees on private land.	Developments are generally required to provide replacement but the outcomes are often in conflict with public trees and other infrastructure due to space limitations and not connected to meeting canopy cover targets.	Developments are required to provide replacement trees or, where space is not adequate according to soil volume available, provide cash-in-lieu for equivalent tree planting on public land. The requirement is not connected to meeting canopy cover targets.	Developments are required to provide a minimum density of trees per unit measure or, where space is not adequate according to soil volume available, provide adequate cash-in-lieu for equivalent tree planting on public land. Planting density is determined based on meeting a municipal-wide canopy cover target.

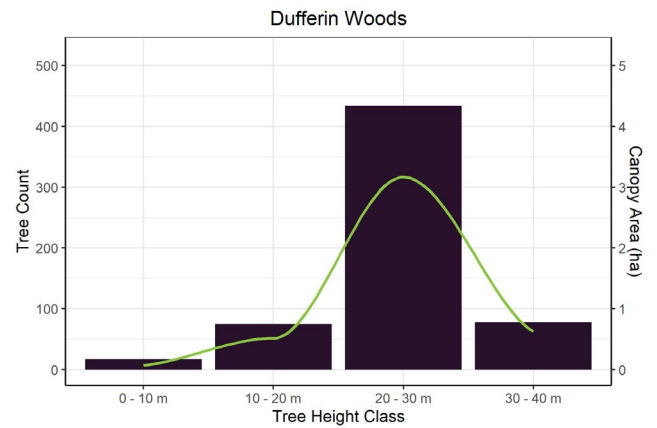
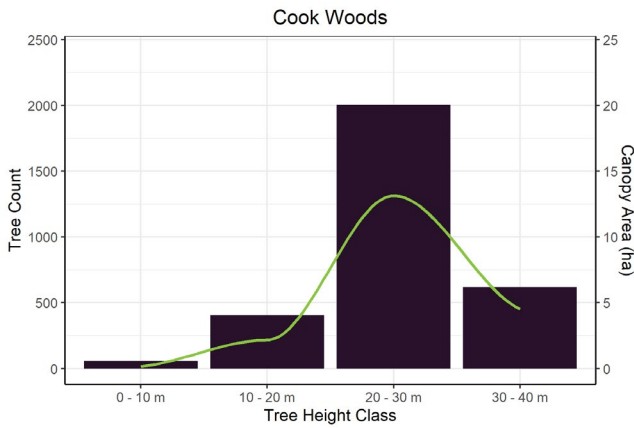
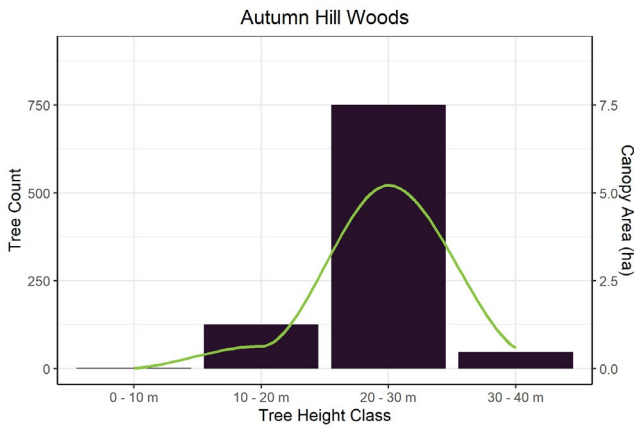
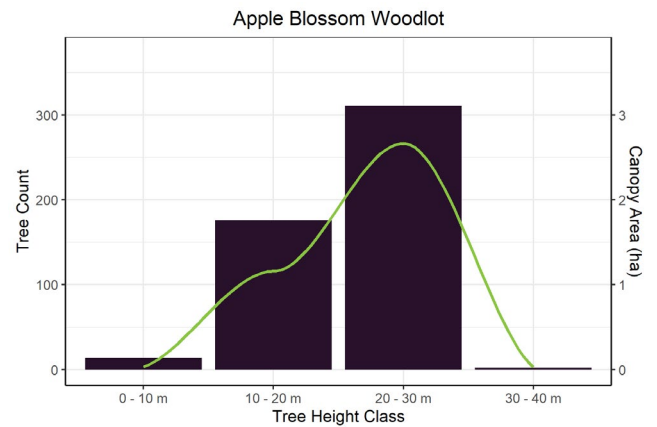
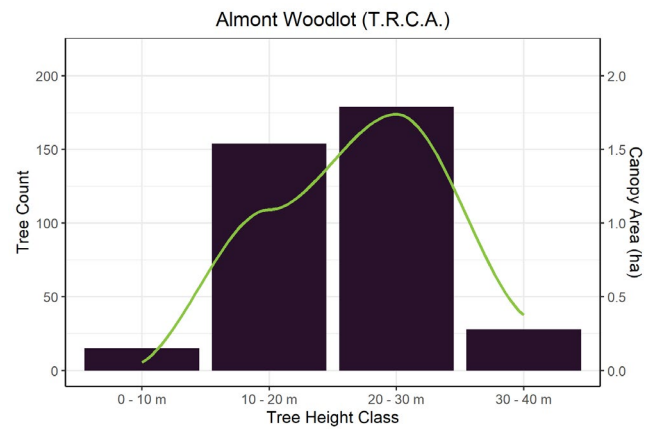
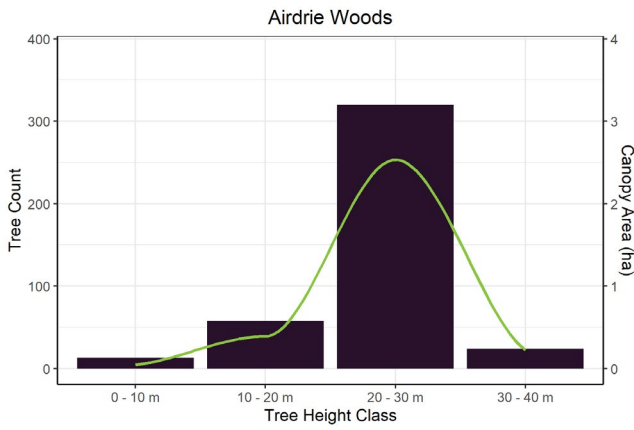
Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Natural areas inventory	A current and comprehensive inventory of sensitive and modified natural ecosystems and their quality mapped to Provincial standards to provide standardized ecological information to support decision-making.	No municipal inventory of natural areas.	Natural areas inventoried in GIS but not recently updated and attribute information not to a standard that can support decision-making.	Natural areas inventoried in GIS and with standard and complete attribute information to support decision-making but not updated in the last 5 years.	Natural areas inventoried in GIS and with standard and complete attribute information to support decision-making and updated in the last 5 years.
Maintenance of intensively managed trees	Maintain all publicly owned intensively managed trees for optimal health and condition in order to extend longevity and maximize current and future benefits.	Intensively managed trees are maintained on a request/reactive basis.	Intensively managed trees are maintained on a request/reactive basis. Limited systematic (block) pruning and/or immature trees are structurally pruned.	All intensively managed trees are systematically maintained on a cycle determined by workload and resource limitations. All immature trees are structurally pruned.	All mature intensively managed trees are maintained on an optimal pruning cycle. All immature trees are structurally pruned.
