PARKSANDFORESTRY

~ Draft ~

Urban Forest Management Plan (UFMP)

August 2013

Natural Heritage & Urban Forest Strategy

MISSISSAUGA
Leading today for tomorrow

ACKNOWLEDGEMENTS

This *Draft* Urban Forest Management Plan has been developed with input from:

- the project Steering Committee, composed of directors and managers representing the City departments of Community Services, Planning and Building, and Transportation and Works
- the project Core Working Team, composed of a cross-section of City staff and representatives from the Region of Peel, Credit Valley Conservation Authority, Toronto and Region Conservation Authority, and Conservation Halton
- the City's Parks and Forestry Division, Policy Planning Division and other staff
- Peel Region's Urban Forest Working Group
- stakeholders representing a range of local groups and organizations, and
- representatives of the community at large.

Summaries of the input received from stakeholders and the community to date will be provided in the Appendices to the Natural Heritage & Urban Forest Strategy (NH&UFS) which is the overarching strategic document that encompasses the actions identified in this Plan.

We would like to extend our sincere thanks to all those who have taken the time to provide comments on preliminary ideas and products, and look forward to further input on this *Draft*.

URBAN FOREST MANAGEMENT PLAN CONSULTING TEAM

Philip van Wassenaer, Urban Forest Innovations Inc.
Margot Ursic, Beacon Environmental Ltd.
Alex Satel, Urban Forest Innovations Inc.

In association with:
Paul Lowes, Sorensen, Gravely and Lowes
Mirek Sharp, North-South Environmental

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EXECUTIVE SUMMARY

Mississauga's urban forest is fundamental to the City's environmental, social and economic well-being. The City's estimated 2.1 million trees provide millions of dollars' worth of environmental services such as pollution filtration and carbon storage annually, as well as many other, less tangible benefits.

The high level of overlap and interconnectedness between natural heritage and the urban forest have been recognized through the inclusion of both within a joint strategy: the Natural Heritage & Urban Forest Strategy (NH&UFS), which is being developed in tandem with this Urban Forest Management Plan (UFMP). The two stand-alone reports can generally be distinguished as follows:

- Natural Heritage & Urban Forest Strategy (NH&UFS): the overarching document for both natural heritage and the urban forest in Mississauga providing strategies related to planning, management, engagement and tracking, with an overall emphasis on strategic planning direction and implementation
- Urban Forest Management Plan (UFMP): a plan that focuses on the operational, technical and tactical aspects required to implement the broader strategies, particularly as they relate to the urban forest

While the NH&UFS and UFMP are two stand-alone documents, the NH&UFS should be read in conjunction with the UFMP to provide the broader context for implementation.

As a result of their interconnections and shared values, **a vision, guiding principles, and objectives were developed for the NH&UFS project that is shared with the UFMP**, as follows:

Vision

The City, private and public stakeholders, and members of the community are working together to protect, enhance, restore, expand and connect Mississauga's Natural Heritage System and urban forest so that native biodiversity and the ecological services essential for a healthy community are sustained for present and future generations.

Guiding Principles

1. First conserve, then enhance, restore and expand.
2. Maximize native biodiversity.
3. Recognize and build on past and current successes.
4. Learn from our past and from others.
5. View the Natural Heritage System (NHS) and urban forest holistically within the City's broader Green System.
6. Understand the value of the City's Green System, and the essential ecological services it provides.
7. Make stewardship on public and private lands part of daily living.
8. Integrate climate change considerations in natural heritage and urban forest planning.
9. Actively pursue opportunities to protect, enhance, restore, expand, connect and support the NHS and urban forest.
10. Track the state of the NHS and urban forest performance.
11. Practice adaptive management of the NHS and urban forest.
12. Recognize the full value of natural areas and the urban forest as part of City planning and budget prioritization.

Objectives

General Objectives

1. Increase internal (within the City) and external (among the community and other stakeholders) awareness of the value and need to protect, enhance, expand and restore the Natural Heritage System (NHS) and the urban forest.
2. Expand the NHS by pursuing opportunities through the development process, in-filling and re-development of public and private lands.
3. Build on existing, and develop new, public and private sector partnerships to help pursue and implement the vision and targets for the NHS and urban forest.
4. Undertake regular monitoring of the NHS and urban forest to evaluate performance and identify trends or changes that may require a shift in management approaches or practices.

Objectives for Public Lands

5. Protect the NHS and urban forest on public lands through proactive management, enforcement of applicable regulations, and education.
6. Enhance and restore the NHS and urban forest on public lands by establishing service levels to improve: the condition of natural areas,

linkages among protected natural areas, and tree establishment practices.

7. Support the NHS and the urban forest by managing public open spaces to maximize their ecological functions (while maintaining their primary uses).

Objectives for Private Lands

8. Protect the NHS and urban forest on private lands through education, implementation of applicable policies and regulations, the development review process, and enforcement.
9. Enhance and restore the NHS and urban forest on private lands by promoting stewardship, naturalization, restoration, tree planting and proactive tree care with creative outreach and incentives.

Recommended Actions

The following recommended actions have been developed with consideration of existing conditions and available resources, relevant best practices and precedents from the scientific and technical literature and other jurisdictions, recommendations from the studies completed by the Peel Urban Forest Working Group, and input from consultations with City staff and a range of stakeholders and representatives of the community.

The following 24 Actions have also been developed to provide more detailed technical, operational and/or tactical guidance regarding the implementation of a number of the Strategies identified within the broader Natural Heritage & Urban Forest Strategy (NH&UFS). The Strategies from the NH&UFS that relate to the UFMP Actions described in this Plan are identified below and in the content of the Plan. Although each Action can be understood as part of this Plan, they are best understood within the broader context of the NH&UFS as well.

While the ultimate goal of strategic urban forest management planning is to achieve urban forest sustainability, it is important to propose realistic actions and achievable targets that are in-line with the City's resource base. The recommended actions presented here support the longer-term goal of urban forest sustainability and will lead to marked improvements in the health, longevity and function of the City's urban forest. These actions have also been developed within the City's means and draw on external support, resources and funding where available.

It has been recognized throughout the development of this Plan, and the broader NH&UFS, that although there are a number actions the City can take to help achieve urban forest and natural heritage objectives in Mississauga, because so much of the City's natural heritage and urban forest assets reside on private lands it is ultimately the community (including homeowners, tenants, businesses, schools, institutions, etc.) who will determine the extent to which this Plan, and the companion NH&UFS, are successful. Although found in the last section of this Plan, actions intended to support education, communication, promotion and partnerships are considered among the most important.

URBAN FOREST PROGRAM ADMINISTRATION

- Action #1: Adopt the three-tiered UFMP framework to implement action items and monitor their status (Strategy #29)
- Action #2: Monitor the status of the urban forest (Strategy #29)
- Action #3: Formalize involvement of City Forestry staff in the City planning and information sharing related to trees (Strategy #1)
- Action #4: Develop consistent and improved City-wide tree preservation and planting specifications and guidelines (Strategy #15)
- Action #5: Improve the inventory of City street and park trees (Strategies #15, #16)

TREE HEALTH AND RISK MANAGEMENT

- Action #6: Improve street and park tree maintenance operations (Strategy #16)
- Action #7: Implement a young tree maintenance program (Strategy #16)
- Action #8: Develop and implement a tree risk management protocol (Strategy #16)
- Action #9: Implement an urban forest pest management plan (Strategy #16)

TREE ESTABLISHMENT AND URBAN FOREST EXPANSION

- Action #10: Work with City staff and external partners to implement urban forest expansion (Strategy #14)
- Action #11: Implement improved tree establishment practices (Strategy #15)

TREE PROTECTION AND URBAN FOREST PRESERVATION

- Action #12: Update Public Tree Protection by-law to better support urban forestry objectives (Strategy #8)
- Action #13: Update Erosion Control by-law and the Nuisance Weeds by-law to support urban forestry and natural heritage objectives (Strategy #8)
- Action #14: Update the Private Tree Protection By-law to better support urban forestry objectives (Strategy #8)
- Action #15: Increase effectiveness of tree preservation as part of private projects (Strategy #19)
- Action #16: Increase effectiveness of tree preservation as part of municipal operations and capital projects (Strategy #19)
- Action #17: Develop and implement City-owned woodland management through Natural Area Conservation Plans (Strategy #13)

PROMOTION, EDUCATION, STEWARDSHIP & PARTNERSHIPS

- Action #18: Develop a short video series and make the City's tree inventory public to support outreach, education and stewardship (Strategy #20, #23)
- Action #19: Improve and maintain awareness among City departments about current natural heritage and urban forest policies, by-laws and technical guidelines (Strategy #1, #21)
- Action #20: Design and implement a City Arboretum / Memorial Forest
- Action #21: Support various partners and organizations in their efforts to undertake targeted engagement of local businesses and schools (Strategy #22)
- Action #22 Continue to work with various partners to undertake stewardship on public and private lands (Strategy #24)
- Action #23: Partner with local agencies and institutions to pursue shared research and monitoring objectives (Strategy #25)
- Action #24: Build on existing partnerships with the Region of Peel and nearby municipalities to facilitate information sharing and coordinate responses to environmental issues (Strategy #25)

These Actions are to be presented within an implementation matrix that places a priority on the action and identifies the lead for the actions item, the anticipated costs / resource requirements and potential partners in implementation as part of the final Plan.

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1 INTRODUCTION

Mississauga's urban forest is fundamental to the City's environmental, social and economic health. The City's estimated 2.1 million trees provide valuable environmental services such as pollution filtration, flood control, and carbon storage, as well as many other benefits to mental and physical health, as well as economic spin-offs. Mississauga has begun to recognize the vital importance of a healthy urban forest through its planning and its programs. The City's *Official Plan* (2011), states that:

> *"Sustainably managing land means directing growth to protect and enhance the natural environment … It means that development is integrated into the community, while negative impacts to the Green System, Urban Forest, ecological processes and biological diversity are avoided."*

This vision can, in part, be achieved through the implementation of an innovative, effective and proactive Urban Forest Management Plan (UFMP). Efforts to protect and maximize the health and longevity of existing trees and to expand the urban forest will, over time, result in the provision of greater and more widespread urban forest benefits. These benefits will become increasingly important and valuable as Mississauga's population continues to grow.

This Urban Forest Management Plan (UFMP) for Mississauga is one of the key plans developed as part of the City's Natural Heritage & Urban Forest Strategy (NH&UFS). The UFMP takes its direction from the vision, guiding principles, and objectives of the NH&UFS (presented in **Section 5.2**), which have been developed with the urban forest in mind. The primary purpose of Mississauga's UFMP is to recommend actions to improve the health, sustainability and performance of the urban forest on both private and public lands.

This UFMP has been developed:

- based upon a comprehensive review of the City's current policies, practices and resources
- by building on the canopy cover data and analyses conducted and provided by the Peel Urban Forest Working Group[1]
- with consideration for the findings and recommendations presented in the *Peel Region Urban Forest Strategy* (2011) and the *City of Mississauga Urban Forest Study* (2011), also developed by the Peel Urban Forest working Group
- with consideration for relevant best management practices and precedents in other jurisdictions, and in the scientific and technical literature, and
- with input from City staff, a wide range of stakeholders[2], and members of the community.

The following key considerations have shaped the development of this UFMP:

- Mississauga is almost entirely built-out, with future development expected to be largely through infill and intensification.

[1] The Peel Urban Forest Working Group includes representatives from the Region of Peel, City of Mississauga, City of Brampton, Town of Caledon, Credit Valley Conservation and Toronto Region Conservation with expertise in urban forestry.

[2] Stakeholders consulted as part of the joint development of the NH&UFS and the UFMP include representatives from aboriginal organizations, government and agencies (including adjacent municipalities and local conservation authorities), committees to City Council, local educational institutions, environmental groups, community groups and residents associations, recreational facilities, business and development organizations, local utilities and transit, and arboriculture firms. Summaries of input received through these consultations are provided in the Natural Heritage & Urban Forest Strategy.

- Mississauga has been gradually building and improving its capacity to implement proactive urban forestry policies, practices and programs over the past two decades. As such, there are a number of innovative policies and successful programs to build on.
- There will be considerable challenges involved in protecting and maintaining the city's current tree cover under existing and anticipated conditions
  (as described in **Section 2**).
- Although the City is responsible for hundreds of thousands of trees on its streets and in its parks and open spaces, more than half of Mississauga's existing urban forest canopy is on private residential lands, and the majority of the opportunities for planting additional trees are on the landscaped areas of the city's private residential, commercial and industrial lands.

This UFMP ultimately identifies 24 actions to be undertaken over a 20-year planning horizon. Some actions are considered as higher priority than others, and some will require longer implementation periods.

This UFMP is intended for use by City staff to guide the planning and implementation of actions to achieve strategic objectives, and to be a resource for City staff and residents to become better informed about the importance of the urban forest, challenges to urban forest health and sustainability, and what can be done to proactively and effectively manage this important resource.

1.1 DEFINING THE URBAN FOREST

The 'urban forest' is generally understood to be all the trees in a given urban or urbanizing jurisdiction. However, this UFMP recognizes that other components (such as the above and below-ground growing conditions) must also be considered if management is to result in genuine enhancement and expansion of the urban forest, and related increases in benefits and services. As such, this UFMP adopts the definition of the urban forest from the *Peel Region Urban Forest Strategy* (2011), which defines the urban forest as: *"a dynamic system that includes all trees, shrubs and understory plants, as well as the soils that sustain them, located on public and private property*".

In accordance with this definition, a successful urban forest management program must consider more than just trees in both strategic initiatives and daily operations. Consequently, this UFMP considers a wide range of topics beyond tree maintenance, such as urban planning, infrastructure development, natural areas connectivity, and public education, among others.

The overall timeframe for this UFMP is a 20-year horizon (2014-2033), and the targets and recommendations presented have been developed within this context. As part of the final Plan, the recommendations will be presented within an implementation matrix that specifies target timelines, estimated resource requirements, potential partners, and links each action to the objectives that they support in **Appendix B**.

The Urban Forest as Green Infrastructure

The urban forest is a key component of what is called the City's "green infrastructure". A city's "grey" infrastructure is generally understood to be the sewage and water systems, waste management systems, electric power generation and transmission networks, communication networks, transit and transportation corridors, and energy pipelines that provide all the services we have come to rely upon for modern day living. However, it is increasingly becoming recognized that trees (as well as untreed open spaces and natural areas) also provide a number of essential and highly desirable services and benefits that facilitate modern life, particularly in urban areas (see **Section 3**). As such, these components have been labelled "green infrastructure" to highlight their functional value in a way that is comparable to the built "grey infrastructure". The City has recognized the value of its green infrastructure, at least in policy, by identifying treed and natural areas, as well as parklands and other open spaces, as being within the City's Green System within the Official Plan. Specific examples of are illustrated in **Table 1**.

Table 1. Examples of grey and green infrastructure

Grey Infrastructure	Green Infrastructure
• Roads, highways and parking lots • Storm and sanitary sewer lines • Public utilities (e.g., hydroelectric lines and stations, natural gas lines, water pipes and filtration plants)	• Trees, shrubs and soil • Rain gardens and naturalized swales • Wetlands (constructed and natural) • Green roofs and living walls • Engineered soils and permeable pavement

1.2 CONTENT OF THE UFMP

This UFMP is comprised of sections that provide the following :

- a framework for review and monitoring (**Section 1.3**)
- an overview of the state of Mississauga's urban forest (**Section 2**)
- a summary of the value of Mississauga's urban forest (**Section 3**)
- an overview of challenges to urban forest sustainability (**Section 4**)
- strategic direction and guidance for implementation (**Section 5**)
- a review of Mississauga's current urban forest practices and programs (**Section 6**)
- relevant best practices and opportunities for improvement (**Section 7**),
- recommendations to enable the City to develop and maintain a healthy and sustainable urban forest over the long-term (i.e., next 20 years) (**Section 8**), and
- a glossary of key technical terms (**Section 9**).

1.3 UFMP STRUCTURE AND MONITORING FRAMEWORK

The 20-year planning framework for this UFMP is divided into three tiers to support an active adaptive management approach, as per **Figure 1**.

Adaptive Management

Forested ecosystems are complex dynamic entities, particularly with the addition of a human element. Urban forest managers cannot always predict the changes or events, such as severe weather, pest infestations or changing resource allocation priorities that they may have to accommodate on the path to achieving urban forest sustainability. For this reason, the concept of active adaptive management is firmly embedded in this UFMP.

Adaptive management requires that a problem or issue be carefully assessed and understood before a strategy to solve it can be designed and implemented. To accommodate this, the objectives and targets of the initial UFMP will be monitored in a systematic manner, and any required adjustments will be made based on experience gained as well as new information. The adjusted approach will be implemented and the evaluation cycle will be repeated for as long as is necessary to accomplish the desired objectives and/or to implement changing environmental, social or policy directions.

What is Active Adaptive Management?

A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning.

(United Nations Millennium Ecosystem Assessment, 2005)

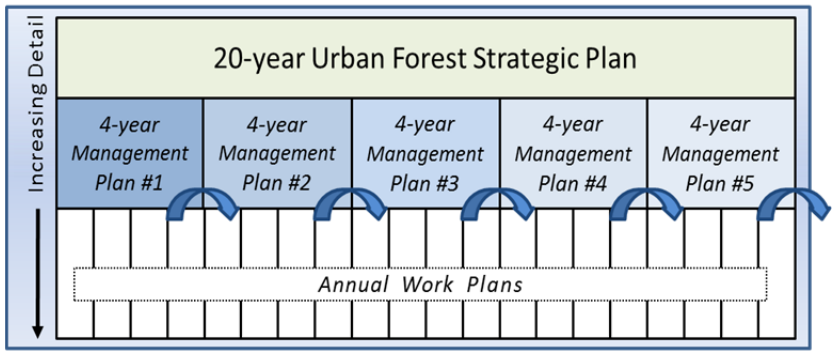


Figure 1: Framework for implementation of Mississauga's Urban Forest Management Plan

Tier 1: 20-year Strategic Direction (2014-2033)

- Identifies a long-term vision, guiding principles and strategic objectives for the duration of the UFMP
- Sets urban forest management targets to be achieved in the 20-year period
- Reviews current practices in Mississauga
- Considers best practices from technical and scientific literature
- Identifies opportunities to improve Mississauga's urban forest management practices and programs that are appropriate for the City's context and in line with the long-term vision

1. **Tier 2: Five Four-year Management Plans (2014-2017, 2018-2021, etc.)**
   - Links guiding principles and long-term objectives with daily practices and on-the-ground operations
   - To be implemented by several departments (i.e., Parks and Forestry, Planning and Building and Transportation and Works)
   - To be tied to recommended budgets and current priorities, but developed with the longer-term big picture vision in mind, as laid out in the UFMP
   - To be reviewed and updated at end of every 4th year of implementation and updated in response to objectives met, as well as those yet to be met, and changes in existing conditions
   - Ensures active adaptive management is implemented

2. **Tier 3: Annual Operating Plan (AOP)**
   - Applied and specific guidance for day-to-day operations
   - Includes operational plans for planting, pruning, removals, inspections, inventory maintenance and public engagement/outreach
   - To be prepared each year by urban forestry staff and management
   - Considers budgets and current priorities, but developed strategically in consideration of vision and objectives, as outlined in the Four-year Management Plans and the UFMP

This UFMP is the "Tier 1" plan. Through its implementation, according to the three-tiered framework, the City will help ensure that this Plan carries on as a 'living document' through built-in periodic plan assessment and review cycles. More details of this review are described in **Section 1.4** - UFMP Review and Monitoring.

Notably, the 20 year time frame for this Plan is the same as the 20 year time frame for the broader Natural Heritage & Urban Forest Strategy (NH&UFS). The 20 year timeframe for implementation of this Plan also:

- Falls within the City's broader 50 year strategic planning horizon
- Is considered a long enough period to be able to implement and document substantial changes in urban forest cover and sustainability, but not so long as to lose sight of long-term objectives
- Coincides with the 20 year time frame for the One Million Trees Program and very closely with the *Future Directions Master Plan for Parks and Natural Areas* (2009) time frame which extends to 2031, and
- Allows for the inclusion of five, four-year review periods within both this Plan and the NH&UFS intended to (a) assess the status of various actions (and strategies), (b) assess the status of the urban forest (and related natural heritage features), and (c) provide opportunities to refine or revise courses of action, if required.

After the 20 year period for this Plan (and the related NH&UFS), it is anticipated that both the overall Strategy and the UFMP will undergo a comprehensive review and update, and a new NH&UFS and UFMP will be developed for the subsequent 20 years.

1.4 UFMP REVIEW AND MONITORING

Various aspects of this UFMP and the implementation of its recommended actions (presented in **Section 8**) are to be periodically reviewed and, if necessary, revised to ensure progress. Mechanisms for review are built in to the strategy through the three-tiered framework and through the principle of active adaptive management (described in **Section 1.3**). In keeping with these principles, the successes and shortcomings experienced during each four-year management planning period should be reviewed, and findings should be incorporated into the subsequent management plan.

Monitoring Progress: Criteria and Indicators (C&I)

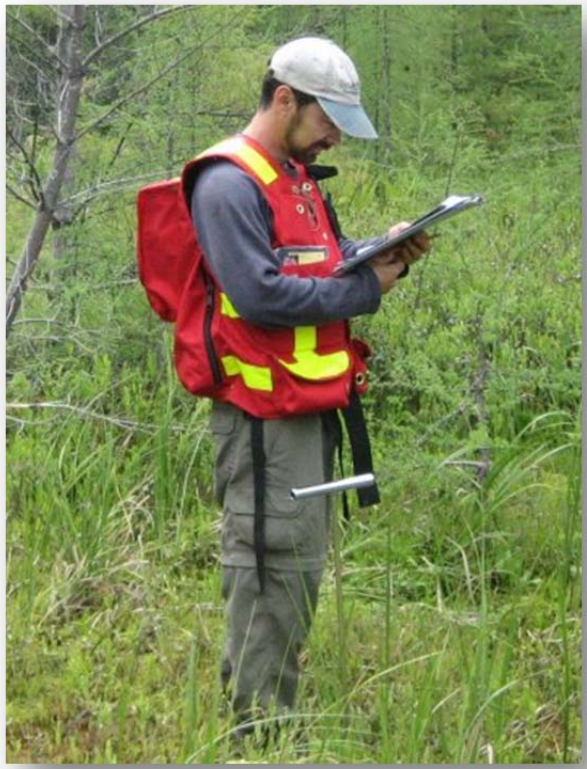
Kenney et al., 2011[3] build on previous work providing a suite of 25 criteria and indicators (C&I) designed to monitor key aspects of the performance of an urban forest. They consider three key components: 1) the Vegetation Resource, or the overall status of the urban forest, (2) the Resource Management Approach, and (3) the Community Framework, or level of community engagement. Each criterion can be assessed as "low", "moderate", "good" and "optimal" using technical indicators.

The C&I framework can be used to establish a baseline at the outset of the urban forest management planning process, and measure status during regular plan review, in order to assess progress towards achieving urban forest sustainability. Criteria and Indicators tailored to reflect Mississauga's current conditions and long-term vision, as well as the targets and objectives developed to help achieve this vision, have been developed as part of this UFMP. This Criteria and Indicators is the baseline assessment of the current status of urban forestry in Mississauga and is to be used as an evaluation tool as part of this framework.

The recommended review and monitoring for Mississauga's urban forest should consist of:

1. **a review and update of the Criteria and Indicators (C&I) based monitoring framework (as presented in Appendix A)**
2. **a review of the status, timing and anticipated budgetary requirements of each action of this UFMP (as presented in Section B) to be included in each Four-year Management Plan (i.e., 2014-2017, 2018-2021, 2022-2025, 2026-2029, 2030-2033), and**
3. **a summary of this information in a simplified, stand-alone format for release to City staff in all departments, Council and the community at least once every four years.**

Notably, some of the more resource-intensive criteria (e.g., such as the collection of plot-based data) should not be re-assessed every four years, but rather should be re-examined every 8 to 12 years.



[3] Kenney, W.A., van Wassenaer, P.J. and A. Satel. 2011. Criteria and Indicators for Strategic Urban Forest Planning and Management. Arboriculture & Urban Forestry, Volume 37, Number 3 April 2011 pp 108-117.

2 STATE OF MISSISSAUGA'S URBAN FOREST

In 2011, the Region of Peel, in partnership with the Toronto and Region Conservation Authority (TRCA), Credit Valley Conservation (CVC), and the constituent municipalities of Mississauga, Brampton and Caledon, developed the *Peel Region Urban Forest Strategy.* These partners, who meet and collaborate regularly under the umbrella of the Peel Urban Forest Working Group, have also undertaken subsequent analyses of canopy cover data in order to determine ranges of potential canopy cover for the Region and each area municipality. Studies supporting the *Urban Forest Strategy* used the United States Department of Agriculture Forest Service's i-Tree Eco field sampling methodology combined with satellite imagery analysis and computer modeling tools to compile data about the general Region's urban forest (e.g., approximate tree cover and distribution, tree age size/class distribution, tree species diversity) and quantify the extent and value of some of the many benefits and services provided by the urban forest (presented in Section 3).

The *Peel Region Urban Forest Strategy* and associated *Mississauga Urban Forest Study,* along with subsequent studies, have found that:

- there are approximately 2.1 million trees in Mississauga,
- Mississauga's urban forest canopy cover is approximately 15%,
- most of Mississauga's trees are in relatively good health, but small in stature,
- the dominant trees in the city are maples and ash, with ash accounting for about 18% of the trees in residential areas and 10% of the street trees, and
- more than half of the city's canopy cover (about 8%) is located in residential areas and almost a third of the city's canopy cover (about 5%) is found in woodlands in the City's natural areas and open spaces, with the remaining scattered within institutional, commercial, industrial and other land uses.

Historical Land Use Context

Mississauga's urban forest is largely shaped by land use patterns and the history of development across the City's 290-plus square kilometres. Prior to the arrival of Europeans, the lands in and around Mississauga were home to a number of aboriginal tribes such as the Objibway (Anishanabe), who farmed, fished and hunted within the area's diversity of woodlands, wetlands, grasslands and rivers. Starting in the 1800's, a number of European settlements were established (e.g., Clarkson, Cooksville, Dixie, Lorne Park, Malton, Meadowvale, Port Credit, Streetsville and Summerville) and the area was quickly dominated by resource extraction and agricultural land uses. This included logging which resulted in the removal of much of the area's woodlands. The next major transition, which has occurred since the 1950's, was from agriculture to urbanization, with construction of major transit routes (i.e., the Queen Elizabeth Way and Highways 401 and 407) and a related surge of industrial, commercial and residential development.

Current Land Use Context and Canopy Cover Distribution

Today, trees are found across the city along its right-of-ways and within parks and natural areas, as well as residential yards, school grounds, and the landscaped grounds of commercial and industrial lots. These trees are found in either remnant natural areas that have regenerated through active or passive management, or in landscaped areas where they have been planted.

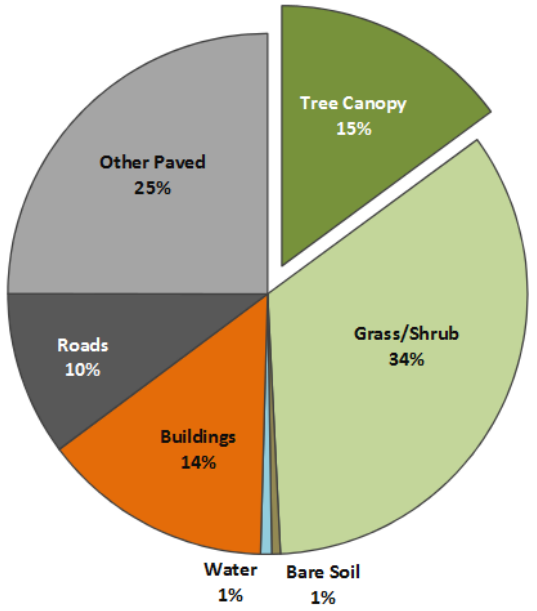


Figure 2. Land cover estimates in Mississauga (from *City of Mississauga Urban Forest Study*, 2011)

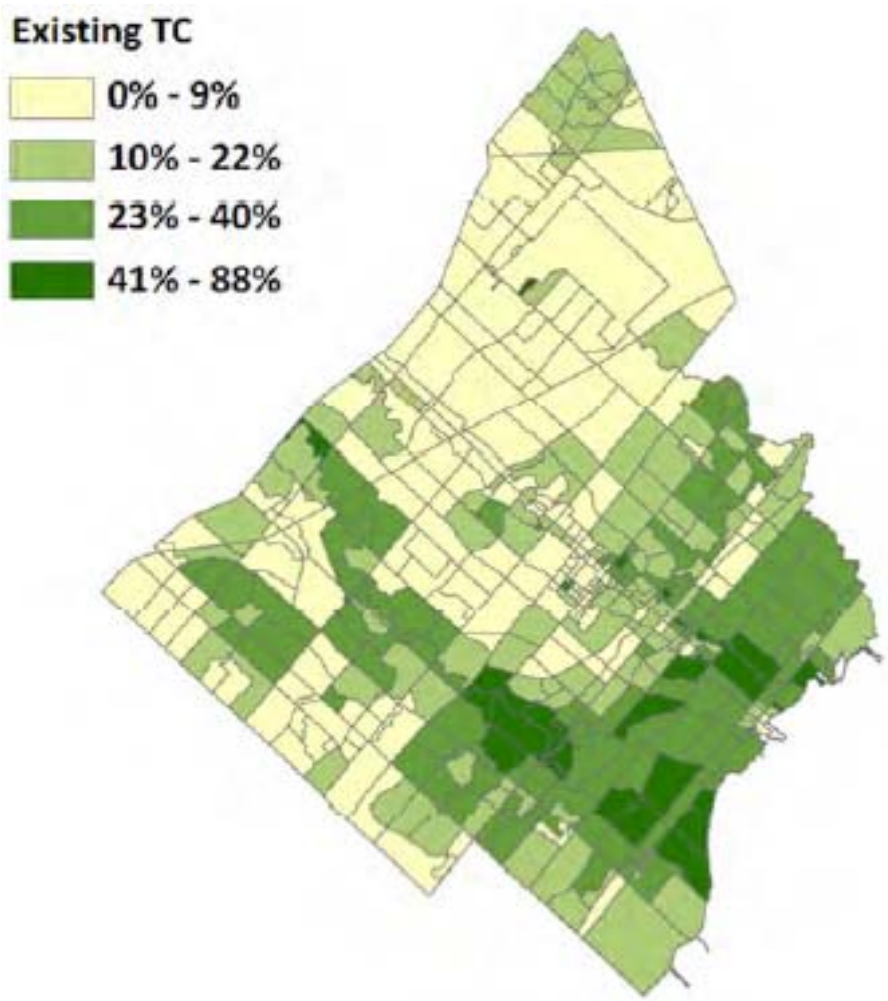


Figure 3. Existing tree canopy cover (TC) by small geographic units (from *City of Mississauga Urban Forest Study*, 2011)

From an urban forestry perspective, the city's landscape ranges from older lakeside and riverfront residential communities with relatively high levels of canopy cover (such as Port Credit, Mineola and Clarkson-Lorne Park) to the industrial parks and commercial areas with relatively low levels of urban forest canopy. In more recently developed subdivisions (such as Meadowvale, Lisgar and Malton) trees have been planted in boulevards, yards and parks, but the extent to which these will mature into large, canopied trees remains to be seen. The City's roadways vary from quiet neighbourhood streets to high-speed, high-capacity thoroughfares. Opportunities for tree protection along transit corridors have been limited, particularly along the major corridors, but efforts over the past few decades to try and work with the applicable authority to integrate trees (and other vegetation) along utility and transportation rights-of-ways where it does not compromise safety considerations has resulted in more tree planting and naturalization projects.

Analysis undertaken by the Peel Urban Forest Working Group suggests that Mississauga's overall urban forest canopy coverage is approximately 15%, with most of this canopy in older residential areas, open spaces and natural areas. The total tree canopy cover is shown in **Figure 2**, and the variability in tree canopy cover in different parts of the city is shown in **Figure 3**.

Like most urban forests, Mississauga's is comprised of trees of a wide range of species, age/size classes, and health/condition categories. However, development of most of the land base means that natural regenerative processes no longer govern the structure of most of the urban forest. Instead, tree selection and planting by City staff and private residents determines what kinds of trees grow within the city, and where. A summary of the diversity, age / structure and condition of Mississauga's urban forest is provided below.

Diversity

Mississauga's Urban Forest Study (2011) found that although there are 234 different tree species and cultivars in Mississauga's street tree population, the overall diversity of the urban forest is relatively low. The top five most common tree species, by leaf area[4], include sugar maple, Norway maple, Manitoba maple, green ash and white ash. Maples together comprise over one-third of tree species across the city. This relatively low level of urban forest species diversity leaves the City vulnerable to threats such as Asian longhorned beetle or emerald ash borer (EAB). EAB threatens some 10%, or 27,462, of the City's street trees, and many thousands more in its parks, natural areas and on other public and private lands.

[4] The abundance of trees can be measured in several ways, but the two most commonly used are by stem (i.e., by individual tree) or by leaf area (i.e., the approximate amount of area occupied by a given tree's leaves). Leaf area can be useful because it reflects the volume of a given species as opposed to simply the number of specimens.

Data generated from the City's street tree inventory (completed in 2009) indicates that the diversity of the City's street trees (as illustrated in **Figure 4**) is similarly low, with four species (i.e., Norway maples, green ash, little leaf linden and honey locust) accounting for almost half of all species planted (by stem count) and many of the most dominant species being non-native, including invasive Norway maples which account for 22% of the City's street trees.

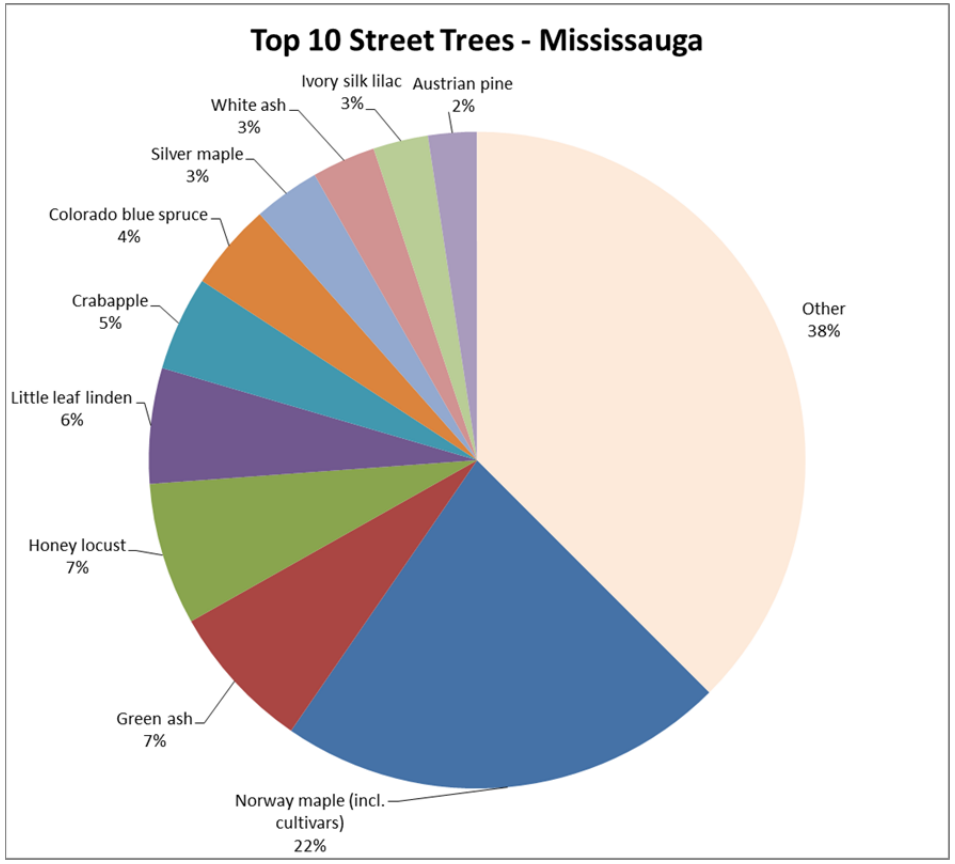


Figure 4. Representation of the diversity of Mississauga's street trees (by stem count)

Age/Size

The majority of Mississauga's trees are relatively small. Over 60% of trees in the City are less than 15.3 cm in diameter (dbh), suggesting that urban forest structure is skewed towards trees of a younger age class. The largest trees, such as red and white oaks, are typically found in older neighbourhoods and natural areas. This reflects the relatively recent development of many of the City's residential areas, and illustrates how the diverse environmental, ecological and social benefits provided by large-stature, mature trees are not currently available to all communities. This is illustrated in the existing canopy cover by Small Geographic Unit (SGU), shown in **Figure 3**.

Condition

Most of Mississauga's street trees are estimated to be in good to excellent condition. Similarly, tree inventory data show that 73% of the City's street trees are in good condition, and only 5% are in poor condition. This is a positive indicator but, at least in part, reflects the relative young age and small stature of trees across the city. It is likely that as trees age and younger trees in newer developments reach the limits imposed by their difficult growing sites, tree health and condition across the city will decline and strategies to maintain and improve tree condition will be needed.

3 VALUING MISSISSAUGA'S URBAN FOREST

The ecosystem services[5] provided by trees in urban areas are well-documented in the scientific and technical literature[6], and are more broadly described in Section 3 of Mississauga's Natural Heritage & Urban Forest Strategy (NH&UFS). The fundamental message from more than a decade of research is that trees in cities are more than just something nice to look at; they are critical assets (just like roads, buildings, and water lines) that provide a wide range of services that make cities healthy and vibrant places to live. While the air quality and cooling benefits of trees are well-established, there is also mounting evidence that trees (both within and outside of natural areas) directly improve human physical and mental health as well. This information has not been lost on schools where "outdoor classrooms" and wilderness courses are becoming a more mainstream component of the curriculum.

The urban forest in Mississauga provides a wide range of environmental, social and health, and economic benefits that accrue to all those who live and work in the city, and beyond. Trees and shrubs not only clean the air and water, they also moderate local climate fluctuations, reduce energy consumption in homes and buildings, sequester and store atmospheric carbon, provide shade, control stormwater runoff, and provide habitat for local and migrating wildlife. Trees and natural areas in neighbourhoods contribute to increased property values, sustain human mental and physical health, and support safer communities. This section of the UFMP presents an overview of these environmental services and benefits. Some additional information is provided in the NH&UFS.

[5] Ecosystem Services is a term used to describe the processes of nature needed to support the health and survival of humans. While ecological services are required and used by all living organisms, the term has been coined to capture their direct value (quantified or not) to humans. Ecosystem services include processes such as air and water purification, flood and drought mitigation, waste detoxification and decomposition, pollination of crops and other vegetation, carbon storage and sequestration, and maintenance of biodiversity. Less tangible services that have also been associated with natural areas and green spaces include the provision of mental health and spiritual well-being. The products generated by these services (sometimes called "ecological goods") include fundamental items like clean air, fresh water, food, fibre, timber, and medicines.

[6] A comprehensive listing and summary of the published scientific and technical literature on this subject can be viewed at websites such as the USDA Forest Services' "Green Cities" site at www.depts.washington.edu/hhwb/

3.1 ENVIRONMENTAL SERVICES

Table 2. Overview of the environmental services provided by Mississauga's urban forest

Environmental Service	Estimated Amount (Dollar Value)*
Carbon Sequestration	7,400 tonnes annually ($220,000 estimated value)
Carbon Storage	203,000 tonnes ($5.8 million estimated value)
Air Pollution Removal	292 tonnes annually ($4.8 million estimated value)
Energy Consumption Reduction	79,000 MBTUS and 7,300 MWH annually ($1.2 million estimated value)

* all data from the *City of Mississauga Urban Forest Study* (2011)

Recent studies by the Peel Urban Forest Working Group have found that the city's urban forest has a basic replacement value[7] of $1.4 billion. The urban forest provides more than $6 million worth of environmental services every year to the City's residents, as well as many other benefits that are equally (or more) valuable but cannot be as readily quantified, as described below.

- In addition to the environmental services listed in **Table 2**, the urban forest provides other environmental services that are harder to quantify and value, such as improving stream water quality (e.g., by reducing surface runoff rates and cooling water temperatures),
- Reducing high urban air temperatures in the summer (through shading and evapotranspiration) (see **Figure 5**),
- Reducing energy usage by shading buildings and vehicles in the summer and buffering the effects of cold winds in the winter (see **Table 2**),
- Conserving soil resources by stabilizing slopes and intercepting water with root networks, and
- Providing habitat for urban wildlife such as mammals, birds, and fish.

[7] The basic "replacement value" (also known as the basic structural value) is the estimated cost of replacing every tree in the city.

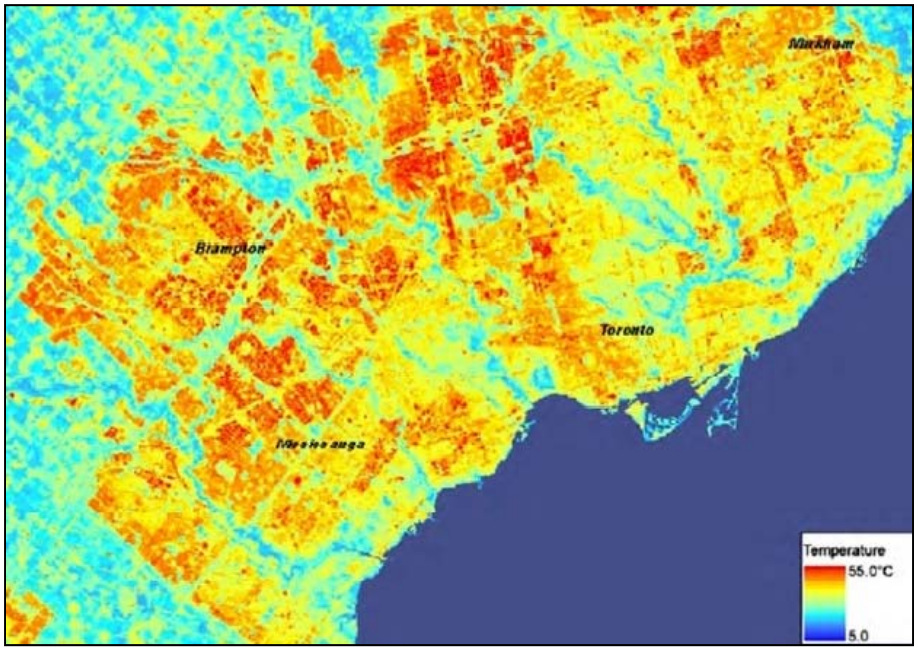


Figure 5. Land surface temperature, Greater Toronto Area, July 2008, showing summer time "hot spots" in urban areas (from *City of Mississauga Urban Forest Study*, 2011)

Climate Change Adaptation and Mitigation

Among the most important environmental services provided by a healthy urban forest are climate change adaptation and mitigation[8]. By moderating local temperatures through shading and evapotranspiration, removing pollution from the air, and moderating storm water flows, Mississauga's trees help the community adapt and be more resilient to climate change. Trees also sequester and store carbon (as shown in **Table 2**), thereby reducing the concentrations of this significant greenhouse gas in the atmosphere, and potentially helping to mitigate the impacts of climate change.

[8] See the *Peel Climate Change Strategy* (2011).

3.2 SOCIAL AND HEALTH BENEFITS

Trees provide important community and human health benefits, particularly in urban areas where population densities are greater. These benefits include:

- Reducing exposure to ultraviolet radiation and extreme heat by providing shade and cooling
- Encouraging active living by providing settings for physical activity
- Providing social settings that tend to reduce incidences of crime
- Supporting human health by reducing exposure to certain environmental risks, such as pollutants, and creating environments supportive of outdoors activities and recreation
- Reducing mental fatigue by providing relaxing places and views
- Building stronger communities by facilitating social interactions, and
- Increasing the safety of community streets by calming traffic flow.

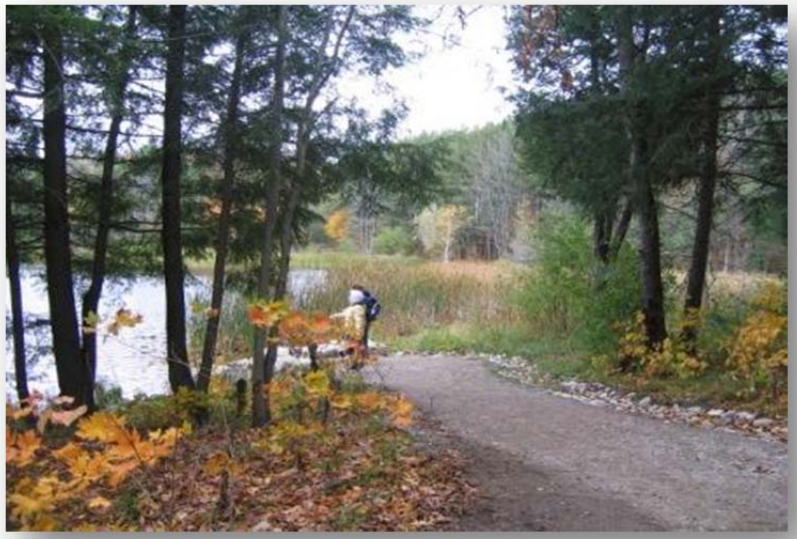
Recent studies have shown that exposure to treed and natural areas can improve recovery after surgery, reduce stress and improve learning and creativity. Reductions in property crimes in residential areas with street trees and vegetation, and 5% to 20% decreases in motor vehicle accidents on roads with trees on the roadsides have also been documented. Many of these community and health benefits are difficult to quantify in dollar values, however their contributions to making Mississauga a liveable community are immense.

3.3 ECONOMIC GOODS AND BENEFITS

Although trees in cities are not generally grown for their timber value, or for generation of products that can be bought and sold, trees in urban forests are good for the local economy. Studies have demonstrated that:

- The presence of large trees in yards and streetscapes can add between 3% and 15% to the value of homes, even if the trees are on neighbouring properties,
- Homes on wooded lots typically sell faster than comparable untreed properties, and
- Shoppers express a willingness to pay, on average, between 9% and 12% more for goods and services in well-treed business districts, and are also willing to travel longer distances to such areas.

Recent movements for re-introducing agriculture into urban environments also present opportunities for considering the potential value of tangible goods produced by some trees such as edible fruits and nuts, as well as maple syrup. In addition, at the end of their life spans, urban trees can become valuable and highly-sought after wood products, or be used as high-quality mulch.



4 URBAN FOREST MANAGEMENT CHALLENGES AND OPPORTUNITIES

The development and implementation of an UFMP in Mississauga is a timely response to a range of challenges facing the City's trees and natural areas. As described in Section 7 of the Natural heritage & Urban Forest strategy (NH&UFS), the City is largely built-out to its urban boundary, and will continue to need to accommodate population growth. While redevelopment and intensification place increasing pressures on existing trees and potential tree habitat, challenges such as climate change-induced drought stress or invasive pests and pathogens will place increasing pressures on urban trees. As these challenges mount, the benefits provided by each urban tree will become increasingly valuable, and urban forest sustainability will become increasingly important. However, these challenges also present some opportunities for improving urban forest sustainability, as described below.

4.1 KEY CHALLENGES

Big picture challenges identified in the NH&UFS include:

- instilling a new mind-set of the "total landscape as a life-support system"
- trying to maintain and enhance ecological connectivity in a built-up landscape
- reconciling natural heritage and urban forest objectives with the need to accommodate continued growth
- building resilience to climate change and related stressors in a context of uncertainty
- getting the entire community to become more fully engaged in caring for the natural areas, urban forest and other green spaces around them, and
- the need for sustained management commitments.

Key challenges faced more specifically by Mississauga's urban forest, and described in more detail below, include:

- Invasive species, pests and pathogens,
- Ongoing development and redevelopment pressures, further reducing opportunities to provide space for trees,
- Conflicts between trees and other municipal infrastructure,
- The impacts of climate change and related stressors on trees,
- Difficult growing conditions in urban landscapes, including limited soil volumes and poor quality (e.g., contamination with road salt and/or other de-icing agents),
- Fragmented ownership of the urban forest, and
- Limited community awareness and engagement.

In addition, these challenges must be addressed within the resources and budgetary limits of the City's Parks and Forestry Division, and the available resources available through partnerships within the community and other supporting partners.