Publicly owned tree species condition assessment	Current and detailed understanding of condition and risk potential of all publicly owned trees that are managed intensively (or individually).	Condition of urban forest is unknown.	Sample-based tree inventory indicating tree condition and risk level.	Complete tree inventory that includes detailed tree condition ratings.	Complete tree inventory that is GIS-based and includes detailed tree condition as well as risk ratings.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Selection and procurement of stock in cooperation with nursery industry	Diversity targets and climate adaptation/mitigation objectives guide tree species selection and nurseries proactively grow stock based on municipal requirements.	Species selection is not guided by diversity targets or climate adaptation/mitigation objectives.	Species selection is guided by diversity and climate adaptation/mitigation but required stock is rarely available from nurseries and acceptable substitutes reduce diversity.	Species selection is guided by targets for diversity and climate adaptation/mitigation and required stock or acceptable substitutes are usually available from nurseries.	Species selection is guided by targets for diversity and climate adaptation/mitigation and required stock is secured ahead of the planned planting year from contract or in-house nurseries.
Ecosystem services targeted in tree planting projects and landscaping	Incorporate ecosystem services objectives into public and private tree planting projects to improve urban tree health and resilience, carbon sequestration, stormwater management and cooling.	Ecosystem services not considered in planting projects or intentionally designed into vegetated landscapes.	Ecosystem services, such as stormwater interception, occasionally incorporated into City or private land planting projects and landscape designs.	Guidelines in place for planting projects and landscape designs on public and private land to deliver specific ecosystem services.	Ecosystem services targets are defined for the urban forest and policy requires planting project and landscape designs on public and private land to contribute to meeting targets.
Manage					
Tree inventory	A current and comprehensive inventory of intensively managed trees to guide management, including data such as age distribution, species mix, tree condition and risk assessment.	No inventory or spatially indiscreet inventory.	Partial inventory of publicly-owned trees in GIS.	Complete inventory of street trees and intensively managed park trees in GIS but inconsistently updated.	The municipal tree inventory is complete, is GIS-based, supported by mapping, and is continuously updated to record growth, work history and tree condition.