Invasive Species, Pests and Pathogens

Trees in the urban forest can be highly susceptible to the effects of invasive species, pests and pathogens. Across North America, urban forests have been affected by a number of invaders. In the past, Dutch elm disease wrought widespread damage to urban elm tree populations; today, emerald ash borer (EAB) threatens to destroy all of Mississauga's ash (*Fraxinus*) trees, representing a potential loss of $208 million in structural value and 16% of urban forest leaf area. About 10% of the City's street trees (23,311 ash trees) are at risk (**Figure 6**), in addition to thousands of other trees in public and private natural areas, parks, yards and open spaces. EAB is already ravaging Mississauga's urban forest, and the Active Management Plan response will cost an estimated $51 million over the next nine to ten years[9]. This wide-scale pest infestation may affect the City's ability to provide core urban forestry services for some time, as available resources will need to be mobilized to address EAB-related tree mortality, treatments and other immediate management needs.

[9] City of Mississauga Emerald Ash Borer Management Plan (2012) that was recently adopted by Council provides details about the components and costs of an Active Management Plan.

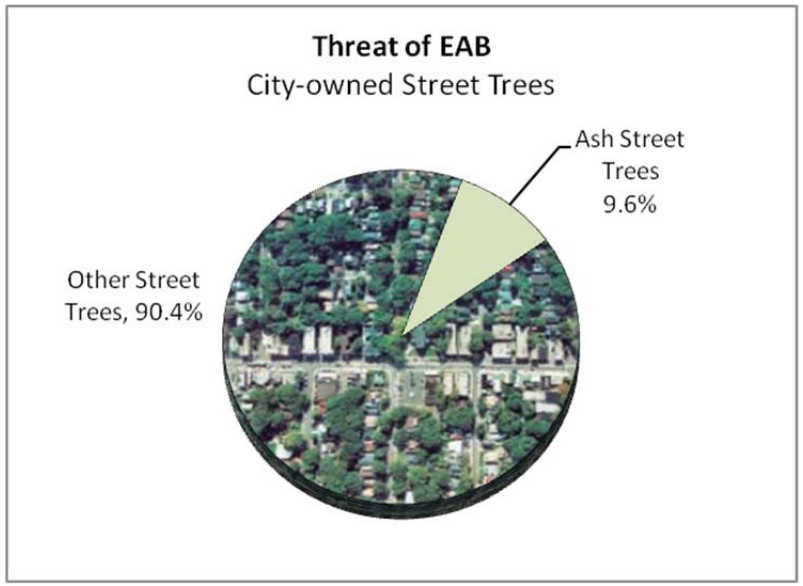


Figure 6. Illustration of the proportion of city-owned street trees at risk from emerald ash borer, by percentage of street tree inventory

Development Pressures

Mississauga's population is forecast to grow by more than 10% above 2008 levels over the next 20 years. The current Official Plan (2011) identifies a range of strategies and planning direction for accommodating intensification, and the City is currently in the process of specifically delineating targeted intensification areas.

New residents bring diversity, ideas and opportunities, but also increase demand for housing and municipal services, including roads, sewers, parks and natural areas. Intensification and redevelopment will make preservation of existing trees and integration of new trees into developed landscapes more challenging and more important, and will also increase the pressure on remaining wooded natural areas and parks.

Tree and Infrastructure Conflicts

Trees occupy space both above and below ground, and must therefore compete with a number of other municipal infrastructure components such as electric and gas utilities, storm and sanitary sewers, water services, roadways and sidewalks, signs, and parking areas. They also compete for space with residences and other buildings. Finding creative solutions so that trees (i.e., "green" infrastructure) and "grey" infrastructure (e.g., above and below ground servicing, sidewalks) can effectively co-exist presents both a challenge and an opportunity to collaborate and innovate.

Climate Change

Climate change is already thought to have increased average annual temperatures in southern Ontario by 0.5°C over the past two decades[10]. Furthermore, the incidence and duration of extreme weather events (wind and ice storms, rainfall) and drought stress is expected to increase in the coming years, making the urban forest more vulnerable to pests, pathogens, invasive species, physical damage and general decline. In urbanized communities such as Mississauga, these effects are likely to be compounded by the extent of impervious and unvegetated surfaces. However, this challenge also presents an opportunity to embrace proactive urban forest management practices, which can make both the city's trees and the city as a whole more resilient to climate change[11].

Difficult Growing Conditions

Most trees are naturally adapted to growing in forest conditions. Growing conditions in urban areas are markedly different, and are typically characterized by a more exposed environment, degraded and compacted soils, altered moisture regimes, and substantially reduced soil biological activity to support tree growth. Another stressor, particularly for street trees, is being subject to road salts and other de-icing agents in the winter.

When trees are an afterthought in landscape planning, insufficient consideration is given to optimizing growing conditions, which causes greater susceptibility to drought and/or nutrient stress, pests and pathogens.

In recent years, strides have been made in Mississauga to improve below-ground growing conditions for trees; however, the City must continue to manage salt use

[10] See http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_085423.pdf

[11] The *Peel Climate Change Strategy* (2011) includes an action that specifically identifies "implementing best practices related to urban forestry" as one of its proactive adaptation actions.

as well as a legacy of difficult growing conditions, and strive to prevent such conditions from recurring in the future.

Tree Preservation on Private Property

As in most communities in southern Ontario, much of the City's urban forest is on privately-owned lands, as are many of the opportunities for urban forest plantings and enhancements. Although the City has a Private Tree Protection by-law to help regulate tree removal on private lands, this in and of itself is not adequate to ensure all opportunities for tree protection and replanting are pursued. Official Plan policies that are supportive of the urban forest, and related zoning provisions, can also help ensure that opportunities for tree protection and replanting are explored through the planning process. Even where there is existing zoning in place that supports some type of development (as in many parts of Mississauga), the type or extent of development may be modified to better accommodate trees, as can the design, where policies support it, although some type of development will usually need to be permitted.

The City is also continually working to acquire wooded (and other) natural areas as opportunities arise, however the comprehensive care and stewardship of the urban forest on private lands can only be achieved through widespread recognition of the value that trees bring to the community, and a willingness to help sustain the urban forest.

Limited Community Awareness and Engagement

Available evidence indicates that while Mississauga's residents generally seem to support having trees in their yards and their neighbourhoods, there is much less support for regulatory mechanisms regarding tree protection, and a limited appreciation for the full value of trees in urban areas[12]. Parks and Forestry Division staff have indicated that while there are members of the community who regularly participate in stewardship activities, in general they have been challenged to engage a broad cross-section of the community in tree planting or related activities. However, because most of the city's urban forest is on private lands, it is imperative for residents to fully understand the value of maintaining and expanding the urban forest, and to contribute to its sustainability through tree preservation, planting and proper tree care on their lands.

4.2 KEY OPPORTUNITIES

This UFMP represents a strategic response to these challenges. Implementation of the actions recommended in this UFMP will benefit the City's urban forest through good planning, improved operational practices, and increased public awareness and engagement in urban forest protection, enhancement and expansion. Opportunities related to the key challenges outlined above include:

- INVASIVE SPECIES, PESTS AND PATHOGENS: Pursuing proactive tree health and risk management on public lands (e.g., implementing an emerald ash borer strategy before all the City's ash are impacted), and encouraging (and, where possible, supporting) it on private lands[13];

[12] T. Conway and T. Shakeel. 2012. Trees and residents: An exploration of residents' role in growing Mississauga's urban forest. Paper for the Department of Geography, University of Toronto, Mississauga, 13 p.

[13] One of the opportunities arising out of the invasion of EAB is the potential to replace diseased ash with a diversity of native and non-invasive species, and ensure they are provided with adequate soil volume and quality.

- DEVELOPMENT PRESSURES: Ensuring opportunities for urban forest canopy expansion are identified in areas that are not also expected to accommodate extensive intensification;
- TREE AND INFRASTRUCTURE CONFLICTS: Working with planners, engineers and architects to find planning and design solutions that can accommodate long-lived, and where possible, large-statured trees in urban environments;
- CLIMATE CHANGE: managing the urban forest as a whole to help the community mitigate stressors associated with climate change, as described in more detail below;
- DIFFICULT GROWING CONDITIONS: Ensuring that trees are given adequate above and below-ground space, soil volume and soil quality by introducing and enforcing minimum requirements, as well as working with other disciplines and partners on a given project to find creative ways to give trees space without compromising other requirements (e.g., servicing, safety, etc.);
- TREE PRESERVATION ON PRIVATE PROPERTY: Facilitating a paradigm shift towards understanding and managing the urban forest as a shared community resource and a vital component of the city's infrastructure through an active promotional campaign and an expanded stewardship program targeted to City staff, external stakeholders and the community; and
- LIMITED COMMUNITY AWARENESS AND ENGAGEMENT: Continually building on existing partnerships and forming new ones that can leverage resources and funding outside the City's purview.

Climate change presents one of the most pressing challenges for urban trees, some of which already suffer from non-climatic stressors such as competition for resources, soil compaction, drought, pests and diseases. Fortunately, strategies to reduce the effects of climate change on the urban forest are aligned with the opportunities above as well as other strategies that contribute to overall urban forest sustainability, as follows:

- Minimizing the further expansion of non-climate stressors (such as impervious surfaces, invasive plant species or pests and diseases) and , with respect to plant species, removing and/or controlling these stressors and replacing them with native plant species;
- Planting a diversity of tree species, including those better adapted to warmer and drier conditions (e.g., Carolinian zone species);
- Developing and implementing an extreme weather response strategy; and
- Protecting and enhancing natural area connectivity to facilitate native species movement and adaptation.

Urban forest management is a resource-intensive undertaking, requiring dedicated administrative and specialized operational staff, specialized contracted service provision, consumptions of materials, and usage and maintenance of specialized equipment. The wide range of urban forest-related issues in Mississauga – from routine tree maintenance, to invasive species management, to development plan review and inspection - requires adequate staffing, appropriate training, and both operational and capital resources.

As in all municipalities, the City will be unable to pursue all of these opportunities independently, and will be challenged to achieve levels of service for various management activities that meet planned or optimal levels. Therefore, it is critical that this UFMP be broadly embraced, and not just used by City staff but by all stakeholders and Mississauga's community. By pursuing the various strategic actions outlined within the UFMP, individuals and groups of all kinds will be able to work together towards improving and expanding Mississauga's urban forest.

5 SETTING THE DIRECTION

Figure 7. Illustration of where the City's Urban Forest Management Plan fits in relation to other City guiding documents

5.1 PLANNING CONTEXT AND PRECEDENTS

There are a number of city-wide planning documents that provide context and guidance for this Urban Forest Management Plan, as illustrated in **Figure 7**. The relevant components from each of these are summarized below.

Strategic Plan (2009)

The City's *Strategic Plan* identifies five pillars for change with the pillar most relevant to this UFMP being the "living green" pillar. The "connect" pillar also has some relevance in so far as trees are a cornerstone of complete communities, and of complete active transportation links and streetscapes.

The three "green" strategic goals (i.e., lead and encourage environmentally responsible approaches; conserve, enhance and connect natural environments; and promote a green culture) are all embedded within this UFMP. Specific strategic actions under the "green" pillar related directly to this plan include:

- Plant one million trees in Mississauga (Action 4)
- Implement a city boulevard beautification program to foster civic pride and raise environmental awareness (Action 5)
- Create an educational program that promotes "living green" (Action 10)

Although Action 7 "Implement an incentive/loan program for energy improvements" does not specifically mention trees, this program could include a subsidy for tree planting in view of the energy conservation benefits provided by trees[14]. In addition, although Action 24 "Make streets safer" (under the "connect" pillar) does not mention trees, it has been documented that treed streets can be safer than those without trees (see **Section 3.1**).

[14] The *City of Mississauga Urban Forest Study* (2011) cites research indicating trees of at least 6 m tall and within 20 m of one or two-storey building confer measurable savings in cooling costs in the summer (from shade) and heating in the summer (by buffering winds). Key variables in the extent of the effect include the number and type of trees (i.e. deciduous vs. coniferous), local climate, and orientation of the building.

Official Plan (2011)

Mississauga's Official Plan is intended to guide the city's growth and development to the year 2031. It provides a land use policy framework to help Mississauga evolve into the city envisioned in the Strategic Plan. The policies are primarily designed to manage and direct redevelopment and intensification - the next stage of the city's growth. The Official Plan also provides the basis for detailed land use designations and urban design policies, and sets the context for the review and approval of development applications.

The City's recently adopted *Official Plan* recognizes the city is entering a new stage in its evolution, "one of intensification and urbanization" and also recognizes the importance of creating an environment where "where people, businesses and the natural environment thrive". Section 6 "Value the Environment" includes a framework for the City's Green System, which includes a wide range of treed areas on both public and private lands, and a specific set of policies for the Urban Forest that include direction for tree protection, tree planting, and urban forest education, stewardship and partnerships (see more details in **Section 6.4**).

Future Directions Master Plan for Parks and Natural Areas (2009)

The Future Direction Master Plan looks at the City's parks and natural areas in an integrated, holistic manner, and provides a comprehensive set of recommendations for guiding the future development of both parks and natural areas in Mississauga, including future parkland requirements to 2031.

This entire plan implicitly and explicitly acknowledges the interrelatedness of parks and natural areas, particularly in urban settings, and also highlights the joint benefits to the community provided by these areas (e.g., physical and psychological health, particularly for youth, environmental services, community building, and direct economic benefits (e.g., increased real estate values, tourism value). Many of the 61 recommendations found in the document relate to trees and woodlands, however recommendation 60 - *"Allocate dedicated and sustained funds towards the adequate long term maintenance required to sustain a healthy urban forest. In this regard, the City could also pursue partnerships with agencies and community organizations"* - relates directly to this UFMP.

Living Green Master Plan (LGMP) (2012)

The recently completed LGMP is primarily a document to prioritize City policies and programs so that the environmental objectives of the Strategic Plan are met. The actions identified in the LGMP are intended to be met by 2021.

The LGMP identifies 49 actions in one of the following three categories: "Actions to Set an Example", "Actions to Encourage Others", and "Actions to Compel Others". While many of these actions relate to the UFMP, those most directly related include:

- Identify priority areas for invasive species management through the Natural Heritage Strategy project (Action 8)
- Develop a Green Development Strategy (Action 27)
- Create an Environmental Grants Program (Action 28)
- Develop a Living Green Education Campaign (Action 42)
- Amend the Street Tree By-law (91-75) and Tree Permit By-law (475-05) (Action 46) to be more restrictive and consistent with the *Official Plan*[15]
- Modify the Nuisance Weeds By-law (0267-2003) and Property Standards By-law (654-98) to support naturalization (Action 48)
- Increase monitoring and enforcement of the Erosion and Sediment Control By-law (512-91) (Action 49)[16]

In addition, the LGMP includes "tree canopy intensity" as one of its performance monitoring indicators, and indicates the desire for both city-wide and neighbourhood level targets. This indicator has been adopted and developed through this UFMP (see **Section 5.3**).

[15] Note the Street Tree By-law (91-75) is in the process of being updated and the Tree Permit By-law has already been updated by City staff and went into effect March 2013.

[16] Note the Erosion and Sediment Control By-law (512-91) is also currently under review by City staff.

Natural Heritage & Urban Forest Strategy (NH&UFS)

In Mississauga, the high level of overlap and interconnectedness between natural heritage and the urban forest have been recognized through the inclusion of both within a joint strategy. The NH&UFS, which is being developed in tandem with this UFMP, fully integrates considerations related to the urban forest (as its title indicates) along with those for natural heritage. However, the NH&UFS addresses these considerations within the context of natural heritage planning, while the UFMP includes more details and technical direction related to the strategic actions from an operational and tactical perspective.

The two stand-alone reports can generally be distinguished as follows:

- Natural Heritage & Urban Forest Strategy: overarching for both natural heritage and the urban forest, as well as more detailed planning direction
- Urban Forest Management Plan: recommended actions focused on the operational, technical and tactical aspects required to implement the broader strategies

The primary connection between the NH&UFS and the UFMP is that they share the same vision, guiding principles and objectives, but address different levels and aspects of the implementation required to achieve these items.

Other Key Sources of Information and Guidance

The two other key sources of information and guidance for the UFMP (as described in **Section 2** and **Section 6.1.1**) are the:

- *Peel Region Urban Forest Strategy* (2011) and
- *City of Mississauga Urban Forest Study* (2011)

Both were developed by the Region of Peel in collaboration with the Area Municipalities (Mississauga, Brampton and Caledon), Credit Valley Conservation and Toronto Region Conservation Authority.

The *Peel Region Urban Forest Strategy (2011)* outlines six guiding principles and eight strategic goals (see **Table 3**) to facilitate a coordinated and consistent approach to sustainable urban forest management across the Region. These principles are echoed in Mississauga's principles for this study (see **Section 5.2**), while the objectives provide some higher level support and resources to facilitate implementation of Mississauga's objectives (see **Section 5.2**).

The *City of Mississauga Urban Forest Study* (2011) provided 27 recommendations to help Mississauga move forward with its urban forest program and practices. A summary of how each of these has been addressed through this study is provided in **Appendix C**.

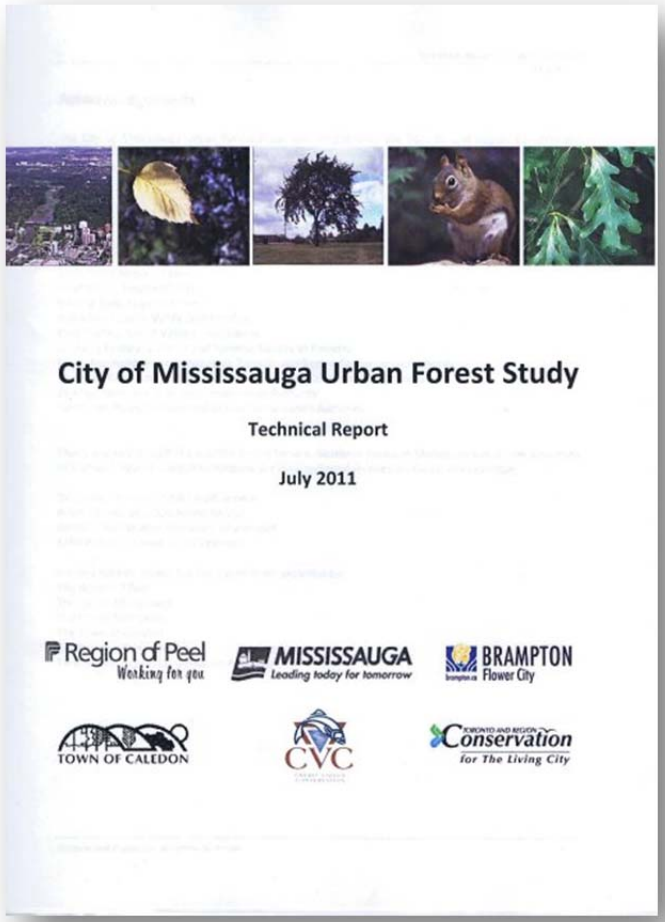


Table 3. *Peel Region Urban Forest Strategy* (2011) guiding principles and strategic objectives

Guiding Principles
1. A sustainable urban forest promotes quality of life, human health and longevity
2. Residents of Peel Region are the most important and influential stewards of the urban forest
3. All residents should have the opportunity and means to benefit equally from the ecosystem services provided by the urban forest
4. Improved communication and coordinated action will result in a more informed, streamlined, and effective approach to urban forest management
5. The urban forest, as natural infrastructure, requires long-term, stable funding
6. Municipal Governments should lead by example

Strategic Objectives
1. Facilitate partnerships and coordinate action across Peel Region
2. Develop urban forest targets
3. Develop and implement urban forest management plans
4. Create a comprehensive urban forest policy framework
5. Gain formal support from upper levels of government for sustainable management of the urban forest as natural infrastructure
6. Implement effective monitoring and research programs
7. Secure long-term funding for urban forest management
8. Provide comprehensive training, education, and support for residents and members of the public and private sector

5.2 VISION, GUIDING PRINCIPLES & OBJECTIVES

As discussed above, **a vision, guiding principles, and objectives were developed for NH&UFS which is the umbrella Strategy for the UFMP**. These are provided in both documents so that each document can be read and understood independently (with cross-references as appropriate). However, the NH&UFS should also be read in order to develop a full understanding of the broader study context and how the vision and objectives are intended to be achieved.

Vision for the Natural Heritage & Urban Forest Strategy (NH&UFS)

The City , private and public stakeholders, and members of the community are working together to protect, enhance, restore, expand and connect Mississauga's Natural Heritage System and urban forest so that native biodiversity and the ecological services essential for a healthy community are sustained for present and future generations.

Guiding Principles for the Natural Heritage & Urban Forest Strategy (NH&UFS)

The following are recommended guiding principles for the long-term protection, enhancement, restoration and expansion of the City's Natural Heritage System (NHS) and urban forest within the broader Green System.

1. Track the state of the NHS and urban forest performance
2. Practice adaptive management[17] of the NHS and urban forest
3. Recognize the full value of natural areas and the urban forest as part of city planning and budget prioritization first conserve - then enhance, restore and expand
4. Maximize native biodiversity
5. Recognize and build on past and current successes
6. Learn from our past and from others
7. view the natural heritage system and urban forest holistically within the city's broader green system
8. Understand the value of the city's green system, and the essential ecological services it provides
9. Make stewardship on public and private lands part of daily living
10. Integrate climate change considerations in natural heritage and urban forest planning
11. Actively pursue opportunities to protect, enhance, restore, expand, connect and support the NHS and urban forest
12. Track the state of the NHS and urban forest performance
13. Practice adaptive management[18] of the NHS and urban forest
14. Recognize the full value of natural areas and the urban forest as part of city planning and budget prioritization

[17] "Adaptive management" is a systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning (United Nations Millennium Ecosystem Assessment, 2005).

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Objectives for the Natural Heritage & Urban Forest Strategy (NH&UFS)

These objectives are intended to provide guidance for the long-term implementation and evaluation of the actions identified in the UFMP (as well as the NH&UFS), and for meeting the established targets (see **Section 6**). To enable their evaluation, the objectives are intended to be achievable and measurable. Measures for evaluating each objective as it relates to the UFMP are provided through the Criteria and Indicators (**Appendix A**).

The UFMP and NH&UFS both include city-wide strategies directed to both public and private lands. It is understood that while some approaches may be applied equally irrespective of landownership, in many cases distinct approaches are required for lands that are public versus those that are not. Therefore, the objectives have been organized into categories that reflect this distinction.

General Objectives

1. **Increase internal (within the City) and external (among the community and other stakeholders) awareness of the value and need to protect, enhance, expand and restore the NHS and the urban forest.**
2. **Expand the NHS by pursuing opportunities through new development, in-filling and re-development of public and private lands.**
3. **Build on existing, and develop new, public and private sector partnerships to help pursue and implement the vision and targets for the NHS and urban forest.**
4. **Undertake regular monitoring of the NHS and urban forest to evaluate performance and identify trends or changes that may require a shift in management approaches or practices.**

Objectives for Public Lands

5. **Protect the NHS and urban forest on public lands through proactive management, enforcement of applicable regulations, and education.**
6. **Enhance and restore the NHS and urban forest on public lands by improving the condition of natural areas, increasing and improving linkages among protected natural areas, and creating habitats where appropriate.**

7. **Support the functionality of the NHS and the urban forest by managing public open spaces to maximize their ecological functions (while maintaining their primary uses).**

Objectives for Private Lands

8. **Protect the NHS and urban forest on private lands through education, implementation of applicable policies and regulations, the development review process, and enforcement.**
9. **Enhance and restore the NHS and urban forest on private lands by encouraging stewardship, naturalization, restoration, tree planting and proactive care with creative outreach and incentives.,**

5.3 URBAN FOREST TARGETS

There are many ways to measure the success of an urban forest management program and to gauge urban forest sustainability. The intent of this UFMP is to provide specific guidance for the implementation of strategic actions which, over time, will lead to the increase or improvement of a wide range of indicators of related to Mississauga's urban forest. As described in **Section 1.4**, the recommended review and monitoring for Mississauga's urban forest includes two components:

1. a review and update of the Criteria and Indicators based monitoring framework (as presented in **Appendix A**), and
2. a review of the status, timing and anticipated budgetary requirements of each action of this UFMP (as presented in **Appendix B**).

The Criteria and Indicators evaluate three aspects related to urban forest sustainability: the state of the urban forest itself, the state of municipal management and operations, and the state of community engagement in the urban forest.

Three targets have been developed specifically for the urban forest (as shown in **Table 4**) that relate exclusively to the state of the urban forest. Three additional targets have been developed for the City's Natural Heritage System (NHS) that also relate to the urban forest in so far as they speak to the wooded portions of the NHS. These six targets are described in detail in Section 6 of the Natural Heritage and Urban Forest Strategy (NH&UFS), and should be considered together. The targets specific to the urban forest are, however, reiterated in this section with the associated discussion for completeness of this Plan.