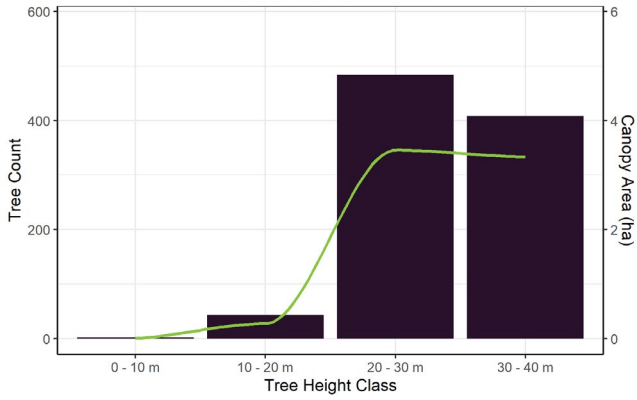
Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Age diversity (size class distribution)	Provide for ideal age distribution for all “intensively” managed trees – municipality-wide as well as at neighbourhood level.	Even-age distribution, or highly skewed toward a single age class (maturity stage) across entire population, or tree age distribution is unclear due to inventory gaps.	Some uneven distribution, but most of the tree population falls into a single age class.	Total tree population across municipality approaches an ideal age distribution of 40 percent immature, 30 percent semi-mature, 20 percent mature, and 10 percent old.	Total population approaches that ideal distribution municipality-wide as well as at the neighborhood level.
Species suitability	Establish a planted tree population suited to the urban environment and adapted to the overall region.	Fewer than 50 percent of planted trees are from species considered suitable for the area, or species suitability is unclear due to inventory gaps.	>50 percent-75 percent of planted trees are from species suitable for the area.	More than 75 percent of planted trees are suitable for the area.	Virtually all planted trees are suitable for the area.
Waste biomass utilization	A closed system diverts all urban wood and green waste through reuse and recycling.	Wood waste from the urban forest is not utilized.	Wood waste from the urban forest is utilized as mulch or biofuel.	Wood waste from the urban forest is utilized as mulch or biofuel and sometimes high value pieces are milled and stored for later use or sold on to local value-added industries.	Low value wood waste from the urban forest is utilized as mulch or biofuel and all high value pieces are milled and stored for later use or sold on to local value-added industries.
Knowledge of trees on private property	Understand the extent, location, and general condition of privately-owned trees.	No information about privately owned trees.	Aerial, point-based or low-resolution assessment of tree canopy on private property, capturing broad extent.	Detailed Urban Tree Canopy analysis of the urban forest on private land, including extent and location, integrated into a municipality-wide GIS system.	The City has an i-Tree Eco analysis of private trees as well as detailed Urban Tree Canopy analysis of the entire urban forest integrated into a municipality-wide GIS system.