The targets presented in **Table 4** have been developed based on:

- consideration for direction from higher level City studies (i.e., the *Strategic Plan* (2009) and *Living Green Master Plan* (2012)), as well as guidance from urban forest studies for the City of Mississauga and Region of Peel
- sound understanding of the extent and condition of the current urban forest in Mississauga, including the fact that emerald ash borer is confirmed and spreading, and likely to kill most of the city's ash trees over the next decade
- the understanding that Mississauga is an urbanized jurisdiction that will continue to experience population growth and intensification over the next 20 years and beyond
- recognition of the many challenges, as well as the opportunities, for sustaining, enhancing and expanding these assets in an urban context
- recognition of the value of the ecosystem services provided by the urban forest, and the need to increase the provision of these services to maintain a high quality of life in this city, and
- input from City staff from various departments, the project Core Working Team, and the project steering committee.

Table 4. Targets for Mississauga's urban forest (UF)

Target Type	Current Status*	Recommended Target
UF Canopy Cover	approximately 15%	15% to 20%
UF Quality (of City Street and Park Trees)	a. Current City tree inventory is not up to date, or comprehensive b. Six species account >40% of the urban forest c. Invasive Norway maple accounts for >8% of the urban forest	a. The city tree inventory is comprehensive and up to date b. Tree species diversity is improved (i.e. no tree species represents >5% of the tree population City-wide or >20% on a given street) c. Proportion of non-native, invasive trees on City lands is reduced
UF Canopy Distribution	Current canopy cover distribution in the city is very uneven.	The distribution of forest cover is improved by focusing more efforts in areas where it is currently below the City-wide target.

* All data cited in this table is from the City of Mississauga Urban Forest Study (2011) and subsequent analyses by the Peel Urban Forest Working Group.

Urban Forest Canopy Cover

The most common metric associated with the urban forest, canopy cover, is useful for illustrating changes in the extent and distribution of mature tree cover in a given area. This was recognized in the 2012 *Living Green Master Plan* which recommended "canopy cover intensity" a measure of environmental performance for Mississauga. While informative and readily understood, this metric is of limited management value as it provides no information on the composition, structure or health of the urban forest. Therefore, additional metrics related to these aspects are also being recommended.

Work completed by the Peel Region Urban Forest Working Group using 2011 aerial imagery and GIS-based analyses confirms that Mississauga's canopy cover is about 15%. Although American Forests'[19] have suggested that a canopy cover target of 40% is optimal for sustainability, this target may be unattainable in many urban jurisdictions. Consequently, some municipalities in southern Ontario have either decided to set targets that are more realistic in relation to what they have, and what they could have, or not to set canopy cover targets at all (as shown in **Table 5**).

In reality, increasing canopy cover in an urban area is more challenging than might be expected. For example, analyses done for the *Town of Oakville's Urban Forest Management Plan* (2008) estimate that increasing tree planting efforts by 10% per year would increase canopy cover from 29.1% to 29.6% over a period of about 30 years, assuming relatively low mortality rates. Real considerations and challenges to increasing canopy cover include: natural tree mortality; loss of trees to pests, diseases and storm events; climate change; the need to accommodate ongoing development, and associated servicing; and realities that limit the amount of resources that can be directed to urban forest activities.

Table 5. Canopy cover estimates and targets from other jurisdictions

Municipality	Canopy Cover Estimate*	Canopy Cover Target	Source
City of Brampton	11%	TBD	*Peel Region Urban Forest Strategy (2011)*
City of Burlington	23%	none	*Urban Forest Management Plan 2011-2030 (2010)*
City of Guelph	20%	40%**	*Urban Canopy Cover Study (2011); Official Plan Target (2010)*
City of Pickering	20%	none	*City of Pickering Urban Forest Study, DRAFT (2011)*
City of St. Catharines	15 to 17%	30%	*Urban Forest Management Plan (2011)*
City of Toronto	26.6 to 28%	40%	*Toronto's Strategic Urban Forest Management Plan (2013)*
City of Thunder Bay	47.40%	none	*Thunder Bay Urban Forest Canopy Cover Project (2009)*
Town of Ajax	18.50%	none	*Town of Ajax Urban Forestry Study, Part A (2009)*
Town of Oakville	29.10%	40%	*Oakville's Urban Forest: Our Solution to Our Pollution (2006); Target set in Official Plan (2009)*

* These estimates have not all been developed using the same method.
** Council have directed staff to review this and identify a more realistic target.

[19] American Forests is a non-profit conservation organization and advocacy group committed to protecting and restoring forests in the United States.

As a result of these considerations, and taking into account available canopy cover data, as well as for Mississauga's current and anticipated land use context over the next 20 years, a city-wide canopy cover target of 15% to 20% has been recommended for the next 20 years (i.e., 2033) through this UFMP (as shown in **Table 4**). This range accounts for the fact that the city will lose more than 10% of the current canopy cover (I.e., all of its ash) to emerald ash borer, and that replacements and additional new plantings will not begin to provide significant canopy until the end of the 20 year span of this UFMP. Consequently, it will require significant effort and resources just to maintain the existing canopy cover, let alone increase it, over the next 20 years.

Canopy cover measures can also be problematic because there is no standard assessment method, and different methods can result in different estimates for the same jurisdiction with different levels of accuracy. Therefore, estimates of canopy cover should be understood to truly be estimates, and comparisons between municipalities should not necessarily be viewed as "apple for apple" comparisons.

Notably, Mississauga's canopy cover target range of 15% to 20% is different than its Natural Heritage System (NHS) target range (i.e., 12% to 14%) as it encompasses all trees in the city, including those within and outside of the NHS.

Why is Mississauga's Canopy Cover Target only 15% to 20%?

A conservative canopy cover target of 15% to 20% for 2033 has been identified to reflect the fact that it will be a significant challenge just to maintain the existing canopy cover over the next 20 years. The City and its partners are already working to sustain and expand canopy cover through various planning, operational and outreach initiatives (described in more detail in the UFMP). However, even with these efforts, a target of 15% to 20% is considered realistic for the following reasons:

- **Emerald ash borer**, a pest that kills almost all ash trees, is established in Mississauga and will peak over the next few years resulting in the loss of most of the City's ash (i.e., more than 10% of the city's canopy cover).
- Many **lands in the City are already zoned for uses that permit some type of development**. Although the City works with proponents to avoid and minimize the removal of trees, and replace them on-site were possible, some trees are typically removed as part of this process.
- The City is responsible for ensuring that existing and approved development has adequate servicing (e.g., roads, water mains, etc.). The **improvement or expansion of existing services**, or installation of new services, can also result in the removal of trees, although the City tries to ensure these are replaced on-site to the extent possible.
- Trees may also be removed for **human safety reasons** if they are severely damaged by natural phenomena such as pests, ice storms, or high winds. This results in the removal of 1500 to 2000 trees annually.
- The **majority of the City's trees are relatively small** (i.e., 15 cm diameter or less) and will not begin to start contributing substantially to canopy cover for at least 10 to 20 years.
- Although urban forestry practices have improved immensely over the past decade or so, in **the past, many trees were planted in sub-optimal conditions**. As a result, some of these trees will need to be removed and replaced, and in improved growing conditions, before they can contribute significantly to the City's future urban forest canopy.
- Most trees planted over the next 20 years will not begin to significantly contribute to canopy cover until the following 20 year period.
- **Trees that are planted, even in good soils with ample below and above ground space, can perish if not adequately maintained**, especially if they are exposed to extended periods of droughts. This will continue to be a challenge for the City, and all those planting trees in the city, under the new reality of climate change.

The City currently has an inventory of its street trees that is useful, but not completely up to date, and there is no inventory for its park trees. Tree health and safety can only be optimized if inventories of these assets are current, and if appropriate management is undertaken proactively. Therefore, having a current street and park tree inventory that is tied into a well-managed maintenance program is one of the best, and most cost-effective ways, way to ensure the City's trees are kept in a safe and healthy condition for as long as possible.

Urban Forest Canopy Cover Distribution

Recent urban forest studies (e.g., City of Guelph's *Canopy Cover Study* (2011), Toronto's *Strategic Urban Forest Management Plan* (2013) and the *City of Mississauga's Urban Forest Study* (2011)) have begun to examine the issue of distribution of canopy cover, and have argued that increasing cover in parts of a jurisdiction that are most lacking should be a key consideration in prioritizing planting and stewardship efforts.

The uneven canopy distribution in Mississauga is reflected, on one level, by the range in differences among wards, as shown in **Table 6**. These differences reflect a combination of the distinct land use history in different parts of the city, and

The *City of Mississauga Urban Forest Study* (2011) identified uneven canopy cover distribution as an issue, and has developed a preliminary Priority Planting Index for the City (as shown in **Figure 14** and **Table 6**). This Priority Planting Index mapping was developed based primarily on consideration for areas of low canopy cover and higher population densities. Preliminary areas identified as priorities for tree planting on this basis are circled in red. This information will be considered, in conjunction with other information and input from City staff and key stakeholders, to develop an Urban Forest Expansion Plan for the city (per Action #10 and NH&UFS Strategy #15).

Table 6. Canopy cover by Ward* in Mississauga

Ward	Current Canopy Cover	Comments
1	25%	includes a portion of the Credit River valley and residential woodlands
2	26%	includes a portion of the Credit River valley and residential woodlands
3	16%	includes a mix of land uses, including residential neighbourhoods, industry and creek valleylands
4	11%	mixed land uses, including the City Centre, low to high-density residential, and open space
5	4%	includes the airport where tree cover is very restricted for safety reasons, as well as many industrial areas
6	20%	includes a large portion of the Credit River valley
7	29%	includes a portion of the Credit River valley and residential woodlands
8	25%	includes a portion of the Credit River valley and residential woodlands
9	11%	predominantly low and mid-density residential land use, with some remnant woodlots
10	5%	predominantly newer subdivisions where street trees have been planted but not yet begun to mature
11	18%	mixed land uses, including agricultural, residential and industrial, and Credit River valley lands
City-wide	*15%*	

* Data provided by the Peel Urban Forest Working Group based on analyses of 2011 aerial imagery.

6 CURRENT URBAN FOREST PRACTICES IN MISSISSAUGA

The City of Mississauga is further ahead than many municipalities in terms of its urban forest management program. The section's certified arborists, ecologists, landscape architects and other staff are involved in many aspects of urban forest administration, maintenance, management and restoration. The City also has a number of regulations and policies intended to help protect urban trees and natural spaces, and several successful stewardship programs to engage the community in urban forest care, restoration and expansion. However, Mississauga's urban forest faces many challenges (see **Section 4**) to its sustainability, and a critical review of current practices, along with consultations with City staff, provides the basis for the identification of best practices and opportunities (as described in **Section 7**).

This section of the UFMP provides an overview of the City's current urban forest management administration, policies, practices and programs directed to both public and private lands. Current approaches to planning and operations activities related to the five key topic areas considered in this UFMP are reviewed, highlighting the role of the Parks and Forestry Division and other stakeholders in maintaining Mississauga's urban forest. Topic areas, each presented in more detail in this section, include:

1. **Urban forest management and administration,** which examines the administrative structure of the urban forestry program, considers resource allocation related to forestry, and reviews overall approaches to urban forest asset management
2. **Tree health and risk management,** which reviews the implementation of urban forest health, maintenance and risk management activities, as well as existing and potential partnerships
3. **Tree establishment and urban forest expansion,** which reviews tree establishment practices and programs, and examines opportunities for urban forest replacement and expansion
4. **Urban forest protection and preservation,** which examines relevant legislation, policies and guidelines, and explores how various municipal planning tools can more effectively promote urban forest sustainability; and
5. **Promotion, education, stewardship and partnerships,** which focuses on current approaches being used to increase awareness of the urban forest both internally (i.e., among City staff) and externally (i.e., among stakeholders and the community), and to engage a wide range of stakeholders and the community in the stewardship of the urban forest on public and private lands.

6.1 URBAN FOREST PROGRAM ADMINISTRATION

This section of the plan provides an overview of:

- The roles of different jurisdictional levels for the urban forest as they relate to Mississauga,
- Mississauga's Parks and Forestry Division's administrative structure, organization and processes, and
- Management of the City's urban forest assets.

6.1.1 RESPONSIBILITY FOR THE URBAN FOREST

Federal Government

The involvement of the federal government in urban forest management has, to date, been limited and indirect. To date, the primary source of support has been through the Canadian Food Inspection Agency (CFIA) and Canadian Forest Service (CFS) efforts to monitor and control the spread of invasive insect pests, the most important of which include Asian long-horned beetle (ALB, *Anoplophora glabripennis*) and emerald ash borer (EAB, *Agrilus planipennis*). Efforts to eradicate a localised ALB infestation in north Toronto, not far from the Mississauga border, which have been entirely successful. Unfortunately, similar efforts to stem the spread of EAB have failed. In response, the CFS had led the way in developing EAB sampling and population monitoring methodologies, including branch sampling and trapping implemented by cities across Ontario.

Provincial Government

Similar to the federal government, the government of Ontario has not been directly involved in urban forest management. However, a wide range of provincial legislation directly and indirectly affects the ability of municipalities to regulate their urban forest resources. **Table 7** provides a list of relevant provincial statutes and policies which directly relate to urban forest management.

Other provincial documents that include support for local urban forest initiatives include:

- *Grow Green: Ontario's Climate Change Action Plan* (2007), which sets a planting target of 50 million new trees in Southern Ontario by 2020, and provides funding for volunteer-driven tree planting projects
- *Ontario Invasive Species Strategic Plan* (2012) which identifies some strategies the various partners can use to help fight invasive species, and
- *Ontario's Biodiversity Strategy* (2011) which sets out a framework for engaging people, reducing threats, enhancing resilience and improving knowledge in relation to native biodiversity and ecosystems, including woodlands, in the Province.

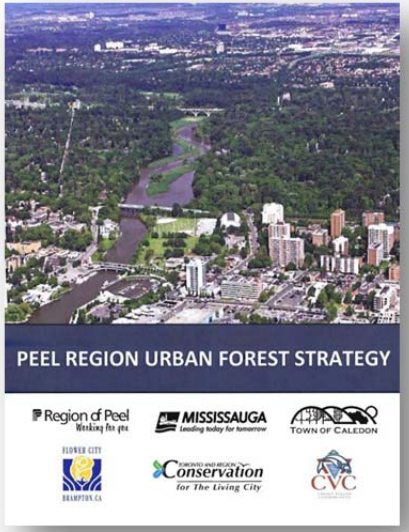
Table 7. Provincial statutes and policies with relevance to urban forest management

Statute or Policy	Relevance
Planning Act, 1990	Establishes the framework for municipal planning in the province. Empowers municipalities to develop official plans and regulate development, including requiring landscaping with trees and shrubs.
Municipal Act, 2001	Establishes municipal powers. Sec. 223.2 allows any municipality greater than 10,000 people to regulate the injury or destruction of trees, while Sec 135-146 provides the legal framework for municipal tree and site alteration by-laws .
Conservation Authorities Act, 1990	Establishes conservation authorities as watershed-based authorities with various responsibilities, including regulation of lands adjacent to watercourses, wetlands and shorelines.
Places to Grow Act, 2005	Enables Province to designate population growth areas, requiring certain jurisdictions to meet established growth targets by certain dates.
Forestry Act, 1990	Provides a legal definition for "woodlands" and "good forestry practices", as well as certain provisions pertaining to boundary/shared trees.
Provincial Policy Statement, 2005	Provides guidance for land use planning, protection for significant woodlands.
Greenbelt Act, 2005	The Greenbelt Act and the supporting Greenbelt Plan were recently amended to provide an additional designation of Urban River Valleys to the Natural Heritage System. This designation is intended to include publicly owned lands located in the urban river valleys extending south from the Greenbelt Plan. The lands within the Greenbelt Urban River Valleys are to be governed by the applicable municipal Official Plan policies provided they have regard for the objectives of the Greenbelt Plan.

Region of Peel

Mississauga is a lower-tier municipality within the Regional Municipality of Peel, along with the other Area Municipalities of Brampton and Caledon. The updated Regional *Official Plan* recognizes the importance of maintaining the Region's Greenlands System, and includes policies that support a range of studies and plans for different components of its natural heritage system. Official Plan Amendment 21B, adopted in 2010, directs the Region to *"...work jointly with the agencies and Area Municipalities to develop urban forest strategies and to encourage and support programs and initiatives that maintain and enhance the urban forest canopy*".

The Region, in collaboration with its Area Municipalities, Credit Valley Conservation (CVC) and the Toronto and Region Conservation Authority (TRCA), undertook the development of the *Peel Region Urban Forest Strategy (2011)*. One outcome of this Strategy has been the establishment of an interagency Urban Forest Working Group, which includes members from the Region, Area Municipalities and Conservation Authorities, who meet on a semi-regular basis to work towards implementing the Strategy's action items. This group has been an invaluable source of both data and feedback to support the development of this UFMP.



The *Peel Climate Change Strategy* (2011) is the strategic framework of all area municipalities (i.e., Mississauga, Brampton and Caledon) and conservation authorities (i.e., CVC and TRCA) in the geographic area of Peel Region that guides climate change mitigation and adaptation. It recognizes the importance of the urban forest in both these endeavours. The Strategy directs regional partners (Area Municipalities and Conservation Authorities) to, on an ongoing basis, "*undertake specific initiatives, such as implementing best practices related to urban forestry, which are intended to maintain and restore natural habitats, trees and naturalized spaces within the urban system*". The Region intends to provide support to its partners in this regard.

City of Mississauga

The City of Mississauga bears the primary responsibility for the planning and implementation of urban forest management within the City. The City's urban forest planning and operations activities focus on:

- establishment and maintenance of trees on public lands
- tree removal and tree planting on private property as part of development projects
- the development and enforcement of regulations related to privately-owned trees
- encroachments from private lands into adjacent public natural areas, and
- activities related to the maintenance and restoration of the City's woodlands and parks.

Urban forest management and maintenance is largely administered by the Forestry section of the Parks and Forestry Division within the Community Services Department. Forestry staff are responsible for the maintenance of over 240,000 street trees and trees in parks and City-owned natural areas, totalling well over 1 million trees. Most other departments are also directly and indirectly involved in planning and operations which may affect existing trees and/or opportunities for future growth of the urban forest, although some to a lesser degree.

The key departments whose work includes decisions affecting planning, operations, outreach and stewardship related to tree preservation and/or planting issues on a regular basis include:

- Community Services Department
  - Environment Division
  - Parks and Forestry Division
    - Park Planning
    - Park Development
    - Parks Operations
    - Forestry
- Planning and Building Department
  - Policy Planning Division
  - Development and Design Division
  - Building Division
- Transportation and Works Department
  - Transportation and Infrastructure Division
  - Development Engineering Division
  - Engineering and Works Division
    - Development Construction Division
- Corporate Services Department
  - Office of the City Clerk (including Committee of Adjustment)
  - Realty Services

Landscape Architects, Landscape Technologists, Site Plan Technologists, and Land Use Planners in Community Services, Planning and Building, and Transportation and Works regularly undertake review of tree preservation and/or planting plans, as well as site inspections, to improve the efficiency of the planning, review and approval process. Foresters, Arborists and Ecologists in the Parks and Forestry Division play a role in most tree-related decisions on municipal and private projects, but are not always involved early enough in the process, and may not be involved in situations where only a one or two trees are being removed, or where no trees are being removed but opportunities for planting exist.

It is important to understand that while the Parks and Forestry Division is the primary group charged with the management and administration of Mississauga's urban forest, responsibility for this vital asset extends to various decision-makers, planners, and operations staff in other City departments and divisions. Successful and sustainable urban forest management can only occur if all groups involved understand and accept this responsibility, and work together to achieve the common vision, goals and targets established through the Mississauga Natural Heritage and Urban Forest Strategy (see **Section 5.2**).

6.1.2 FORESTRY RESOURCES AND ASSET MANAGEMENT

The Forestry section currently has staff with forestry, arboriculture, ecology and other relevant areas of expertise under the direction of the section Manager that are divided among five key tasks: contract administration, protection and preservation, inspections, City tree maintenance, and woodland/natural area services (including community planting and stewardship).

Many municipalities maintain inventories of a wide variety of infrastructure elements, such as fleet vehicles or facilities. Far fewer communities fully benefit from maintaining a similar knowledge of their green infrastructure components, including municipally-owned trees.

Mississauga currently has an inventory of about 243,000 city-owned street trees and will potentially be expanded to include trees in City parks and hundreds of thousands more added through the One Million Trees program. Some Region of Peel trees are also included in the inventory, as the City maintains the trees on Regional roads as well. The inventory is GIS-based, but contains a limited amount of information about each individual tree. Attributes include a unique identification number, municipal address of property closest to street tree, forestry management zone,, overall condition rating, diameter (in cm), service status (Operations or Warranty), and location coordinates.

The Parks and Forestry Division currently uses Hansen asset management software to receive service requests and develop work orders for planning operations such as tree pruning or planting. In its 2013 business plan, the Parks and Forestry Division put forward a budget request to enable the Forestry section to transition towards a more comprehensive asset management system, including in-field solutions such as mobile computers, wireless access and mobile printers. This will increase staff productivity by enabling real-time or automated information updating, work order generation and other tasks currently done manually in-office, and should result in improved timing of service delivery.

6.2 TREE HEALTH AND RISK ASSESSMENT

6.2.1 STREET TREE MAINTENANCE AND BLOCK PRUNING

Street Tree Elevation Program

Like many jurisdictions with responsibility for publicly-owned street trees, Mississauga regularly undertakes street tree pruning across the City, through the Parks and Forestry Division's Street Tree Elevation Program. The program focuses on providing the minimum required clearances between tree branches, roads and sidewalks, and typically begins when trees are between 10 and 20 years of age. The program is intended to operate on an 8-year cycle, meaning that most trees along City streets should be pruned once every 8 years. This length of cycle is generally considered adequate to balance maintenance costs and the benefits provided by proper pruning.

Young Tree Training

Pruning of young trees to develop good structure, often called 'training', is one of the best investments in the health of the future urban forest. Proactive and early pruning provides trees with good form which can be maintained throughout their lives, thereby lowering the risk of future failure and reducing liability and long-term arboricultural maintenance requirements and costs.

Currently, the City prunes some young trees, typically three to four years following planting. However, the young tree pruning program is not formalized, not all young trees are pruned, and pruned trees may not be revisited again until they are incorporated into the Street Tree Elevation Program, which may be long enough after the initial pruning that significant structural problems may develop.

6.2.2 URBAN FOREST HEALTH MANAGEMENT

Urban forest health management primarily involves utilizing a range of management practices to monitor and mitigate the effects of tree pests, diseases, and invasive plant species (in natural areas).

Pest and Disease Management

As in most jurisdictions, Mississauga's approach to pest and disease management is a combination of proactive (e.g., site inspections, monitoring, tree pruning) and reactive (e.g., tree removal, pesticide treatment) measures. As part of their duties, the City's Parks and Forestry Division Inspectors monitor City-owned street and park trees for signs of invasive pests or pathogens, and

Ecologists monitor for invasive plants in natural areas. In recent decades, the City has committed to implementing an Integrated Pest Management (IPM)-based approach to pest and disease management. This holistic approach balances cultural and biological approaches (such as maintaining tree health) with methods to reduce pest or disease populations, while reducing the use of chemical pesticides.

Emerald Ash Borer (EAB)

The relatively recent emergence of the emerald ash borer (*Agrilus planipennis*) places an estimated 16% of the City's urban forest in significant danger. This invasive beetle causes near-complete mortality of ash trees wherever they occur if they are not treated with a stem-injectable pesticide. The borer is established across the entire City, and widespread ash mortality is already beginning. In response, the City has begun implementation of an Active Management Plan, scheduled over the next nine to 10 years, that will see approximately 20,000 trees treated and will help fund the costly removal of dead and potentially hazardous trees and their replacement. The cost of the EAB Management Plan is an estimated $51 million over the plan horizon, and may vary depending on the rate and extent of tree mortality. The Plan is funded in part by a Special Purpose tax levy.

Natural Areas Invasive Species Management

Invasive plant species, such as dog-strangling vine, buckthorn, or garlic mustard, are a significant threat to the ecological integrity and health of wooded natural areas. The City's approach to managing invasive species in wooded or any natural areas has, to date, been relatively limited and focused on intensive management of individual infestations, rather than a wide-ranging strategic effort to reduce or eliminate invasive plant species. Efforts involving the community, such as weed pulls, are occasionally undertaken. Invasive species removals are often required by the conservation authorities as part of development approvals on regulated lands, and are recommended more broadly through Natural Areas Conservation Plans recommended in the Natural Heritage & Urban Forest Strategy (Strategy #13). In addition, the conservation authorities have extensive resources related to the identification and management of invasive species on their websites, and undertake some of this work on public natural areas in Mississauga, and elsewhere in the watershed.

6.2.3 TREE RISK MANAGEMENT

Despite being an extremely valuable asset (see **Section 3**), trees may pose risk to persons or property. Although tree risk is statistically minimal in relation to many factors of daily life, the potential for tree-related risk increases as trees age, if tree health and condition decline, or if young trees are not properly pruned to develop good structure. The City is responsible for ensuring that its trees are maintained to minimize potential risks presented by them.

Street Tree Risk Management

Currently, street tree risk management is undertaken through a combination of proactive and reactive methods. Risk reduction through methods such as deadwood and structural pruning is undertaken during the course of the daily operations of the City's tree maintenance staff and contractors. Additionally, the City's Forestry Inspectors respond to resident requests for tree assessment and, if necessary, create work orders through the City's asset management system, which are prioritized based upon urgency (#1 – 24 hours, #2 – up to 3 months, #3 – 3 to 6 months). In 2011, some Forestry staff received training in both basic and advanced methods of tree risk assessment in order to improve the City's ability to practice more conservation-based tree risk management, where appropriate.

Woodland Tree Risk Management

The City does not currently have a formalized program for tree risk inspection or mitigation in the 152 woodlands or other natural areas it manages. In some woodlands where risk is a known issue there has been some mitigation work, such as selective tree removal, done in the past. Additionally, woodlands in Riverwood Park have some tree risk inspection done by volunteers, but it is not conducted by trained professionals.

Management of tree-related risk in woodlands and other natural areas is challenging due to the large numbers of trees present in such areas, and has recently been made even more challenging because of the resources required to deal with emerald ash borer (EAB). It is anticipated that, as the borer spreads across the City and causes increasing ash mortality, more woodlands and natural areas may require fencing or other risk management approaches, due to the rapid rate of root decay and tree uprooting following EAB-induced mortality.

6.3 TREE ESTABLISHMENT AND URBAN FOREST EXPANSION

Direct management is necessary to ensure the expansion of the urban forest. This is in large part due to the fact that trees in predominantly urban settings often cannot regenerate naturally; seeding and vegetative growth account for only a small part of urban forest regeneration. In addition, there are stressors and threats specifically related to the urban context (e.g., encroachment, vandalism) that require active management.

6.3.1 TREE ESTABLISHMENT PROGRAMS AND PROCEDURES

A key component of Mississauga's urban forest program is the establishment and expansion of the urban forest, primarily through tree planting. Trees in Mississauga are generally planted under City programs by municipal staff and contractors, or by private residents.

Street Tree Planting Program

The City plants caliper-size trees as replacements for removed trees or to fill available planting sites on the public portions of streetscapes. City residents can submit requests for tree planting, which are addressed in a similar manner as other work order requests.

Commemorative Tree Program

The City maintains a Commemorative Tree Program whereby residents can donate a commemorative tree for $750. Forestry staff work with the contributor to determine an appropriate species and location for the tree to be planted. Commemorative plaques may also be installed for $250.

Planting in New Developments and Redevelopments

The City assumes responsibility for street trees planted on public rights-of-way as part of new development, redevelopment, and other dwelling projects, under agreement with the developer, after the plantings are completed and the warranty period (usually two years) has passed. Costs for tree planting (as determined by Forestry staff) are usually incorporated into the closing purchase price of new residences, and securities for estimated landscape costs are provided by the developer.

Trees are typically planted after homes have been built, roadways have been paved, and other streetscape elements have been completed. While this may delay the provision of trees in a new neighbourhood, it is consistent with best practices as it greatly reduces the likelihood of tree damage and enables better maintenance. Typically, one tree is planted per 10 m, except where trees need to be excluded to avoid infrastructure conflicts.

One Million Trees Mississauga

One Million Trees Mississauga, a program to plant one million trees on public and private lands over the next 20 years, started in 2012 and had its official launch in April 2013. The program is an action item from the City's *Living Green Master Plan* (2012) and *Strategic Plan* (2009). Trees will be planted by City staff on public lands, and support will be given to individual volunteers, community groups, organizations and businesses to plant trees across the City. The program will track plantings conducted through various activities on public and private lands, including tree establishment through site plan and subdivision development, and plantings on private residential lots (where the land owners choose to report it).

Naturalization and Urban Forest Expansion

The City facilitates a number of community-focused tree planting, naturalization and stewardship programs in the spring, summer and fall. These activities are often community-organized or conducted in conjunction with Credit Valley Conservation, the Toronto Region Conservation Authority, non-profit organization (e.g., Evergreen) and/or local businesses. Every year thousands of small-stock native trees and shrubs are planted through such programs, and in 2012 nearly 30,000 trees and shrubs were planted.

6.3.2 STANDARDS AND SPECIFICATIONS

Planting standards and technical specifications can help ensure the consistent application of proper tree planting techniques, including site preparation, species selection, tree installation and post-planting maintenance.

Guiding Documents

Several standards and specifications help guide the tree establishment process in Mississauga. Guiding documents which outline aspects of tree planting standards and specifications include:

- *Site Plan Application: Process Guidelines* (Planning and Building Department, 2012)
- *Development Requirements Manual, Subdivision Requirements, Section 1: General Requirements for Servicing Subdivisions* (Transportation and Works Department, 2009)
- *Community Services Subdivision Requirements Manual* (Community Services Department, last rev. 2006, currently under review)
- *Green Development Standards* (Planning and Building Department, 2010)

Technical Requirements

Mississauga's tree planting specifications outline the City's requirements for aspects of tree establishment, including planting stock selection (species, size, quality, etc.), tree spacing, soil quality and volumes, and establishment methods. The primary guiding document which outlines these specifications is the *Community Services Subdivision Requirements Manual,* and its associated detail drawings and specifications. Section 02950 – Planting, was last revised in 2002 and is the primary specification used by the City to guide planting on municipal rights-of-way in new developments. Many of the provisions of this specification are in accordance with recognized best practices, but some require updating or modification to promote improved tree health and successful urban forest establishment. Most notably, minimum soil volume requirements should be included and should reflect the City's *Green Development Standards* (2010), and specifications for soil quality and texture should be revised to better reflect the scientific and technical understanding of urban tree soils and tree requirements.

Tree Species Selection

The City's Parks and Forestry Division currently has a list of acceptable or appropriate tree species to guide street tree establishment. Typically, species selection for development plans on private property is reviewed by the Landscape Architects or Site Plan Technologists in the Development and Design Division of the Planning and Building Department, while Forestry staff typically review species selection for trees proposed on public lands through the planning process. Notably, CVC has a comprehensive Plant Selection Guideline and list of desirable and undesirable species suitable for the watershed, particularly for naturalization projects.

Commonly-planted street tree species include varieties of maple, linden, elm, oak, hackberry, Kentucky coffee tree, honey locust, ivory silk lilac, and some species of conifers. Species selection for parks and naturalization projects tend to be more exclusively focused on native species, and more diverse.

Due to limited soil volumes and the difficult growing sites across the City (and particularly in boulevards), the available palette of suitable hardy tree species is limited. As a consequence, opportunities for increasing urban forest species diversity are reduced, and an increased amount of resources must be dedicated to sustaining planted trees.

Mississauga "Stage One" Green Development Standards

In 2010, the City published its first *Green Development Standards* as part of its Green Development Strategy. The Standards address several aspects of sustainable development, including storm water management, green roofs, bird strike prevention and incorporation of new trees into development sites. The Standards support the implementation of known best practices, including the provision of 30 m^3 of soil per individual tree in hardscape areas, or 15 m^3 per tree when open soil areas are shared among more than one tree. The Standards also recognize the importance of planting large-stature shade trees at an appropriate spacing (6 to 8 m) to enable the development of large canopies along frontages and pedestrian areas. Currently, implementation of the Green Development Standards is encouraged.

6.4 TREE PROTECTION AND URBAN FOREST PRESERVATION

The City's approach to tree protection and urban forest preservation has become increasingly comprehensive in terms of introducing and revising policies, by-laws, standards and specifications that support protection of trees and require replacement for healthy trees that need to be removed. A summary of the current policies, by-laws and specifications is provided below.

6.4.1 OFFICIAL PLAN POLICIES

Mississauga is one of few municipalities with a specific section dedicated to urban forest policies in its Official Plan. The policies, found in Section 6.4 of the *Official Plan* (2011), are comprehensive, providing support for a range of tools to protect and plant trees while also providing flexibility to accommodate appropriate development. The policies encourage tree protection and planting on public and private lands, and provide specific direction for:

- developing a strategic planting program that targets different parts of the City
- implementing a strategic maintenance program for trees on public land
- ensuring development and site alteration will have "no negative impact" on the urban forest
- planting the right tree in the right place, with enough soil to sustain it
- implementing and complying with tree by-laws (on public and private lands)
- promoting greater awareness and stewardship, both internally and externally; and
- building strategic partnerships for promotion and implementation.

Some of this policy direction carries over into policies for desirable urban form and neighbourhoods where consideration for and integration of trees is recognized as important, particularly in those neighbourhoods with Residential Woodlands overlays. Notably, Section 9.5.2.11 states, *"Site development will be required to … (f) preserve significant trees on public and private lands"*, although the term "significant trees" is not defined in the Official Plan.

The Natural Environment section of the Official Plan (Section 6) presents a framework for a City-wide Green System. Although this system does not explicitly include the urban forest, it incorporates treed natural areas, Residential Woodlands, and Parks and Open Spaces, which include many natural and manicured treed areas.

Residential Woodlands (as shown in **Figure 8**) are residential areas, primarily on private property, identified as having relatively high levels of canopy cover and mapped as part of the City's Green System. The Residential Woodlands overlay is a unique policy tool that encompasses areas where tree preservation and replacement are particularly important because of the relatively high levels of canopy cover and the ecological value[20] of some of these areas. The Residential Woodlands policies encourage protection and enhancement of the urban forest in these areas, and some Special Policy Areas require it (e.g., parts of Cooksville).

In some cases these policies have been used successfully as tools to prevent significant expansion of existing residential developments into treed areas, and treed areas identified for protection through the redevelopment process have been zoned as Greenbelt to allow for natural regeneration, effectively protecting them from future re-development or expansion proposals.

The Residential Woodlands mapping in the City's current Official Plan has been carried forward from the previous Official Plan, and is based on data and analyses from the late 1980s. Residential Woodlands were mapped using the available tools at that time (i.e., a visual assessment of black and white aerial photos) and is now outdated.

Figure 8. The density of canopy cover in a mapped Residential Woodland area (CL7) in dark green hatching along Mississauga's lakeshore

[20] Examples of ecological value provided by some of these residential woodlands include stopover habitat for migratory birds in the spring and fall, and habitat for resident urban-adapted wildlife.

6.4.2 BY-LAWS

Through the provincial *Municipal Act* (2001), any municipality with a population over 10,000 residents is empowered to enact legislation to regulate the injury and destruction of trees on public or private lands. Tree protection by-laws are primarily enacted to regulate the injury or destruction of trees outside of the development process. Mississauga has enacted three by-laws specifically addressing these issues, and several others that also support urban forest objectives.

Private Tree Protection By-law

The City's first private Tree Permit by-law (0624-2001) was approved December 2001. This by-law was amended in December 2005 (474-05) and was recently revised again, and passed by Council in 2012. The 2012 amendment, which changed the by-law name to the Private Tree Protection by-law (0254-2012), has been in effect since March 1, 2013. This amendment incorporates several significant changes to the by-law making it more restrictive.

The Private Tree Protection by-law has always generally regulated the injury or destruction (removal) of trees on private property in the City. Key changes in the recent amendment include:

- regulation of three or more trees with diameters greater than 15 cm per calendar year (as opposed to five)
- requirements for one or two replacement trees to be planted for each healthy tree removed (depending on the diameter of the one removed) or that a contribution be made to the Corporate Replacement Tree Planting Fund equivalent to the replacement costs, and
- Increases in the penalties for by-law infraction to the maximum allowable under the *Municipal Act*.

Street Tree By-law

By-law 91-75 regulates injury and destruction of trees located in City-owned rights-of-way and other publicly owned lands. This by-law, which is out-of-date, is currently being revised by City staff to bring it into accordance with the current legislative framework and practices, and should be completed shortly. This by-law will:

- improve the City's ability to prevent and/ or stop works which may result in the injury or removal of City-owned trees, and
- fine parties responsible for such damages.

Parks By-law

By-law 186-05 regulates the use of City-owned parks. The by-law prohibits persons from engaging *"in any activity that may cause injury or damage to any… tree"* and from planting, pruning, climbing, removing, damaging or defacing any trees.

Other Relevant By-laws

In addition to these "tree-specific" by-laws, the City has enacted an Encroachment By-law (57-04), and an Erosion and Sediment Control By-law (512-91). The Encroachment By-law, enacted in 2004 and last amended in 2011, is intended to prohibit any type of encroachment on to City lands unless specifically approved by the City or other public landowners (e.g., the Conservation Authorities). This by-law has been used effectively to prevent and require removal of any structures or changes in land use that extend from private property into adjacent City-owned natural areas, most of which are wooded. Over the past nine years, since by-law enactment, approximately 3.44 hectares (8.2 acres) have been effectively reclaimed.

The City's Erosion and Sediment Control By-law, which is currently being updated, regulates the removal or placement of topsoil from any lands (public or private) throughout the city without a permit. It currently exempts removal from lots 1 ha and less in area, except for removal adjacent (within 30 m) to water bodies, which requires a permit in all cases. As part of the permitting process, applicants must provide the location and type of vegetative cover in the area to be affected. However, the by-law is not currently being used as a tool to support urban forestry or natural area objectives.

6.4.3 TREE PRESERVATION THROUGH THE PLANNING PROCESS

Tree Preservation through Subdivision Development

The subdivision development process is coordinated by staff from the Planning and Building, Community Services and Transportation and Works departments. The principal guide for tree preservation and planting as part of this form of development is the *Community Services Subdivision Requirements Manual* (last revised in 2006, currently under review). This manual outlines requirements for site-wide and individual lot/block preservation plans, including tree and site information, standard notes, and tree hoarding. In accordance with the manual, woodland management plans may also be required.

Various City staff are involved in overseeing tree preservation, depending on the location of the tree(s). Landscape Architects in the Planning and Building Department oversee tree preservation on private property; Landscape Architects in the Community Services Department oversee tree preservation on public property and lands to be dedicated to the City, and Certified Arborists from Forestry provide site-specific expertise as required.

Because the City is built out, subdivision development in Mississauga is increasingly uncommon. Consequently, the *Manual* is being revised to ensure its utility as a guiding document for infill and intensification projects, as well as subdivisions.

Tree Preservation under Site Plan Control

Site Plan Control is intended to ensure development conforms to the policies of the City's Official Plan, including those relating to the environment. Site Plan Control applies to several different categories of lands, including certain residential areas of the City. Through this process, development proponents must submit detailed Site Plan Applications, outlining various aspects of the proposed development for review by City staff, other regulatory bodies and potentially affected stakeholders. Unlike the subdivision planning process, Site Plan Control is primarily administered by one City department - Planning and Building, with support from Landscape Architects and Planners in Park Planning where the proposals are adjacent to City-owned lands. Other departments may also provide comment, if required, through participation in the Development Application Review Committee (DARC).

Site Plan Technologists and Landscape Architects in the Planning and Building Department are the primary reviewers of tree protection and planting on these types of applications, but may request input from Certified Arborists in Forestry if they feel additional technical support is required.

The City's *Site Plan Applications: Process Guidelines* manual is the primary guiding document for this form of development planning (specifically under Site Plan Control By-law 0293-2006). Key requirements for tree preservation planning under Site Plan Control include a tree survey plan (including mapping and identification of trees >15 cm DBH), general site information, and tree protection hoarding (if applicable to the site). Notably, there is no formal requirement for a detailed written arborist report, although these are often requested by the Site Plan Technologist in Planning and Development as part of the Site Plan Application. The City's *Design Guidelines and Site Plan Requirements: New Dwellings, Replacement Housing and Additions* manual (May 2010) also provides guidance for tree protection during development specifically tailored to infill situations.

Under both subdivision planning and Site Plan Control, development proponents are typically required to adhere to Mississauga's tree protection by-laws. Furthermore, the City is able to request and hold financial securities against tree protection, in addition to several other elements of development.. Securities against tree protection are typically released within one growing season following completion of all site works, and are only held longer if hoarding is not in place during construction works or if damage to trees due to construction practices is observed.

Tree Preservation outside Development Control

Certain types of site development are not subject to stringent development controls, and are primarily subject to municipal zoning regulations or provincial statutes. This includes many forms of construction outside of Site Plan Control

areas (which still require Building Permits), or minor works such as swimming pool installations. Opportunities for tree preservation in these situations are more limited, with the primary mechanisms being the City's existing tree protection by-laws and the *Tree Injury or Destruction Questionnaire and Declaration* form. This form is intended to be submitted to the Forestry Section of the Community Services department in conjunction with any Building Permit application, and requests that applicants assess and declare whether tree injury or removal permits are required, pursuant to City by-laws. However, these forms are not reviewed by Forestry Section staff, and site inspection to verify the declaration is rarely undertaken by a Certified Arborist. This is partly due to provincial legislation, which mandates short timelines for Building Permit issuance following submission of an application for such a permit. This absence of follow-up for minor development applications may result in damage to or removal of by-law regulated trees without the City's knowledge or permission.

Another possible opportunity for tree preservation during development exists through the Committee of Adjustment process, where development applications requesting variances from zoning by-laws are reviewed by community members and City staff. The Development and Design division reviews and comments on applications, and may consult with Forestry staff. Because Committee of Adjustment review is a largely precedent-based, "applicant-driven" process, tree protection usually only becomes an issue if public pressure is brought to bear on the review process.

6.4.4 TREE PROTECTION DURING MUNICIPAL WORKS

Existing trees, particularly those owned by the City, can be impacted during the course of municipal works ranging from common maintenance operations such as sidewalk panel repair, to major capital projects such as road widening. While the City generally makes efforts to ensure that trees are not adversely affected, tree protection during municipal works may be overlooked or not fully implemented due to several factors, as described below.

Municipal works, whether planned or in response to emergency situations, are not generally reviewed or supervised by Forestry Section staff. If tree preservation hoarding or fencing are installed during municipal works, there is no set standard for tree protection zone sizes to ensure consistent application and effective protection of trees to be retained. Tree protection measures are inspected by Parks Planning section or Transportation and Works department staff along with other elements of the works being undertaken. This may result in missed opportunities to implement effective and comprehensive tree protection as part of municipal works.

The absence of City-wide standard engineering specifications or detailed drawings for tree protection may also result in missed opportunities for effective tree preservation. While the Development and Design division has standard details for tree protection for use during site development, there are no comparable standards or supporting specifications included in Transportation and Works' standard drawings.

Increasingly, City departments involved in planning and implementing municipal works, including infrastructure maintenance and capital projects, are consulting with Forestry Section staff when tree preservation issues arise. While certain types of municipal works may require adjustments to standard tree protection measures to accommodate site-specific circumstances, making these adjustments early in the works planning process will help ensure that existing trees are protected to the fullest extent possible.

6.4.5 TREE PROTECTION SPECIFICATIONS

Tree protection specifications and standards are intended to guide the design and implementation of on-site tree protection measures. Currently, the City maintains two different sets of tree protection fencing/hoarding standard detail drawings and one set of written specifications.

Standard drawing No. 02950-8 was published in 2002 by the Community Services department and is contained within the *Community Services Subdivision Requirements Manual* (currently under review). It provides details for installation of 'farm fence' tree protection fencing, along with standard notes, and is supported by Specification No. 02104 – Site Protection.

6.5 PROMOTION, EDUCATION, STEWARDSHIP & PARTNERSHIPS

Both the *Peel Region Urban Forest Strategy* (2011) and the *Mississauga Urban Forest Study* (2011) recognize that residential property owners and tenants manage most of the existing urban forest, and also oversee the lands where most of the opportunities for urban forest expansion exist in the city. Therefore, their awareness and support of local urban forest objectives is critical in achieving established targets and goals.

> ***Residents of Peel Region have … expressed a desire to steward the urban forest; however, direction is needed. In addition, many New Canadians must now be introduced to the urban forest.***
>
> Peel Region Urban Forest Strategy (2011)

In recognition of this reality, the City of Mississauga, and its agency partners and adjacent municipalities, are becoming increasingly involved in various forms of outreach to specific stakeholder groups and the community at large, on a wide range of topics related to urban forestry and natural heritage. Existing awareness campaigns, tools and programs that apply in Mississauga are led by different organizations that fall into one of the following categories:

- Region of Peel
- City of Mississauga
- Conservation Authorities
- Community
- Industry

Current initiatives involve promotion, education, stewardship and partnerships, and/or a combination of those elements, and are described briefly below.

6.5.1 WEBSITE AND SOCIAL MEDIA

Although not specific to urban forestry, the Region has also launched a "Let Your Green Show" campaign with its own website (www.letyourgreenshow.ca) that encourages residents to: (1) grow and eat local, (2) use less water, and (3) give their cars a break. Having drought tolerant gardens of native species and planting trees are part of what is promoted through this program. The program tries to foster interest through local competitions (e.g. last year Mississauga's

Ward 1 was recognized as the "greenest" ward in the City) and also provides links to local climate change and environmental master plans.

Also not specific to urban forestry, the City now provides a range of social media connections. Recent developments include the ability of anyone to join the City on Facebook, Twitter, blogs (e.g., for the *Living Green Master Plan*) or newsfeeds. The City also has its own "hotline" 3-1-1 which is available Monday to Friday from 7 a.m. to 7 p.m. for various inquiries about City or Regional programs or services, including Forestry. Common forestry and natural heritage inquiries include reports of noxious Giant Hogweed, questions about the Private Tree Protection By-law, and reports of trees on City property that may be hazardous. Live streaming of public committee meetings is also provided through the City's website.

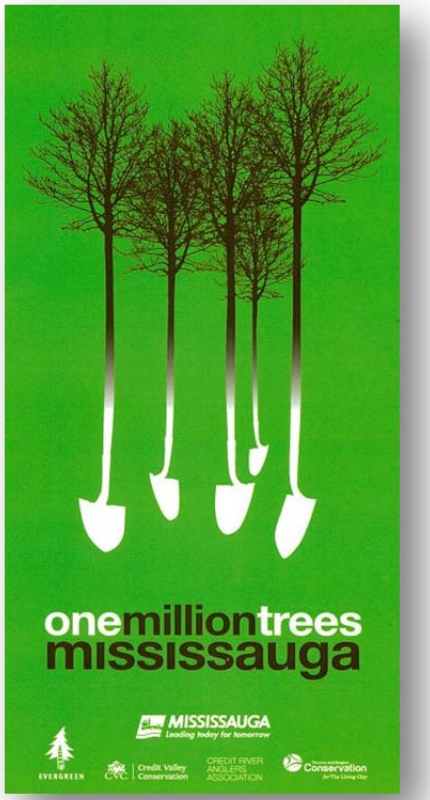
The City's website has a Forestry section that has been recently updated and includes specific pages on:

- City trees and boulevards
- Private trees and encroachment
- Pests and disease management
- Maintaining the City's Natural Areas
- Getting involved (i.e., tree planting and stewardship programs, including links to the One Million Trees program website)
- Tree-related by-laws

The website section is well-organized, comprehensive and concise. In addition to information and links it also includes an interactive map of all the City's Natural Areas where detailed ecological maps and fact sheets on each one can be downloaded. This is a valuable tool that facilitates natural heritage planning, and keeps the process transparent from an information sharing perspective. Although the City does have a street tree inventory, this inventory is out of date and has not been made available to the public through the website.

In addition, the City recently launched a stand-alone website for the One Million Trees Program (www.onemilliontrees.ca/) which has a very fresh and modern look, an on-line tracking log for the number of trees planted since program inception and a list of who has planted them, and clear information on:

- Who should participate
- How to participate
- Different planning considerations for different planting objectives (e.g., for saving energy, for creating a woodland)
- Recommended species and planting tips (including deer and rabbit resistant plants)
- Planting programs for public lands, residential properties, business properties, and school grounds
- The benefits of trees



Although entirely voluntary (and therefore not necessarily comprehensive), this will be the first mechanism for tracking plantings on private as well as public property throughout Mississauga. This website also provides a cohesive umbrella for a number of supporting organizations that contribute resources and information.