Assessment Criteria	Objective	Indicators for Urban Forestry Performance			
		Poor	Fair	Good	Optimal
Tree risk management	Comprehensive tree risk management program fully implemented, according to ANSI A300 (Part 9) "Tree Risk Assessment" standards, and supporting industry best management practices.	No coordinated tree risk assessment or risk management program. Response is on a reactive basis only.	Some areas within the city are prioritized for risk assessment and management. Little annual budget is available to develop a more proactive inspection program.	Priority areas of the City are inspected on a regular schedule and operational standards and budgets are in place for responding to and managing tree risks within an appropriate timeframe.	A comprehensive risk management program is in place, with all public lands inspected on defined schedules and operational standards and budgets in place for responding to and managing tree risks within an appropriate timeframe.
Emergency response planning	A response plan guides call-out procedures, resources available and the clean-up response for extreme weather and earthquake.	Response plan not documented or not current.	Response plan is documented and includes call-out procedures, roles and responsibilities but lacks details to prioritize hazards and clean-up.	Response plan includes call-out procedure, roles and responsibilities, and criteria for prioritizing tree hazards and removing debris is in place.	A comprehensive response plan is in place and a response drill occurs annually.
Pest and Disease Management	An Integrated Pest Management (IPM) plan guides treatment responses to existing and potential pest, disease and invasive species threats to the urban forest.	No integrated pest management plan and no pest management.	No or otherwise outdated integrated pest management plan and reactive pest management.	An integrated pest management plan is in place and implemented.	A comprehensive pest management program is in place, with detection, communication, rapid response and IPM practiced.
Species diversity	Establish a genetically diverse population across the municipality as well as at the neighbourhood scale.	Five or fewer species dominate the entire tree population across municipality, or species proportions are unclear due to inventory gaps.	No single species represents more than 10 percent of the total tree population; no genus more than 20 percent, and no family more than 30 percent.	No single species represents more than 5 percent of total tree population; no genus more than 10 percent; and no family more than 15 percent.	At least as diverse as "Good" rating (5/10/15) municipality-wide - and at least as diverse as "fair" (10/20/30) at the neighborhood level.

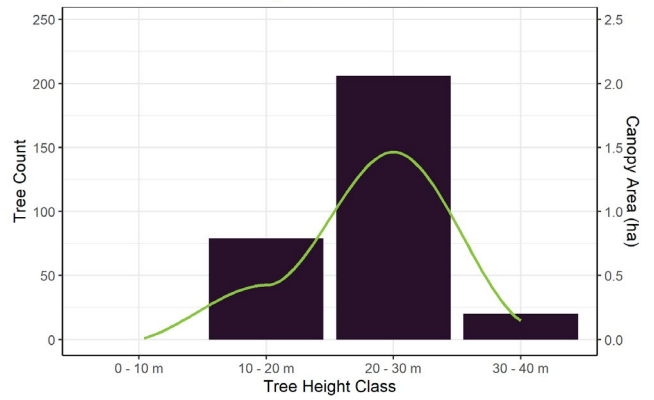
Appendix B: Woodlot Height-Area Frequency Plots