The One Million Trees Program also has hardcopy posters and flyers that have been circulated and posted in various public venues, and will be available at selected public events.

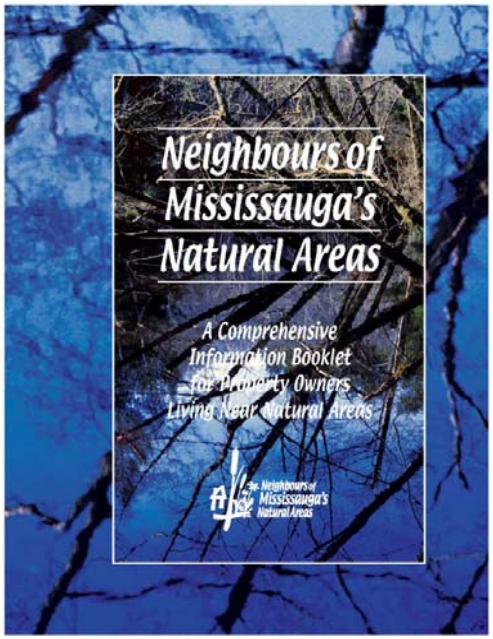
The local conservation authorities also have a number of resources posted on their websites that are directly relevant both to natural heritage and urban forest planning, management and outreach. Examples include plant lists of desirable native species (and undesirable invasive species to avoid), a series of publications on ecosystem services, and brochures providing guidance on how to plant trees and naturalize landscapes.

6.5.2 PROMOTION AND EDUCATION

In terms of day-to-day outreach, City staff in the Parks and Forestry Division that support by-law enforcement and stewardship consider education a key part of their job, and use face-to-face meetings as opportunities for outreach. The Division has also developed a series of pamphlets and information post cards (printed in colour, with a consistent look to them, and written in non-technical language) on key topics including: gypsy moth, emerald ash borer, and the private tree protection by-law. These publications are available through the Parks and Forestry Division, and are disseminated to residents as appropriate. City staff in other departments (e.g., Planning and Building, Transportation and Works) also have opportunities to educate proponents on the benefits of trees and the City's current policies, guidelines and by-laws related to trees.

The City has often holds open houses on "hot" urban forestry topics (e.g., emerald ash borer), typically at a City venue (such as City Hall or the Living Arts Centre). The City has also been involved in some outreach to youth through its various stewardship initiatives. However, holding workshops targeted to particular interest groups, as well as meeting people in their own community centres has not been normal practice.

The City of Mississauga was one of the first municipalities to develop a city-wide brochure for residents abutting City-owned Natural Areas that provides guidance about "do's" and "don'ts". While the information and guidance in this booklet is still relevant, it should be updated to reflect changes in the relevant policies and by-laws, shortened, and include more graphics.



Technical information (i.e., maps and fact sheets) are available on-line for all Natural Areas in the City However, the City's public Natural Areas, and additional information is posted on a few high profile parks on the City's website. In addition, the City and Credit Valley Conservation (CVC) have developed colourful information brochures on selected parks and Natural Areas, such as the Lakefront Promenade Park and Marina brochure.

City programs related to urban forestry that have been in place for some time include the Annual Arbour Day Program, Annual Earth Day Program / week, and the Commemorative Tree program that is administered through the Forestry Section, in conjunction with the Commemorative Bench program. The purpose of the program is to provide members of the public a way to recognize or honour others through a lasting tribute to a loved one. Trees are planted twice annually (spring and fall) and the locations of the trees are chosen with the help of Parks & Forestry staff to ensure that the tree is planted in a location in which they will thrive. With the future creation of a Memorial Forest, all future trees would be planted in one central location instead of various sites across the City.

SIGNIFICANT TREES

More recently, the City has initiated a Significant Trees Program to get residents to think about the value of trees in their neighborhoods by nominating old, large, interesting or unique trees on City property. The City of Mississauga has defined Significant Trees as a tree that is recognized because of its size, form, rarity of species, age, its association with a historical figure or event, and/or a tree that is distinctive in the community. Ultimately, this registry could form the basis of designation of these trees under the *Ontario Heritage Act*.

6.5.3 STEWARDSHIP, PARTNERSHIPS & FUNDING

The Region currently has a couple of programs that provide outreach to the community on topics related to urban forestry.

- The *Teach Green in Peel* program is an on-line database that helps teachers in the Region find locally-relevant environmental education resources and programs.
- Peel's *Fusion Landscapes* program targets residential homeowners or tenants who are interested in landscaping their yard with drought-tolerant and native species, and provides home visits from a landscape technician to a certain number of residences annually.

Over the past decade, the City has developed and expanded partnerships to pursue a range of stewardship activities with all the local conservation authorities as well as a number of other non-profit organizations (e.g., Evergreen, Trees Canada, ACER, Riverwood Conservancy, Credit River Anglers, Ecosource, etc.), schools (e.g., University of Toronto Mississauga Campus), the Greater Toronto Airport Authority, and a number of local businesses. This resulted in the planting of close to 30,000 trees and shrubs in 2012 in various locations throughout the City, primarily on City lands. As opportunities for tree planting and/or naturalization on City lands are becoming increasingly limited, more effort will be required to pursue opportunities on other lands in the city.

Stewardship programs currently available within the City of Mississauga, shown with their sponsors in brackets, include:

- One Million Trees Program (City of Mississauga with CVC, TRCA, Evergreen and Credit River Anglers Association)
- Partners in Project Green (PPG) (Toronto Pearson with CVC, TRCA, Region of Peel, City of Mississauga, City of Brampton)
- Greening Corporate Grounds (CVC with TRCA, Evergreen)
- Caring for the Credit Corporate Volunteering Program (CVC)
- Volunteer Tree Planting Program (City of Mississauga with Evergreen, CVC, TRCA)
- Adopt-a-Tree Program (City of Mississauga)
- Credit River Watershed Volunteer Tree Planting Program (CVC)
- Grow Your Green Yard Program (CVC)
- Healthy Yards Program (TRCA)
- Conservation Youth Corps (CVC)
- Private Landowner Reforestation / Naturalization Program (CVC)
- CVC Private Landowner Aquatic Planting Program (CVC)
- CVC Multi-cultural Outreach Program (CVC)
- Etobicoke & Mimico Creeks Watersheds Volunteer Plantings (TRCA)
- Credit River Anglers Conservation Works (Credit River Anglers Association (CRAA))
- School Greening (CVC)
- Watershed on Wheels (TRCA with CVC
- School Grounds Greening (Evergreen)
- Riverwood Conservancy (City of Mississauga)
- Sierra Club Ontario (City of Mississauga / CVC)
- CN EcoConnexions From the Ground Up (CN with Tree Canada)
- Common Grounds (Evergreen)
- Community Grants Program (Ontario Trillium Foundation)
- Conservation Land Tax Incentive Program (CLTIP) (Province of Ontario (OMNR))
- Corporate Greening for Carbon Credits (Tree Canada)
- EcoAction Community Funding Program (Environment Canada)
- Edible Trees (Tree Canada)
- Greening Canada's School Grounds (Tree Canada)
- Jack Kimmel Grants (Canadian Tree Fund)
- In-Store Native Tree/Shrub Rebates (LEAF)
- Managed Forest Tax Incentive Program (MFTIP) (Province of Ontario (OMNR))
- TD Green Streets Program (Tree Canada (with TD Canada Trust))
- Toyota Learning School Grounds Greening (Evergreen)

These are presented in Appendix G of the Natural Heritage & Urban Forest Strategy (NH&UFS) with details about the scope of the program, what groups the program targets, and contact details.

In terms of partnerships, the City of Mississauga has been an active partner in the Peel Region Urban Forest Working Group since 2009 and continues to benefit from regular (i.e., three times annually) meetings where information and ideas are shared, along with some joint initiatives and resources. To date this group has:

- worked with the United Stated Department of Agriculture (USDA) Forest Service and University of Vermont Spatial Analysis Laboratory to generate canopy cover analyses using the most current tools and technologies
- been able to jointly produce the *Peel Region Urban Forest Strategy* (2011) as well as urban forest studies for the three area municipalities in the Region (i.e., Mississauga, Brampton and Caledon), and
- shared information among its members on current approaches to EAB and strategies of dealing with other current urban forest issues.

The City has also collaborated with adjacent municipalities and the Canadian Food Inspection Agency (CFIA) on cross-boundary invasive pest issues (e.g., Asian long-horned beetle control, and more recently, emerald ash borer research). Although these collaborations are typically *ad hoc*, the eradication of Asian long-horned beetle from the area has been a direct result of effective collaboration of these partners. The CFIA also continues to provide some research and technical support in terms of the latest approaches for dealing with EAB.

The local conservation authorities, and in particular Credit Valley Conservation (CVC), continue to be very active partners with respect to maintaining and restoring tree (and natural) cover within their regulated areas and in other CVC owned and public lands across the City. CVC also has a number of outreach and stewardship programs (as listed above) designed to educate and engage various sectors of Mississauga's community, as well as annual stewardship and volunteer appreciation events. A number of these are pursued in partnership with, and/or with the support of the City.

In addition, CVC has been a very active partner with the City in terms of natural heritage planning, and in 2010 completed a Landscape Scale Analysis identifying all current natural areas in the City, as well as prioritizing some of these sites (e.g., for restoration and/or protection) based on ecological attributes. They have also been conducting comprehensive ecological monitoring in a number of the City's public wooded areas, collecting data that can assist the city in management of these areas.

The local Association for Canadian Educational Resources (ACER) is also very active locally and has established a number of plots in Mississauga, and elsewhere in the GTA, looking at changes to forested ecosystems over time. Their programs are specifically targeted at engaging youth and are both science-based and applied.

Toronto Region Conservation Authority (TRCA) also provides a number of outreach and stewardship programs available to Mississauga residents (see above), continues to be a source of technical support on natural heritage matters (e.g., for this project, and others), and has been a key partner in the development of urban forestry products through the Peel Urban Forest Working Group.

T

TRCA has also been working with the City to establish a Sustainable Neighbourhood Action Plan (also known as SNAP) initiative in the Applewood area. The SNAP program is an innovative initiative that seeks to develop action plans to improve the local environment on the neighbourhood scale and build resiliency against climate change by greening local infrastructure and encouraging positive behaviour changes among residents. Each plan builds the

business case for implementation by measuring individual and community benefits and cost savings.

Halton Conservation, although only a small area of their jurisdiction falls within the City, have also provided natural heritage technical support (on this project and others) and resources for outreach and stewardship.

The City has also been very successful through the Partners in Project Green in working with a community of businesses to develop an internationally recognized eco-business zone around Pearson Airport. Activities range from sharing power generation to tree planting and naturalization. The group is now seeking to expand their initiative beyond the Pearson Airport area.

Although there is interest in building more local research partnerships (e.g., with local academic institutions), none have been established to date beyond a partnership with University of Toronto in Mississauga`s intern program which includes a short-term research component.

TD Green Streets

With respect to funding, the Parks and Forestry Division has been successfully pursuing funding and resource sharing opportunities through Evergreen, TD Green Streets, and various partnerships. The partnership with Evergreen is a good example of the cross-pollination between different stewardship initiatives. The partnership with Evergreen began in 2004 and now includes annual activities in more than 10 City parks. Evergreen also participates in local Earth Day events and the Mississauga Fall Fair, has partnered with the University of Toronto in Mississauga to plant 22 sites on campus, and launched the Greening Corporate Grounds campaign with CVC. TD Green Streets is another example of a program that provides matching funding (of up to $15,000) to municipalities for a variety of community-based urban forestry initiatives.

The City needs to continue to build on these successes, and explore additional opportunities for engaging stakeholders and the community more broadly, and for engaging with various partners for both resources and funding.

7 BEST PRACTICES & OPPORTUNITIES FOR IMPROVEMENT

This section of the UFMP provides a critical assessment of opportunities for improvement of Mississauga's urban forestry program, and presents relevant best practices recognized in the scientific and technical literature. Examples of innovative practices and programs from leaders in urban forest management, including a number of municipalities in Southern Ontario and beyond, are also presented.

7.1 URBAN FOREST MANAGEMENT AND ADMINISTRATION

7.1.1 URBAN FOREST MONITORING

Monitoring the status of the urban forest and of actions intended to improve its management are necessary if active adaptive management is to be effectively implemented, targets are to be achieved, and progress is to be made towards urban forest sustainability.

Urban forest management plans[21] are a relatively new tool that only a few municipalities have begun to implement, and there are no known implementation and results of urban forest monitoring reports available to refer to as of yet. However, there has been recent work on developing a set of standard Criteria and Indicators (C&I) for urban forest management (Kenney et al., 2011). These Criteria and Indicators build on the model for measuring urban forest sustainability developed by Clark et al. (1997) and provide a useful tool for tracking the three key components of effective urban forest management: the status of the vegetation resource, the municipal resource management approach, and community and stakeholder engagement. The 25 criteria laid out in the model include measures that are commonly used (e.g., canopy cover, species distribution, agency co-operation, tree inventory and tree risk management) and ensure that all aspects of urban forest management are considered and evaluated.

The structure of the UFMP facilitates the application of various monitoring tools – particularly the Criteria and Indicators model. Through the three-tiered framework, a comprehensive monitoring exercise should be undertaken near the end of each of the five four-year management plan cycles, and comparison with a baseline or previous C&I assessment can clearly demonstrate progress (or regress) with respect to any of the 25 criteria of sustainable urban forest management. While a complete Criteria and Indicators assessment should be undertaken on a periodic review cycle in accordance with the plan framework, it should be done with the understanding that the more technical and resource-intensive criteria (e.g., change in canopy cover), may be re-assessed at longer intervals, such as every 8 or more years.

7.1.2 TREE INVENTORY

A tree inventory is comparable to a human population census in that it identifies each individual tree in a given study area. Each tree can then be assessed for a wide range of variables including location, size, health and condition, and required maintenance. Having this information in a centralized and accessible format is one of the most useful urban forest management tools available. Key uses for a comprehensive tree inventory include:

[21] The format and content of an Urban Forest Management Plan will vary depending on the current conditions, objectives, resources, planning context, and political direction of a given municipality. However, it is generally a relatively long-term (e.g., 10 to 20 year) plan that identifies strategic priorities for sustaining and enhancing a given jurisdiction's urban forest.

- Improved and more efficient urban forest management and maintenance: Staff can use tree inventory information to accomplish a variety of goals and objectives. For example, by combining inventory data and spatial attributes, the mixture of species in a given area can be determined and managed, area-based maintenance requirements can be established by tree size and age, tree planting locations and storm response activities can be prioritized, and species-based pest management strategies can be developed and implemented. Ideally, the tree inventory should be the main tool for urban forest management at the individual tree level.

- A broader understanding of urban forest structure: A tree inventory can include, among other attributes, tree species, stem and crown diameter measurements, and height/age classifications. Using this information in combination with spatial data, urban forest structure indicators such as relative age class and species distribution can be mapped and assessed. These data can support tree establishment planning, priority maintenance and urban forest monitoring, such as size-rank ordered tree risk assessment prioritization.

- Improved project planning: An urban forest inventory integrated into the municipal GIS (Geographic Information System) enables Engineers, Planners, Landscape Architects, and Forestry staff to work collaboratively to locate individual trees in proximity of proposed municipal works, identify potential conflicts, and plan effective tree protection measures in the earliest stages of planning. This can all be accomplished well in advance of project implementation, saving time and costs, and reducing uncertainties.

Mississauga maintains an operating inventory for about 243,000 street trees and some park trees. However, the inventory is not currently optimized for street tree management. In order to be a useful urban forest management tool, a tree inventory must be 1) maintained up-to-date, 2) user-friendly and integrated into municipal asset management systems and practices, and 3) sufficiently detailed to enable operational planning. While the inventory is updated as trees are removed, the opportunity to provide almost real-time updating capability is available through the primary tool the City already uses to manage its work order system – Hansen 8 and Trees2Go. The Forestry Section is currently developing the use of field-based solutions including mobile computers, and will begin to implement this tool in 2014. More importantly, however, the inventory currently has few attributes that enable tree-by-tree management planning, and should be expanded to include attributes such as site type, maintenance requirements, risk assessment and pest/pathogen identification. The inventory should also be expanded to include trees in actively-managed parks (as opposed to City-owned Natural Areas, which do not require an inventory of individual trees), as the same types of risk management and maintenance requirements are generally required for these trees and street trees.

Examples of nearby municipalities with effective and exemplary tree inventories include Kitchener, London and New Tecumseth, Ontario. These inventories share the common feature of including maintenance requirements for each tree. Further abroad, good examples include Pittsburgh, Pennsylvania and San Francisco, California. These inventories are also used in management and maintenance planning due to the inclusion of detailed inventory attributes. Oakville, ON; London, ON; Pittsburgh and San Francisco, along with other communities, also make some inventory attributes available online to encourage citizen engagement with the urban forest. In San Francisco, members of the public can actually contribute to the City's tree inventory by inputting tree location, species and other data.

7.1.3 INTERDEPARTMENTAL COORDINATION

In most municipalities where urban forest management is undertaken, it is recognized that a multi-departmental and multi-disciplinary approach is required to effectively manage the urban forest. Interdepartmental coordination around urban forestry issues is a continually improving process, but there are still opportunities for improvement. Ensuring Forestry Section representation in development application review (e.g., the Development Application Review Committee group) meetings and capital project planning will help ensure that opportunities for tree protection and/or planting are identified at the outset of the process. Circulation on Building Permit applications if trees may be impacted (which will require more comprehensive review of Tree Declaration forms) will result in similar gains.

In Oakville, the first municipality in southern Ontario to undertake an urban forest study (Town of Oakville 2006) and to develop a comprehensive urban forest management plan, one of the recommendations was to create an Inter-departmental / Interagency Technical Advisory Committee comprised of staff from Parks and Open Space, Engineering, and Planning. The intent was for this group to:

- bring a multi-disciplinary perspective;
- review plans (particularly larger scale plans) early in the process to ensure all opportunities for tree preservation and planting are considered, and;
- review / develop staff operating procedures or policies supportive of urban forest sustainability.

Saanich, British Columbia, is another municipality that recently developed an urban forest management plan, proposed an inter-departmental working group to synchronize tree-related initiatives. The working group is to include depart-mental representatives from Planning, Development, Engineering (including Public Works), Legal Services, Risk Management, Finance, Parks and Recreation, and Fire/ Police. Tasks for this group include:

- Coordination of by-laws, policies and regulations so that the urban forest is consistently referenced, planned, enhanced and maintained, and;
- Coordination of various initiatives that have tree-related components (e.g., Stormwater Management By-law, Watershed Planning, Climate Action and Adaptation Plan, Natural Areas Action Plan, Invasive Species Plan; Parks and Recreation Master Plan)

Establishment of an internal 'Urban Forest Working Team' including management and staff from Parks and Forestry Division (Community Services Department), Development and Design division (Planning and Building Department), Engineering and Works and Transportation and Infrastructure Planning Divisions (Transportation and Works Department) will ensure improved interdepartmental coordination, build a better environment for the identification and collaborative resolution of urban forest-related issues, enable knowledge transfer and ensure consistent application of municipal standards and adherence to policies.

7.1.4 SPECIFICATIONS, STANDARDS AND GUIDELINES

Written specifications, standard detail drawings and guidelines are intended to guide the planning and implementation of a wide range of activities, often related to site development and potentially involving trees, soils or other urban forest-related aspects. In Mississauga, there are duplicate yet inconsistent sets of specifications and standards, maintained by different departments (Community Services and Planning and Building) yet intended for application in similar situations. For example, the Development and Design Division provides specifications for solid panel or framed hoarding, while Community Services specifications require farm fencing. Other aspects of these specifications are also not consistent with recognized best practices for tree protection. Such potential inconsistencies may result in missed opportunities for effective tree protection or establishment, and warrant a comprehensive review and updating of existing standards.

To address such issues, some municipalities have developed comprehensive tree protection specifications for implementation during construction near trees and tree establishment specifications for planting of trees on public lands. Some examples include:

- City of Palo Alto, CA – "Tree Technical Manual"
- Barrie, ON – "Tree Protection Manual"
- City of Toronto, ON – "Tree Protection Policy and Specifications for Construction near Trees" and "Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual"

- Regional Municipality of York, ON – "Street Tree Preservation and Planting Design Guidelines"
- Town of Markham, ON – "Trees for Tomorrow Streetscape Manual"
- Town of Oakville, ON – "Tree Protection and Preservation Guidelines for Site Plan Applications"
- Town of Richmond Hill, ON – "Tree Preservation By-Law No. 41-07 Fact Sheet No. 5 – Guidelines for Construction near Trees"

Markham, Palo Alto and Guelph (in development) have compiled comprehensive 'tree technical manuals' which include virtually all regulations, standards and specifications concerning urban forest management in the community. Such documents provide an easy-to-use and detailed 'one-stop' reference for residents, site plan applicants, municipal staff and others involved in nearly any aspect of urban forestry. The development of a comprehensive tree technical manual or similar document would encourage consistent application of City requirements and facilitate more efficient future review and revision of all standards and regulations to ensure Mississauga continues as a leader in urban forest management.

7.2 TREE HEALTH AND RISK ASSESSMENT

7.2.1 YOUNG TREE PRUNING

Maintenance during the 'formative years' of a tree's life, which can be conducted from the ground and at little cost, is one of the best, and most cost-effective investments in the future urban forest. Proactive and early pruning greatly increases the prospects for long-term tree survival. By providing trees with good form and structure, which will be maintained throughout their lives, it also greatly reduces future liability and increases urban forest canopy cover.

Research and experience in leading municipalities suggests that immature trees should generally be pruned at least three times within the first ten years after planting, preferably at regular intervals. Young trees should be pruned to 'train' them towards good structure; typically no more than five to eight pruning cuts should be required during each pruning round. Young tree pruning can be conducted from the ground using secateurs and pole pruners; climbing and use of aerial lift devices will not be necessary.

Mississauga currently prunes some young trees to develop structure, but the program is not formalized and pruning is not regularly scheduled. As such, the program should be formalized, with an annual implementation plan and supporting budget. Annual planting lists should be used to direct the pruning, which should take place three times within 10 years planting.

Given the fast growth rate of young trees in good growing sites, it is difficult to incorporate young tree pruning into a cyclical pruning program, and longer cycles will lead to backlogs in structural pruning requirements. Furthermore, the type of resources required make it inefficient to integrate young tree pruning with block pruning as there is no need for arborists equipped with aerial lift equipment or wood chippers to tend to small trees reachable from the ground.

While the number of trees planted and subsequently pruned in Mississauga will vary annually, the City currently plants up to 4000 caliper trees per year as part the street tree replacement, new subdivision and part tree planting programs.

A leading example of a successful young tree pruning program can be found in Calgary, AB, where young trees are inspected and pruned (if necessary) a minimum of three times in the first ten years. Forestry staff in Kitchener, ON,

have recently been trained in young tree structural pruning techniques and a structural pruning program is being developed.

7.2.2 CYCLICAL PRUNING

Many municipalities inspect and maintain street trees in a scheduled, cyclical manner. This is termed "grid", "block" or "cyclical" pruning. There are many variations to a cyclical pruning approach. A sampling of municipalities across North America found that urban forest inspection and pruning intervals vary widely between municipalities, from short five year cycles to a much longer 16-year cycle.

Another successful approach to cyclical pruning is to establish a different cycle depending on the age or species of the trees to be maintained. For example, most trees in Edmonton are pruned on a seven year cycle, while elm trees are pruned on a four year cycle.

A four to five year pruning cycle generally provides the optimum balance between operating costs and maintained tree value, but various municipalities successfully implement a wide range of different schedules and service delivery models (Miller and Sylvester, 1981). Over the long term, a planned and cyclical approach can provide significant cost savings over reactionary pruning and tree maintenance. A shorter cycle (i.e., five to eight years) reduces the number of resident service requests (which are costly to fulfill as inspection staff time is spent travelling from site to site, rather than progressing through a linear work area). Furthermore, systematic tree maintenance enables earlier detection of pest and other plant health issues, resulting in improved overall urban forest condition.