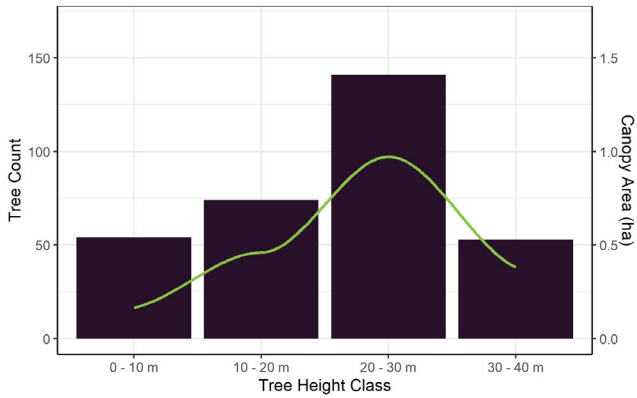
Frank Robson Woodlot



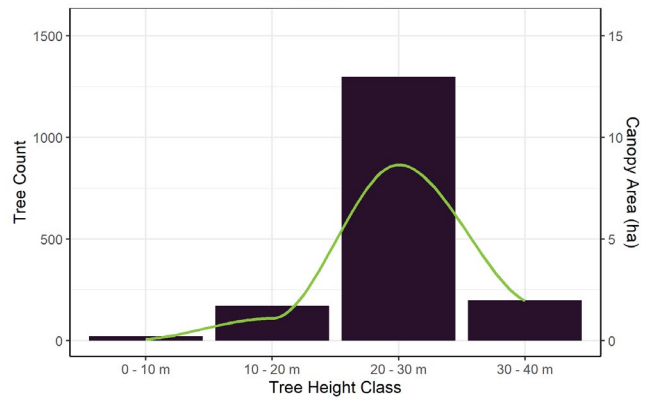
Graywoods Woodlot



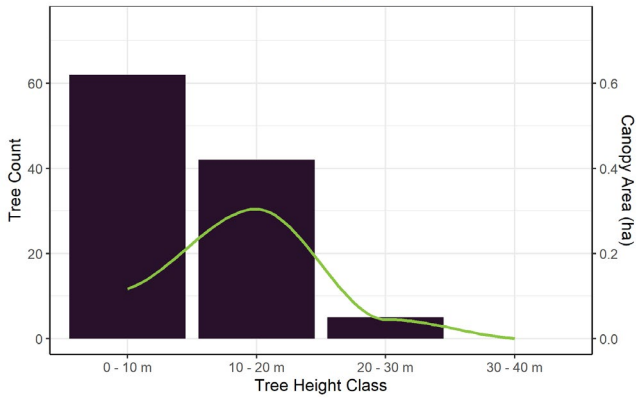
Heintzman Woods



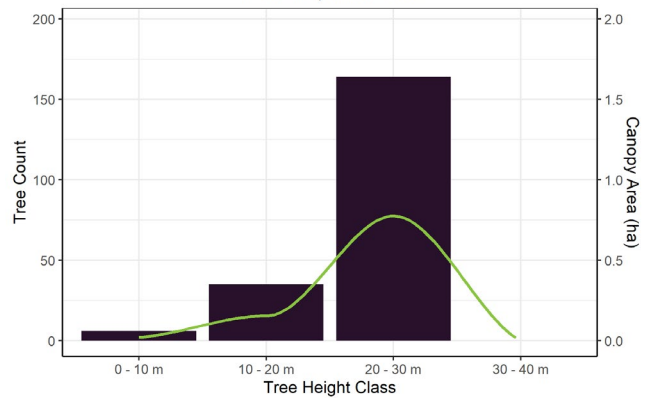
McCarter Woods



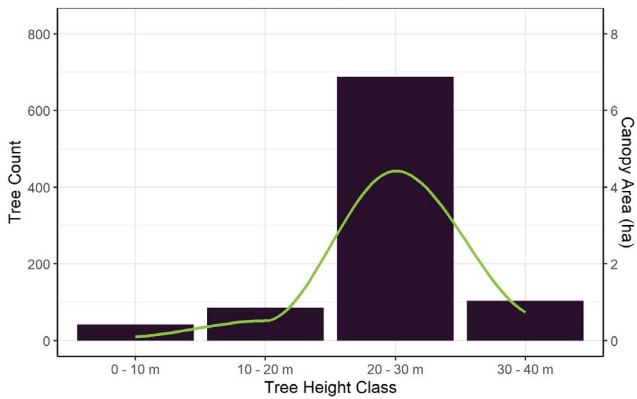
Millwood Woods



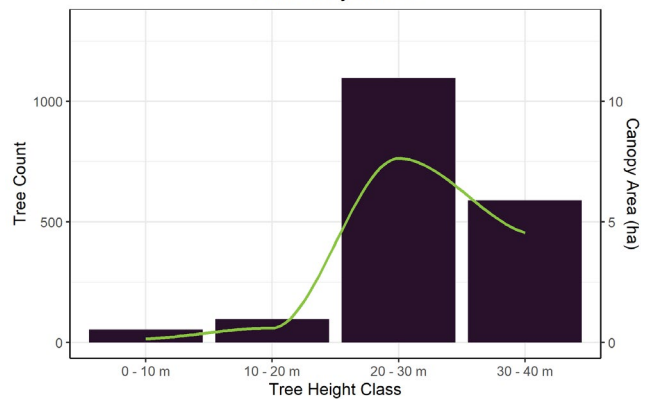