Mississauga's current pruning cycle is close to 8 years. Funding to improve this level of service from a 11 to 12 year cycle to an 8 year cycle was approved in 2010, the Forestry Section has now effectively caught up. Although this is longer than the optimal cycle of four to five years quoted in some best practices, experience in southern Ontario and elsewhere suggests that a 7 to 9 year street tree pruning cycle effectively balances costs with tree maintenance requirements. Cities such as Burlington, ON; Calgary, AB; Edmonton, AB; Hamilton, ON; Toronto, ON and Vancouver, BC, attempt to operate on seven to nine-year street tree pruning cycles.

7.2.3 PARK TREE MAINTENANCE

Park tree maintenance in Mississauga is carried out in a largely reactive nature, as it is in many Canadian municipalities. According to the 2000 ISA Ontario Municipal Arborists and Urban Foresters Committee *Best Management Practices for Ontario Municipalities*, trees in active parks (as opposed to Natural Areas) should be visually inspected annually, with maintenance on an as-needed basis. However, this is likely unachievable in most jurisdictions due to resource constraints. The maximum inspection cycle considered acceptable is once every five years, however even this cycle can be difficult to achieve. For example, in Burlington, ON, park trees are visually inspected approximately once every seven years, and maintenance is carried out on an as-needed basis.

It is recommended that a maximum 5-year inspection cycle be implemented in Mississauga for actively-managed park trees, with maintenance continuing to be undertaken on an as-needed basis based upon work order requests and results of visual inspection. Expansion of the City tree inventory to actively-managed park areas should also generate some more immediate maintenance recommendations but, once carried out, will reduce future work requirements and result in longer-term cost savings.

7.2.4 TREE RISK MANAGEMENT

Tree risk assessment and mitigation are becoming increasingly recognized as a critical component of urban forest management. The key to effective tree risk management lies in an operational policy or protocol that coordinates inspection, mitigation and proactive planning in order to reduce risk, uncertainty and liability. A dedicated protocol will set minimum standards for risk assessment and documentation, resulting in consistency of assessment and sustained resources for inspection over the long term. Key components of an effective risk management policy or protocol include:

- A policy statement framing the scope of work (i.e., which trees/areas are to be included), assigning responsibility, setting goals and outlining a realistic Standard of Care statement;
- Determination of acceptable risk, outlining what the City considers an acceptable threshold for risk of tree failure;
- Minimum levels of training and qualifications of risk assessors, outlining the expected credentials that tree risk assessors should possess;

- Frequency of assessment, outlining how often publicly-owned trees in different settings (e.g., trails, high-traffic streets, new communities) are to be inspected for risk;
- Management options, outlining what arboricultural treatments the City will consider for implementation to mitigate risk, such as pruning, cabling, bracing, or removal.
- Record-keeping protocols, to enable tracking of inspections and mitigation actions;
- Strategy funding and/or partnerships, to identify expected costs and anticipated sources of funding to enable the implementation of the strategy, and;
- A strategy for program assessment and reporting to enable adaptive management and ongoing improvement.

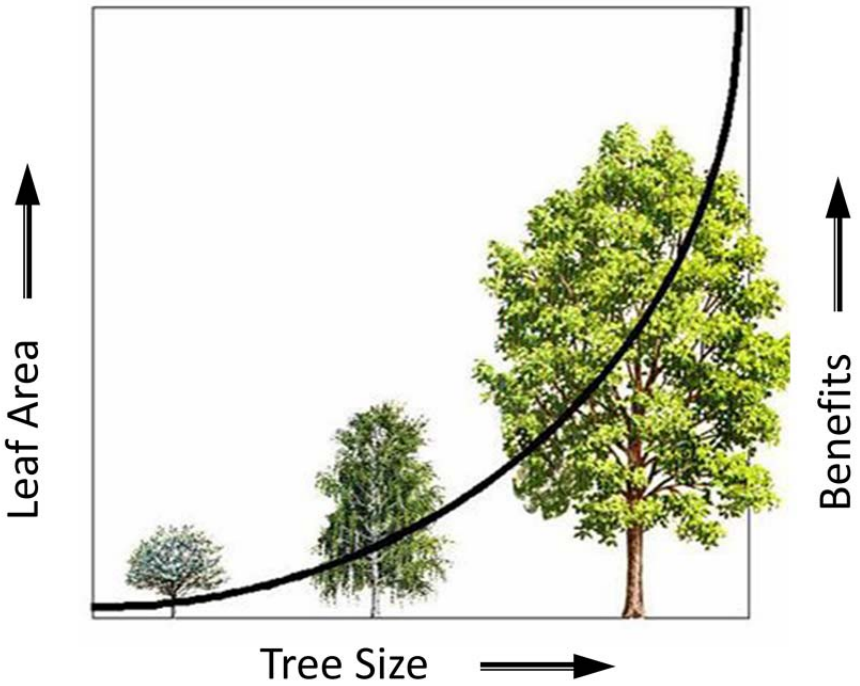


Figure 9. Illustration of the exponential increase in ecosystem services (or benefits) provided by trees as they mature.

A comprehensive risk management protocol should also include consideration for post-storm emergency response, including prioritized inspection and maintenance areas.

Tree risk mitigation is an important practice and one that can extend the life of a tree that might otherwise be considered a risk. Practices such as soil amendments and structural pruning (if performed correctly and managed appropriately) can greatly reduce the risk presented by certain aging trees, while maintaining the ecosystem services that such trees provide. Because large trees provide such a disproportionate amount of ecosystem services (as compared to smaller trees) (see **Figure 9**), the benefits accrued to community of taking a conservative approach to and investing in their retention are exponential.

Recent advances in tree risk assessment have given rise to new levels of risk assessment training and qualification by bodies such as the International Society of Arboriculture. Notably, the City has recently conducted a structural review combining two positions allowing for the development of a Forestry Inspector who completes multiple inspections against varied assets within a distinct geographic area. This should help support the growing resource needs to address risk issues.

While Forestry staff in Mississauga have received introductory levels of tree risk assessment training, the City's Forestry Inspectors should be provided with advanced training and qualification through the ISA's Tree Risk Assessor Qualification (TRAQ) program.

Basic visual inspection of trees in actively managed and high-traffic locations (e.g., streetscapes, parks and along woodland trails) should be undertaken and documented systematically to demonstrate the City's fulfillment of its duty of care. Annual inspection is optimal but likely unachievable given resource constraints and fiscal realities. As such, higher-risk trees and locations should be prioritized for tree risk assessment and management.

Effective and proactive tree risk management may also require fencing-off or other intensive management due to the emerald ash borer infestation, which will lead to widespread ash tree mortality in the City's woodlands and wooded natural areas.

7.2.5 INVASIVE SPECIES MANAGEMENT

Invasive plant species are considered one of the primary drains on ecological integrity in wooded natural areas of the urban forest. In many parts of southern Ontario, urban forests and wooded natural areas are heavily invaded by invasive trees and shrubs such as Norway maple, Tree-of-Heaven, and European buckthorn, as well as herbaceous plants such as garlic mustard, dog-strangling vine, and many others. The federal and provincial governments do not provide any resources to assist with the control of such plant species (beyond information such as Ontario's Invading Species Awareness Program), and coordinated strategies to control invasive plant species are few, largely because the resources and staff required to implement such efforts would be substantial and the benefits would not be immediately evident to the general public.

Currently, invasive plant species management in Mississauga is relatively small in scale and not effective in completely controlling targeted invasive species. Once exception to this has been efforts to detect and control giant hogweed, an invasive known to burn and even blind people exposed to its sap, which have been quite effective.

The *Ontario Invasive Species Strategic Plan* (2012) published by the Provincial government identifies a series of 27 Actions for addressing this issue under the topics of: (1) leadership and co-ordination, (2) communication and co-ordination, (3) improving the effectiveness of existing committees, (4) legislation, regulation and policy, (5) risk analysis, (6) monitoring and science, (7) management measures, and (8) communication and education. This document considers all invasive species, not just forest plants, and includes actions that speak to the need for rapid response protocols for new infestations and increasing governmental capacity to develop and implement risk assessment tools. This provides some useful guidance, but does not really help the City prioritize its invasive plant species management approach.

Effective invasive species management must consider a wide range of factors, including but not limited to: prevention of invasions, identification and mapping of invasive populations, cost-effective control measures, community partnerships, funding, and public education and awareness. Strategies for addressing priority invasive species management in Mississauga's Natural Areas will be developed in conjunction through the broader Natural Heritage and Urban Forest Strategy (NH&UFS), and recommendations for prioritizing certain species within certain Natural Areas will also be provided.

7.3 TREE ESTABLISHMENT AND URBAN FOREST EXPANSION

7.3.1 TREE SPECIES SELECTION

The sustainability and health of the future urban forest will rely on the selection and planting of a diversity of tree species, planted in appropriate locations and maintained until they are well-established. While the use of native species is preferable, some non-invasive, non-native trees are also suitable under difficult growing conditions. Species selection should be based on a wide range of considerations. For example, research has shown that selecting the proper trees and placing them appropriately can significantly reduce energy usage for heating and cooling buildings. Planting small statured trees under utility wires can also reduce the need for costly corrective pruning. Planting a diversity of native and/or non-invasive tree species is perhaps the most important consideration, since doing so builds in resiliency to stressors such as insect infestations.

A general guiding principle for species selection of actively managed street and park trees has been the "30-20-10" rule, proposed by Santamour (1990), whereby:

- No tree family exceeds 30% of the inventory;
- No tree genus exceeds 20% of the inventory; and
- No tree species exceeds 10% of the inventory.

In its strategic plan, the City of Peterborough, Ontario, committed to undertaking an innovative step to achieving long-term urban forest sustainability through species suitability trials. The Town of Oakville has made the same commitment. This involves planting small numbers of previously untested species, and closely tracking their performance over time.

Species selection for wooded natural area enhancement, restoration and expansion should be based on ecological and biophysical considerations, and should strive to mimic the community composition of relatively undisturbed wooded areas within the same ecozone. Considerations should include the local biophysical conditions, the relative age / successional stage of the wooded area, and the re-creation of native structural diversity over time.

Increasing the diversity of street and park tree plantings will be an important step in working towards urban forest sustainability in Mississauga. The City should develop a comprehensive list of suitable and acceptable tree species, to be included with its updated and comprehensive specifications, standards and guidelines, in order to better guide tree establishment planning and practices during site development and tree planting program implementation. The list should include a wide range of information about acceptable species, including site requirements, acceptable locations, etc., to help guide the landscape planning process for new developments. The City should also continue to undertake and monitor species suitability trials, the performance of which can be tracked along with other plantings under the Million Trees Mississauga program.

7.3.2 TREE HABITAT

Tree habitat is a critical consideration when planning tree establishment and urban forest expansion. For example, roadside boulevards rarely provide optimal growth conditions, and plantings in boulevards invariably perform worse than those in neighbouring front yards. A critical determinant of tree establishment success is the below-ground growing environment, including factors such as soil volume, quality, texture and drainage.

While species requirements vary, minimum recommended soil volumes for large-stature (40 cm dbh) trees in areas which receive adequate rainfall are around 30m^3. In accordance with these requirements, the recent North Oakville UFMP requires 15 m^3, 30 m^3 and 45 m^3 of soil for small, medium and large-sized trees, respectively. The City of Toronto's recent *Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual* outlines similar requirements for street side plantings, but recognizes the concept of "shared soil volume" among groups of trees. Mississauga's Green Development Standards also outlined these soil volume requirements, and increased implementation of these standards will result in improved tree growth performance and increase the urban forest canopy.

It is acknowledged that it may not be possible to substantially increase soil volume for tree plantings in established areas of the City during the course of replacement street tree planting. However, enhanced rooting environment techniques such as soil cells or continuous trenches should be considered in order to provide adequate soil volumes during the course of new development and through capital projects. A review of the City's tree establishment specifications, standards and guidelines should also consider required implementation of minimum soil volumes. While more costly than common tree establishment methods, implementing enhanced rooting environment techniques has been demonstrated to achieve significantly higher rates of tree establishment success, enable the development of larger trees, and promote the provision of a greater range and value of urban forest benefits.

Another key consideration is the quality of the soil in a tree's rooting area. In addition to lack of consideration for soil quality in many planting areas over the years, salt spray continues to be a widespread problem along city streets and boulevards. This spray can damage foliage, reduce growth and sometimes cause death. The development of "witches' brooms" in tree and shrubs branches is a common response. Possible responses include: planting more salt tolerant species in heavily affected areas, reducing salt use by using alternatives or reducing the proportion of sodium in sprays, limiting salt application in ecologically sensitive areas, and protecting susceptible plants (e.g., with burlap or snow fencing), increase irrigation and mulching.

7.3.3 TREE ESTABLISHMENT PROGRAMS

In Mississauga, trees can be established through several different programs, including Forestry operations (replacement of removed trees, request-based planting, or filling of available spaces), tree establishment in new developments, or naturalization/restoration plantings.

Opportunities to improve planting specifications, guidelines and practices have been outlined in other sections of the UFMP. However, opportunities to improve the implementation of tree establishment programs are also available.

In order to promote urban forest expansion and ensure trees are planted where the likelihood of post-planting care is highest, the City's request-based tree establishment program should be more effectively promoted and formalized. Such programs exist in many communities; among the most effective examples are in Toronto and in Hamilton, where online information and brochures help residents pre-select desirable species and provide information to help City staff decide whether planting is appropriate.

Suitable sites for tree planting in municipal rights-of-way should be identified during the course of Forestry operations and included in an inventory, to be used to guide tree establishment planning and to ensure that no available sites are overlooked. Trying to keep boulevards free of above and below-ground utilities as much as possible would also help create better tree planting opportunities.

For expansion/restoration planting programs, it is important to verify the appropriate tree planting locations and ensure they are intended to be treed for the long-term. For example, it is very discouraging for a community group to see that a site on which they planted trees has been disturbed or altered by development. Good planning and direction of volunteer activities can avoid these scenarios. When planted trees must be removed, volunteers appreciate efforts to have them properly transplanted. A key component of the City's new One Million Trees Mississauga program should be strategic long-term planning of future potential restoration/expansion sites, which must consider existing planning commitments and future potential land uses. The program should prioritize planting on City-owned lands, particularly in areas where existing canopy cover is low and the Priority Planting Index (PPI) identified in the *Mississauga Urban Forest Study* (2011) is high. Areas identified for naturalization in conservation authority subwatershed plans and those most heavily affected by emerald ash borer-caused tree mortality should also be prioritized.

Several other communities have undertaken One Million Tree planting projects, including London (Ontario), Los Angeles and New York. Through various partnerships and community involvement, London's Million Tree Challenge has seen the planting of over 97,000 trees.

Among the greatest challenges associated with Million Tree-type programs is to ensure tree survival. Follow-up inspection, post-planting care, and performance tracking must be considered critical components of any large-scale planting program, and should be incorporated into One Million Trees Mississauga.

7.4 TREE PROTECTION AND URBAN FOREST PRESERVATION

The protection of existing trees is among the most critical aspects of sustainable urban forest management. Existing mature trees provide significantly more benefits than newly-planted ones (see **Figure 9**), and the incremental loss of mature trees makes increasing urban forest canopy coverage difficult. Mature trees are lost regularly due to natural mortality, pests and diseases, and removal during site development, and at landowners' discretion. While tree removal may be required for risk mitigation or to accommodate development, removal of healthy trees, particularly when they are large-statured native species, should not be undertaken without full consideration of alternative development or design options in addition to tree preservation measures.

7.4.1 OFFICIAL PLAN POLICIES

Over the past few years, an increasing number of municipalities in southern Ontario with active urban forestry programs have introduced urban forest visioning into their strategic plans and urban forest policies into their Official Plans. Municipalities with specific policy sections in their Official Plans dedicated to urban forestry include the Town of Oakville, Town of Ajax, City of Guelph, City of Brampton and the City of Mississauga. Some other nearby municipalities with active urban forest programs, such as the City of Toronto and the Town of Milton, have policies related to the urban forest in their Official Plans that are embedded in other policy sections, while some others, such as the City of Burlington, have yet to include policies directed towards the urban forest in their current Official Plans.

The current Urban Forest policies Section 6.4 of Mississauga's *Official Plan* (2011) strike a good balance between supporting overall protection, enhancement and expansion of the urban forest, while still allowing for development considered appropriate by the City. They also incorporate some of the same policy directives as the municipalities listed above.

Despite their strengths, these policies:

a) lack overarching goals or obejctives
b) use the phrase "no negative impacts to trees" as well as "no negative impacts to the urban forest" without defining either
c) do not emphasize the need for identification of opportunities for tree replacement along with the current policies supporting protection, or require planting off-site or cash-in-lieu where replacement cannot be accommodated on site
d) do not require development and implementation of consistent city-wide standards for tree protection and replacement
e) limit the scope of strategic partnerships to invasive species management
f) do not specify the need to avoid using invasive, non-native tree species, and
g) lack definitions for key terms such as "urban forest" and "no (net) negative impacts to the urban forest" and "significant tree".

"No negative impacts" or "no net negative impacts" to the urban forest should be understood to allow for some removal of trees where required and permitted as part of the planning process, as long as the removed trees, and to the extent possible their functions, are replaced so that ultimately there is "no net loss" and, in time, "net gain" to the urban forest as a whole.

> ***The City of Mississauga has defined Significant Trees as a tree that is recognized because of its size, form, rarity of species, age, its association with a historical figure or event, and/or a tree that is distinctive in the community.***
>
> *- City of Mississauga Significant Trees website page (July 2013)*

As stated in Section 6.5, the Official Plan includes a policy that: "*Site development will be required to … (f) preserve significant trees on public and private lands"*, but does not define "significant trees". The City currently has a "Significant Tree" program whereby mature and large statured trees identified by members of the community and City staff on public lands are added to a list. The use of the term "Significant Tree" should be consistent in all City documents and publicartions. Given that the term "significant" is already defined for the program, the City should consider verifying if the use of this term in the Official Plan is intended to be the same. .

The definition of a "significant tree" varies considerably among municipalities who use this term. Often trees are considered significant due to their size. Thresholds for minimum tree diameters considered worth protecting through private tree by-laws range from 15 to 76 centimetres. Some municipalities consider all trees above a specified diameter to have some significance, while others exclude certain invasive species. Determining what trees are "significant" in Mississauga will require consideration for the existing treed resources, and how to approach identification of such trees on private lands.

Notably, the broader document that provides the umbrella direction for this UFMP (i.e., the Natural Heritage and Urban Forest Strategy or NH&UFS) includes a section on planning with several strategies that speak to planning for the urban forest, including Strategy #6 "Strengthen Official Plan policies related to the urban forest", which provides guidance for moving forward on the gaps identified in this section.

7.4.2 TREE PRESERVATION BY-LAWS

Private Tree Protection By-law

Mississauga, like many urban area municipalities across southern Ontario, has a by-law in place that regulates injury and removal of trees on private property. Best practices related to private tree by-laws are difficult to assess since each municipality's by-law is tailored to local circumstances and resources, and there is currently no mechanism for tracking the relative effectiveness of the different by-laws. However, it is generally agreed among tree by-law officers that these by-laws are as much an educational tool as a regulatory tool, and that any by-law is only as effective as the resources dedicated to its implementation and enforcement.

Given that Mississauga's by-law has just been updated based on local research and consultations, some time will be required to educate residents and staff about these changes, and to see if these changes better support the city's urban forest. Key changes in the recent update include allowing for fewer trees of 15 cm and above to be cut without a permit each year (i.e., two instead of four). While this change will tighten up the current by-law, it still allows for the removal of some potentially large, mature trees without a permit.

Based on the current conditions of Mississauga's urban forest, as described in Section 2 of this UFMP, it is recommended that in four to eight years when the Private Tree Protection By-law comes up for review again, that the City consider the potential benefits of requiring permits to remove all individual trees above a certain diameter on private lands. This change should also be considered in conjunction with the anticipated costs associated with regulating more trees, and enforcing this regulation. In Mississauga, as elsewhere, it is not generally advisable to have a private tree by-law that the municipality is not able to enforce.

Notably, Mississauga currently has one by-law inspector dedicated to the administration and enforcement of this by-law. The recent tightening of the by-law will presumably result in a greater work load. This will need to be monitored to ensure that current levels of enforcement can be maintained.

Street Tree By-law

Many municipalities have by-laws regulating the injury or destruction of publicly-owned trees. These by-laws help protect the municipality's assets, and show municipal commitment to its urban forest. Key components of such by-laws can include requirements for compensation if trees must be removed for development, and the ability to levy fines and stop work orders to prevent damage to publicly-owned trees.

The City's updated Public Tree Protection By-law, currently under development by City staff, will extend the current by-law to include all trees on City lands (not just on boulevards) and, among other things, will be addressing the treatment of boundary trees[22], as this can become an issue when the tree is shared between the City and a private landowner.

Other Relevant By-laws

The City's Encroachment By-law was last updated in 2004, and is increasingly being used as an effective tool for reducing the expansion of private land uses into adjacent public natural areas (as described in **Section 6.4.2**). There are not many other municipalities with such by-laws, and fewer that actively enforce them as well as Mississauga. The City of London is currently in the process of implementing a more active enforcement program for its Encroachment By-law (with assistance from the Upper Thames River Conservation Authority) that includes an education component, and systematic tracking of the types and severity of encroachments.

Erosion Control By-laws, also called Site Alteration By-laws, are authorized under the Municipal Act (just like tree by-laws) and regulate the removal or placement of topsoil within a jurisdiction. Among other things, these by-laws typically require the identification and description of all trees that may be impacted by the proposed grade changes, and therefore provide an opportunity for the

[22] Boundary trees can become an issue when activities or development on one property have the potential to harm trees shared by the adjacent property owner. The Forestry Act (1990) makes it an offense to injure or destroy a boundary tree without the neighbour's formal consent.

identification of tree preservation, tree replacement and/or compensation for trees approved for removal. The benefit, from an urban forest perspective, of these by-laws is that they require permits for activities that may not be under the purview of the Planning Act or other City by-laws, and therefore enable identification of opportunities for tree protection and replacement that may otherwise be overlooked.

The City's Erosion and Sediment Control By-law is an existing regulatory mechanism that could be used to flag the need for tree protection and identify opportunities for tree planting and naturalization while also regulating removal and addition of fill in the city. As this by-law is currently being updated by City staff in Transportation and Works, it is a good opportunity to ensure the by-law can be used to achieve urban forest and natural heritage objectives. Key gaps identified in the current by-law in this context include:

- an exemption for lands of up to 1 hectare (which is quite large in a jurisdiction where most future development will be infill and intensification)
- only a general requirement for the identification of vegetation on site (rather than specific requirements to provide an inventory of trees, as well other vegetation, on site)
- an absence of any requirements related to tree protection for specimens being retained, and
- a lack of compliance with the current Private Tree Protection By-law in terms of compensation requirements for trees of at least 15 cm diameter proposed for removal.

Revisions to the by-law to make it more consistent with current in force tree by-laws, and best practices regarding tree preservation would go a long way towards making it a useful tool for identifying opportunities for tree protection and replacement. These changes would also need to be accompanied with education of the City staff administering and enforcing the by-law to ensure effective implementation of these changes, and would be facilitated with support from a Certified Arborist in the Forestry Section familiar with by-law enforcement.

7.4.3 TREE PRESERVATION THROUGH THE PLANNING PROCESS

Tree Preservation under Development Control

The *Planning Act* (in particular Section 41, Site Plan Control) provides municipalities with the authority to identify trees for protection and require replacements on private lands subject to the development application and approval process (typically termed Site Plan Control). A number of municipalities in southern Ontario use this authority and require that all trees of typically 10 cm or 15 cm or greater in diameter be assessed and inventoried and that detailed tree preservation plans be submitted as part of a Site Plan Application.

Site Plan review and approval, if applied in conjunction with guidelines and specifications intended to support tree health and longevity (e.g., appropriate soil volumes, adequate above-ground space, and appropriate species selection), is one of the best tools at a municipality's disposal to foster urban forest sustainability through the development process. It is at this planning level where important decisions around tree protection and planting can be made, and where municipalities with a vision for their urban forest, and the will to implement it, can ensure that all opportunities are explored.