Peter Rupert Woods

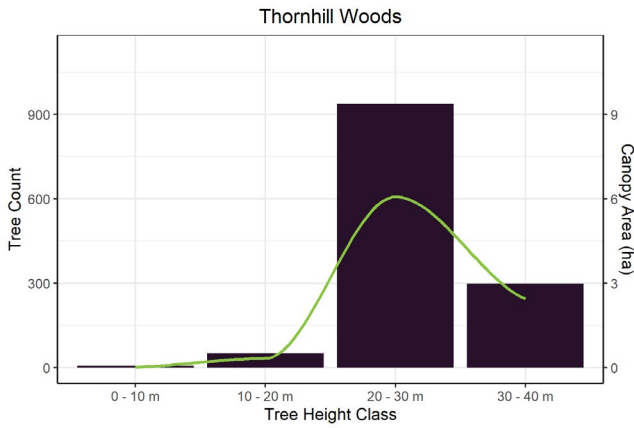
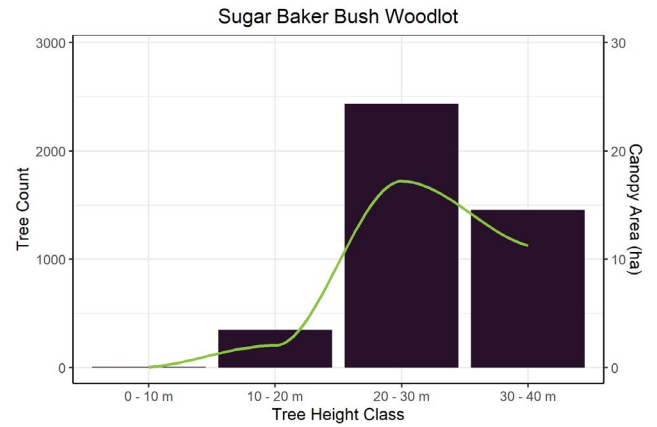
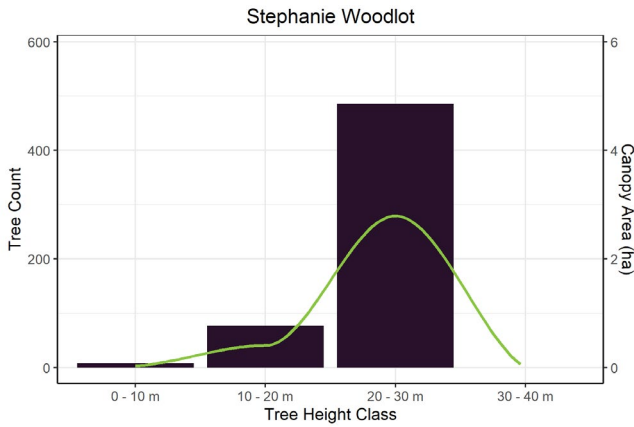
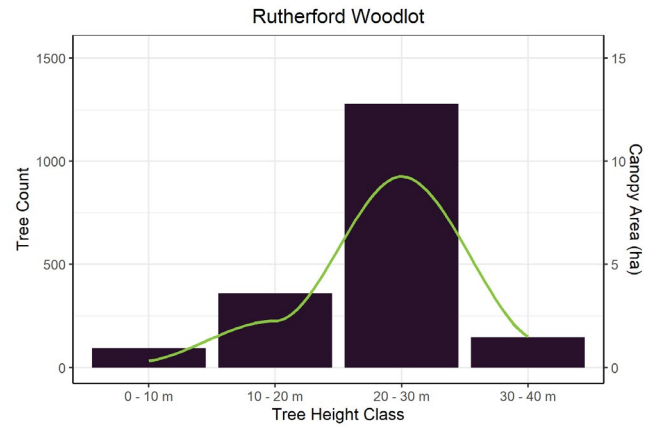
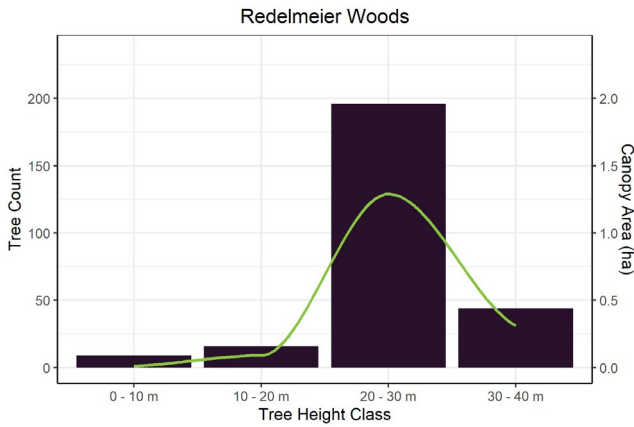
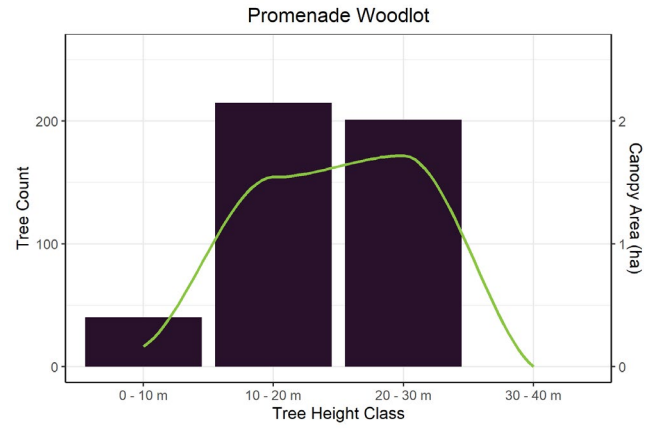
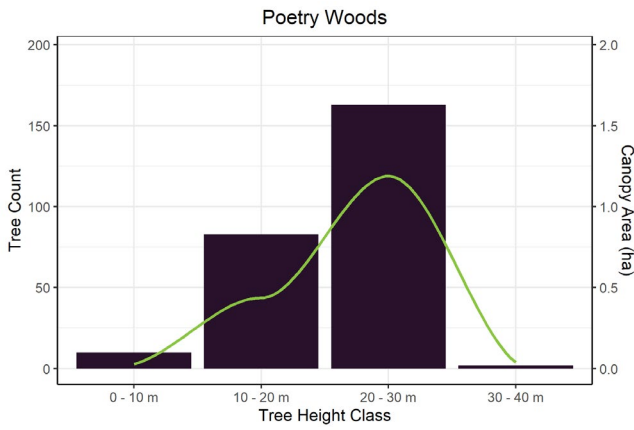


Pierre Berton Woodlot

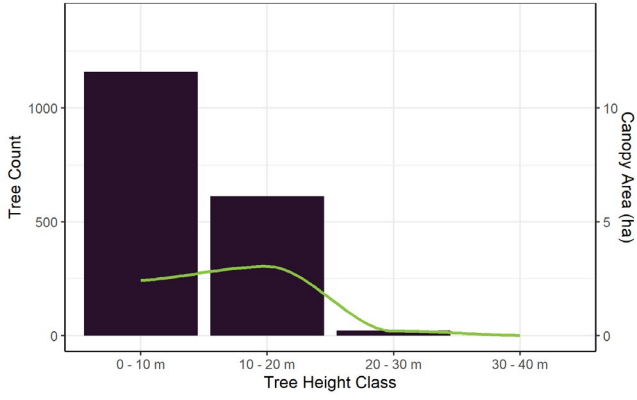


Pine Valley Woods

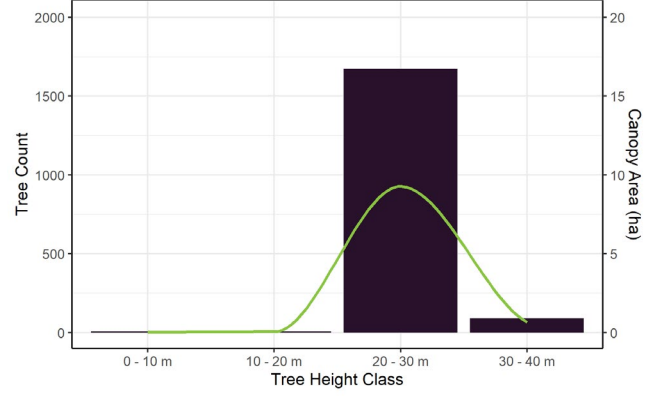




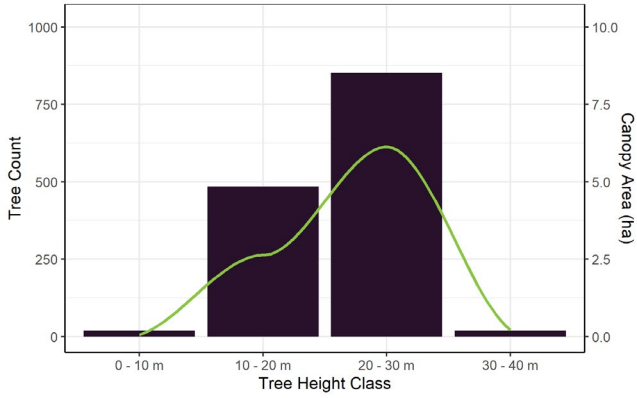
William T. Foster Woods



Woodend Place Woods



Yellowood Woodlot



Appendix C: Version History

Version 1.0: June 2023

- *original publication.*

Version 1.2: September 2023

Changes:

- *pg.4 Correction - dollar value (\$) for C Sequestered annually in trees (t).*
- *pg.4 Correction - dollar value (\$) for C stored in trees (t).*
- *pg.4 Correction - software reference.*

City of Vaughan
Parks, Forestry and Horticulture Operations

Joint Operations Centre
2800 Rutherford Rd.
Vaughan, ON, Canada L4K 2N9

905-832-2281
service@vaughan.ca
vaughan.ca