Tree preservation and protection during development under site plan control is required by Mississauga, in accordance with various municipal policies outlined in this UFMP. However, many opportunities are available to improve the implementation of these practices, beginning with the earliest stages of the development planning process. These opportunities include:

- Involvement of Forestry Section staff, where trees exist on the subject lands and at the discretion of Landscape Architects in Planning and Building, in earliest stages of development pre-consultation, before Site Plan Application packages are submitted
- An improved collection and review process for all *Tree Injury or Destruction Questionnaire and Declaration* forms
- Requiring detailed arborist reporting, including tree inventory and tree preservation methods for all development applications where trees may be affected
- Improving the City's ability to conduct site inspections during development to ensure compliance with municipal requirements and adherence to approved tree protection measures

- Increasing the value of securities held against tree protection to increase incentives for compliance, and
- Requiring arborist inspections, with supporting reports submitted to the City for review

Tree Preservation outside Development Control

Opportunities to ensure compliance with tree preservation regulations (e.g., Private Tree Protection by-law) and policies outside of development control are more limited and more difficult to implement. For example, smaller development outside of Site Plan-regulated areas in Mississauga may also not be regulated pursuant to the Erosion Control by-law and may not require Committee of Adjustment approval. In such an instance, the only required permit may be a Building Permit, which must be issued within a Provincially-mandated timeline generally not exceeding 10 days (longer for larger or more complex structures). In Mississauga, a Building Permit application should be supported by a completed *Tree Injury or Destruction Questionnaire and Declaration,* but these are rarely reviewed or field verified to confirm accuracy, and opportunities to identify potential tree injury or tree preservation requirements may therefore be missed. A similar situation can occur during installation of a swimming pool, which does not require a permit except for its enclosure.

As such, ensuring compliance with municipal tree preservation requirements outside of development control is very challenging. Tools such as the City's Erosion Control by-law should be reviewed and updated if they can be used more effectively to regulate site development outside Site Plan Control, and Tree Declaration forms should be reviewed and acted upon if potential injury to by-law protected trees is suspected.

Many municipalities have, and enforce, erosion control and/or site alteration by-laws to the removal or placement of topsoil within a jurisdiction, which can be used to identify or prevent contravention of tree preservation by-laws. Cities in southern Ontario with such by-laws include Markham, London, Kingston, the Town of Oakville, Hamilton, Guelph, and Niagara Falls.

7.4.4 TREE PROTECTION DURING MUNICIPAL WORKS

In general, tree protection planning and implementation during municipal operations or capital works should receive the same level of consideration as during site development. Review of conceptual plans, project requirements and potential conflicts should be undertaken early on in the process by an interdisciplinary review group including project planners, landscape architects, engineers and arborists, in order to explore opportunities to minimize tree injury or removal. Where such measures are implemented, City arborists should be involved in the site review of tree protection measures including hoarding, root-sensitive excavation or other methods. Alternately, these could be supervised by a contract arborist who is required to report to the Parks and Forestry Division to ensure compliance with municipal policies and regulations.

Municipalities are increasingly realizing the benefits of interdepartmental coordination and cooperation when planning large-scale capital projects or even smaller scale maintenance operations. For example, all Town and Regional capital projects in the Town of Oakville must be supported by a complete arborist report, including a tree inventory, tree preservation/removal plan, tree compensation calculation and, where required, tree injury or removal permits. Securities can also be held by the department of the municipality responsible for signing off on the tree-related / landscaping works. These approaches should be adopted in the City of Mississauga to demonstrate the City's commitment to leading by example.

7.4.5 TREE PROTECTION SPECIFICATIONS

A number of municipalities in Southern Ontario recognize that their visions and policies require strong guidelines, standards and specifications related to tree protection to ensure implementation 'on the ground'.

While tree protection policies and standards are in place in Mississauga, opportunities to strengthen them to promote more effective tree protection exist. These should be explored through a comprehensive review and updating of tree protection specifications. Factors to consider include improved fencing techniques (solid hoarding except where sightlines are an issue), diameter-based tree protection zones to protect larger root zone areas, and innovative technologies such as directional boring, hydraulic and pneumatic soil excavation and "tree-first" design, to protect existing trees affected by construction and development.

Municipalities with leading examples of tree protection specifications and standards include:

- The City of Burlington, Specification SS12 – a key highlight includes consideration for both Tree Protection Zones (TPZ) and Critical Root Zone (CRZ), an area beyond the Tree Protection Zone where works are permitted but may still damage important roots unless proper root-sensitive procedures are implemented.
- City of Toronto: *Tree Protection Policy and Specifications for Construction near Trees* – key highlights include larger sized tree protection zones for trees in natural (ravine) areas than for landscape trees, recognizing the increased sensitivity of such trees to disturbance.
- Palo Alto, California: this city's comprehensive program is a model for tree protection planning, with a wide range of case-specific requirements such as species-dependent tree protection zones, variable required utility boring depths depending on tree diameter, or stringent requirements for tree injury mitigation and replacement based on canopy projection ratios.

7.5 PROMOTION, EDUCATION, STEWARDSHIP & PARTNERSHIPS

As in all municipalities in southern Ontario, much of the City's urban forest is located on lands that are not under municipal ownership or control. Furthermore, the resources that the City is able to allocate to urban forest management will not support the full range of desired stewardship activities, at least not within the desired timelines. Consequently, the importance of improving the community's understanding of the urban forest, actively encouraging proper tree care and planting practices, and nurturing partnerships with as many stakeholders with an interest in the urban forest as possible is critical to the sustainability of Mississauga's urban forest.

7.5.1 OUTREACH USING PUBLIC WEBSITES AND SOCIAL MEDIA

Recent social marketing research conducted in the City of Toronto, and elsewhere, has found that one fundamental barrier to fostering stewardship is the growing detachment most people have from nature in our society. The key challenge, then, is how to break and get beyond this barrier.

Municipal websites represent a cost-effective tool for sharing a wide range of information related to a municipality's natural heritage and urban forest assets, as well as informative links to other websites. Examples of jurisdictions with very comprehensive urban forestry websites include the City of Toronto and the City of Ottawa, as well as the City Edmonton, AB. The City of Mississauga has just updated the Forestry section of its website and launched the One Million Trees program website, and should continue to update the content and look of these resources.

Websites can also be used as tool for engagement. A growing number of municipalities with active urban forestry programs are putting their municipal tree inventories on-line for use by City staff in other departments and the public. The City of London and Town of Oakville have had their inventories on-line for several years. The City of Ottawa recently launched their on-line tree inventory. The City of Mississauga should, after it is updated and expanded, look to posting its tree inventory on-line for the public (as well as for use by City staff).

Mississauga is one of the few municipalities in Ontario to post current summaries of all of its Natural Areas through an interactive city-wide map, and to undertake an ambitious One Million Tree program over the next 20 years. Notably, Peel Region also has an interactive map showing data on its natural areas gathered through the CVCs Natural areas Inventory, and the City of London also launched a "Million Tree Challenge" several years ago with a local non-profit group called Reforest London. The City's Natural Areas monitoring program should be better promoted, both internally and externally, as a resource and a platform for engaging stakeholders, and for fostering broader partnerships. The City should also consider developing directories of local residents, businesses and other stakeholders that are interested in stewardship activities and willing to be contacted for future activities, or who just want to be kept informed.

Although an increasing number of municipalities are starting to build social media outreach into their day to day service, few have developed and posted video clips, particularly related to urban forest topics. The City of Calgary is one of the few that has posted videos on how to plant a tree, as has the non-profit Toronto-based organization LEAF. The City's website is already set up for Facebeook, Twitter, You Tube, and already provides live video feeds of committee meetings. Therefore, it would be relatively easy to adapt these tools so they are more targeted to natural heritage and urban forest promotion at key times of the year. Key dates would include:

- National Tree Day (September 25)
- Arbour Day / Earth Week (mid-April)
- International Day for Biodiversity (May 22)

The City should also develop a series of short video clips on topics of interest related to natural heritage and the urban forest. Possible examples of topics include: ecosystem services provided by Mississauga's Natural Heritage System and urban forest, how to plant a tree, and a video about EAB. In all cases the messaging should be clear and engaging,. Where possible, these materials should be made available in languages other than English that are widely spoken in the Mississauga.

Key themes to convey through these materials include:

- The direct connections between the health of the Natural Heritage System and urban forest, and human health
- The ability and importance of the contributions of individual private citizens and businesses to local sustainability
- The fact that local programs and resources are readily available
- The City is working to protect, manage and expand the urban forest on public lands, but needs local residents, businesses and other stakeholders to contribute if natural heritage and urban forest objectives are to be met

7.5.2 GENERAL AND TARGETED MARKETING

More municipalities are recognizing the importance of branding and marketing their messages to compete on a level playing field with the many other sources of information and imagery people are exposed to on a daily basis. Examples include the City of Guelph's Healthy Landscapes program which has its own logo and look that appears in newspaper advertisements as well as on resources

developed for this program. These days it is commonplace for programs to have their own logos.
The City of Mississauga's One Million Trees Program is an example of a well-branded program with a unique look that carries over from the program website to the posters and pamphlets developed to date. The City has also developed a "look" for Parks and Recreation publications, and recognizes the importance of clear messaging and captivating the audience.

In addition to general marketing to the general public, this Strategy includes a range of outreach tools targeted to certain groups because of their disproportionate ability to influence the development of Mississauga's landscape. Key groups identified through the project consultations include: youth / students, businesses / corporations, local arboriculture firms and landscapers, developers and their planning consultants, and new Canadians.

Examples of approaches for targeting these groups include:

- workshops on specific topics or technical issues (e.g., native plant selection, tree planting tips, etc.) like those offered by the Town of Oakville and City of Brampton as well as the non-profit organization LEAF in the Greater Toronto Area and beyond
- presentations and workshops provided where people work or congregate for social or religious reasons, rather than having them come to a City Hall or comparable location (e.g., City of Guelph Healthy Landscapes program)
- bringing programs like TRCA's "Watershed on Wheels" (that has been designed to meet Grades 1 through 8 Ontario science and technology curriculum expectations) to the attention of the various school boards

7.5.3 PROMOTING THE VALUE OF NATURAL AREAS AND THEIR SENSITIVITIES

One of the key opportunities identified through this project has been that of better promoting the ecosystem services provided by the Natural Heritage System and the urban forest, and specifically promoting the value of Natural Areas in the city in terms of their contributions to quality of life, and their need for management that carefully balances appropriate access with protection of key ecological functions.

Many of the most current and relevant materials related to ecosystem service provision are cited in Section 3 of this UFMP, and of the NH&UFS. These materials and sources can be used as the basis for developing City brochures (web0based and hardcopy) that promote the important of these ecosystem services in the context of Mississauga.

In addition, the City's Natural Heritage System, and the City-owned Natural areas within it, should be promoted for (a) their ecosystem services, and (b) their intrinsic ecological values (e.g., provision of habitat, support of biodiversity, provision of ecological connectivity in the landscape) while still highlighting their sensitivities to overuse and misuse.

A good example it the City of Kitchener distinguishes its publicly accessible natural areas from its active recreational parks in name and in planning. Natural areas are managed very differently from active parklands, and also have their own promotional program. Kitchener's Natural Areas Program is designed to engage the community in environmental stewardship projects, educate people about Kitchener's natural areas, and create opportunities for people to experience nature in the city.

7.5.4 STAKEHOLDER ENGAGEMENT & FOSTERING COMMUNITY PARTNERSHIPS

Municipalities with progressive natural heritage and/or urban forest agendas are recognizing that stewardship by the community and local stakeholders is key to natural heritage and urban forest sustainability because so much of the extant and potential urban forest is on private lands.

Encouraging and supporting tree planting, and particularly of site-appropriate native species, is a key strategy employed by many such municipalities. The City of Guelph and Town of Richmond Hill both have municipal programs that provide: (a) information and education on how residents can naturalize their lawns and gardens with native species, (b) plants and/or advice at a discount or free. The Toronto-based non-profit organization LEAF continues to provide a range of urban

forestry services focussed on supporting tree planting and care in residential yards in the Greater Toronto Area and beyond.

In Mississauga there are already tree planting / landscaping programs targeted to residents through the Peel Fusion Landscapes Program, TRCA's Healthy Yards Program and CVC's Grow Your Green Yard Program. There are also programs sponsored by the City, CVC, TRCA and Evergreen (see Appendix G in the NH&UFS for a complete list) that target businesses / corporate lands and schools. The City has been able to bring many of these programs together through the One Million Trees Program where they are promoted, with relevant resources and information. The City should continue to foster and leverage these partnerships to support its urban forest objectives, and to provide support to these various initiatives where possible.

Many municipalities have commemorative tree and/or bench programs, and some larger municipalities also have arboreta (typically associated with an academic institution), however very few have memorial programs tied to a central, municipally-owned arboretum that also serves as an educational and research centre. An example of a native tree arboretum is the Louise Pearson Memorial Arboretum in Tennessee, while other notable arboreta focused on educational and research objectives include Missouri Botanical Gardens in St. Louis and the Louise Kreher Forest Ecology Preserve. Closer to Mississauga there is the Royal Botanical Gardens in Hamilton, and the University of Guelph's Arboretum which both have memorial components but are primarily focused on educational and research objectives.

Having a City-owned and operate Arboretum / Memorial Forest would be a unique opportunity to provide a centralized place of natural respite, reflection and solace for the memorial of loved ones, as well as a place for the City to educate and engage youth and other members of the community on the diversity of native trees (and shrubs) that can grown in Mississauga, the ecosystem services they provide, and techniques for planting and caring for these plants. The Arboretum could also provide a venue for selected joint research projects between the City and local academic institutions, agencies and non-profits.

7.5.5 BUILDING RESEARCH PARTNERSHIPS

Although some municipalities try, it can be challenging to coordinate partnerships with academic and/or research institutions to conduct applied research that addresses selected local natural heritage and urban forest issues. In part, this is because many of the natural heritage and urban forest questions needing to be answered are complex and therefore need to be studied over many years. It is also challenging because municipal staff do not generally have the time or the expertise to pursue research projects independently, and therefore must partner with nearby government agencies and/or academic institutions and/or non-profit organizations that have research as part of their mandate.

The USDA Forest Service, in collaboration with the University of Vermont, has become an excellent urban forest resource, and have worked with many municipalities in the U.S. and Canada (including Peel Region) to develop and undertake urban forest canopy assessments using the latest tools and technologies. This relationship should continue to be fostered, and the Region and Peel Urban Forest Working Group should continue to collaborate with the USDA group to generate future canopy cover assessments against with the 2011 baseline can be compared.

In Canada, there is no comparable government body dedicated to urban forest issues, and therefore urban forest research closer to home is left to universities, colleges and agencies. In Ontario, two of the best known and most well-established urban forestry programs are in Lakehead in Thunder Bay, and the University of Toronto, which coincidentally has a campus in Mississauga. There have already been several Mississauga-based research projects related to urban forestry undertaken through this campus, but none in collaboration with the City. Opportunities to pursue projects in a more joint fashion should be explored.

Both CVC and TRCA are active in research and monitoring, generally related to natural heritage, but increasingly also looking at urban forest-specific issues as well. Several local non-profit groups, such as ACER, are also actively involved in monitoring. The City should work with these groups to determine where and how their research can support the City's urban forestry interests, and how the City may in turn be able to support their work.

Other agencies such as the Canadian Food Inspection Agency are already actively involved in EAB research. There may be opportunities to have pilot or case studies in Mississauga that would also help inform local management needs.

As discussed above, there is also interest in establishing a City-owned and operated Arboretum / Memorial Forest. This venue could also provide an ideal location for future collaborative research projects, as well as engagement, education, stewardship, and respite.

There are many potential projects that could be pursued, and these would to a large extent be determined based on joint interest, available resources, and the mandates of the individuals / organizations involved. Potential projects, several of which were recommended through the *Mississauga Urban Forest Study* (2011), could include:

- responses of different native tree species to different soil types and conditions in the city
- evaluation of the use of structural soils, subsurface cells and other enhanced rooting environment techniques for street trees
- working with local growers to diversify stock and reduce reliance on clones, and
- development of a seed collection program for native ash species (to bank the genetic stock) in partnership with TRCA, CVC and the National Tree Seed Centre.

7.5.6 FUNDING OPPORTUNITIES AND INCENTIVES

Current funding for urban forest initiatives are available to the municipality, if proposals are submitted and awarded through Tree Canada (in partnership with TD, and more recently CN), but many of the funding grants requires either a non-profit community group or school take the lead. Organizations such as Evergreen, the Ontario Trillium Foundation, Tree Canada, and LEAF all offer a few grants of variable sizes to schools and community groups. Environment Canada and the Ontario Ministry of Natural Resources also offer some tax rebates / subsidies to landowners (see Appendix I in the NH&UFS for a complete list). Even though many of these are not directly accessible to the municipality, websites like that of the One Million Tree Program can promote and be a central place for residents and local schools to review and screen these resources. The grants that are already out these should also be considered when the City is considering coming up with its own incentives related to natural heritage and urban forest stewardship.

There are a variety of incentives used in different jurisdictions to engage the community in implementation of natural heritage and urban forest objectives. One of the most common, as in Mississauga already, is the provision of a free tree for the front yards on request.

In addition, the City of Mississauga is currently exploring the feasibility of a unique incentive via a tax rebate tied to maintaining a certain proportion of the yard in permeable surface to recognize its infiltration function and contribution to storm water management. There are also various incentives (e.g., free trees, free labour), associated with many of the programs identified in (see Appendix G of the NH&UFS).

More conventional incentives that have been used elsewhere and could also be effective in Mississauga include:

- Improved recognition through an awards program that includes awards specifically for natural heritage and urban forest stewardship (note this is already being pursued through the *Living Green Master Plan* (2012))
- Opportunities for support and/or recognition of larger scale efforts or support through the naming of parklands / open space, buildings / rooms, multi-use trails, and gardens

8 RECOMMENDED ACTIONS

The following recommended actions have been developed with consideration of existing conditions and available resources, relevant best practices and precedents from the scientific and technical literature and other jurisdictions, recommendations from the studies completed by the Peel Urban Forest Working Group, and input from consultations with City staff and a range of stakeholders and representatives of the community.
These recommendations have been developed to:

- work within a built-up land use context where most anticipated development will be in the form of infill and intensification;
- build on existing practices, policies and programs that are supportive of urban forestry objectives (as laid out in **Section 5.2**);
- include a variety of Implementation Guidance to improve tree protection and urban forest establishment and expansion on both public and private lands;
- help meet established targets as identified through a suite of Criteria and Indicators tailored to Mississauga (presented in **Appendix A**); and
- achieve established objectives and targets using cost-effective and collaborative approaches.

The following 24 Actions have also been developed to provide more detailed technical, operational and/or tactical guidance regarding the implementation of a number of the Strategies identified within the broader Natural Heritage & Urban Forest Strategy (NH&UFS). The Strategies from the NH&UFS that relate to the UFMP Actions described in this Plan are identified below and in the content of the Plan. Although each Action can be understood as part of this Plan, they are best understood within the broader context of the NH&UFS as well.

While the ultimate goal of strategic urban forest management planning is to achieve urban forest sustainability, it is important to propose realistic actions and achievable targets that are in-line with the City's resource base. The recommended actions presented here support the longer-term goal of urban forest sustainability and will lead to marked improvements in the health, longevity and function of the City's urban forest, but are also considered within the City's means and draw on external support, resources and funding wherever possible.

8.1 URBAN FOREST MANAGEMENT AND ADMINISTRATION

ACTION #1: ADOPT THE THREE-TIERED UFMP FRAMEWORK TO IMPLEMENT ACTION ITEMS AND MONITOR THEIR STATUS

Related NH&UFS Strategies: #29

Implementation Guidance:

- Develop and implement four-year city-wide Management Plans within the context of this UFMP
- Revise strategic action items at end of each 4-year management planning cycle, as required
- Develop and implement Annual Operating Plans (AOPs) outlining priority-based annual work plan

Current Practices: Implementation of this action item will be a new addition to the Forestry Section work plan.

Best Practices: A number of other municipalities in Southern Ontario (e.g., Town of Ajax, City of Burlington, Town of Oakville) have begun the implementation of strategic urban forest management plans. While the planning horizon and content of the plans may differ, they share common structural elements linking higher-level objectives with implementable tasks through a three-tiered framework.

Rationale: Utilizing the framework of the UFMP to guide its implementation will ensure that active adaptive urban forest management will be undertaken. Urban forest managers will be better able to anticipate necessary changes and improve their ability to plan operating and capital budgets, allocate resources to address priorities, and incorporate new knowledge to learn from successes and shortcomings of the urban forestry program over time.

ACTION #2: MONITOR THE STATUS OF THE URBAN FOREST

Related NH&UFS Strategies: #29

Implementation Guidance:

- Review the status of UFMP Action Items at the end of each four-year management planning cycle
- Complete a Criteria and Indicators assessment at end of each four-year management planning cycle, with the understanding that some more resource-intensive metrics may be assessed at longer intervals.

Current Practices: Implementation of this action item will be a new addition to the Forestry Section work plan.

Best Practices: Applied urban forestry research has developed a suite of Criteria and Indicators for use by urban forest managers to conduct periodic assessments of the Vegetation Resource (i.e., the urban forest), Resource Management Approach, and Community Framework. First adopted in the Town of Oakville in 2008, this framework is recommended by the Toronto Region Conservation Authority in all its urban forest studies, and becoming increasingly recognized by municipalities as a useful tool to establish baselines and undertake periodic urban forest program performance review.

Rationale: Tracking the status of urban forest metrics and various aspects of urban forestry programs and practices will enable the implementation of active adaptive management, and will enable staff to evaluate and adjust management activities in response to changing needs and circumstances. Monitoring also provides useful information for communicating the status of urban forestry in Mississauga to staff outside the Forestry Section, Council, stakeholders and the community.

ACTION #3: FORMALIZE THE INVOLVEMENT OF CITY FORESTRY STAFF IN THE CITY PLANNING AND INFORMATION SHARING RELATED TO TREES

Related NH&UFS Strategies: #1

Implementation Guidance:

- Ensure Forestry staff are consistently circulated or consulted on development applications (Site Plan Applications, subdivision plans, Committee of Adjustment applications, etc.), and capital project to ensure opportunities for tree protection and/or planting are identified at the outset of the process
    - Ensure a representative from the Forestry Section is involved in monthly Development Approval Review Committee meetings and capital project review meetings when required by the Landscape Architects in Planning and Building to help assess when tree preservation/planting may be required
    - Try to ensure Forestry staff are circulated on Building Permits if trees may be impacted or removed when possible
    - Consult with Forestry staff when tree issues arise through the Committee of Adjustment process
- Establish an internal urban forest working team including management and staff from the Parks and Forestry Division, Development and Design Division (Planning and Building department), Engineering and Works, and Transportation and Infrastructure Planning Divisions (Transportation and Works department)
    - Hold bimonthly meetings (6 times annually) addressing key urban forest-related issues including UFMP action item implementation, planning coordination, etc.
    - Include, as required, staff from other departments, divisions and sections

Current Practices: Several formal processes are in place to facilitate collaboration between departments, especially regarding development proposal review. These include circulation of Site Plan Applications and other development proposals, Development Application Review Committee, and interdepartmental meetings (as required). Some staff in Community Services, Planning and Building, and Transportation and Works request Forestry staff support on an "as-needed" basis.

Best Practices: Every municipality has a unique organizational framework and different mechanisms for coordinating tree-related planning, management and operational activities between departments. However, irrespective of the organizational framework, to be effective trees must be dealt with in a collaborative, multi-departmental way. This means breaking down the so-called 'silo effect', so that cooperation around shared tree issues can be achieved.

Rationale: Improved interdepartmental coordination and cooperation will enable knowledge transfer, ensure consistent application of municipal standards and adherence to policies, and provide opportunities for creative planning and problem solving in support of urban forestry objectives.

ACTION #4: DEVELOP CONSISTENT AND IMPROVED CITY-WIDE TREE PRESERVATION AND PLANTING SPECIFICATIONS AND GUIDELINES

Related NH&UFS Strategies: #15

Implementation Guidance:

- Develop "made in Mississauga" tree preservation and tree planting standards, specifications and guidelines consistent with technical and scientific best practices and examples from neighbouring jurisdictions for city-wide use in public and private projects
    - For tree preservation specifications and standards, consider factors such as pre-construction care and maintenance, tree species, diameter-based tree protection zones, root zone compaction protection, post-construction inspection and maintenance.
    - For tree hoarding/fencing, eliminate need for deep in-ground staking; instead provide two acceptable, minimally-invasive construction specifications (i.e., solid framed plywood hoarding and framed construction fencing).
    - For tree planting specifications and guidelines, consider factors such as tree species selection, stock sizing, density, soil quality/texture/volume, planting depth, post-planting maintenance.
    - Include an acceptable tree species list for different site types and apply to all projects Develop typologies for different tree growing environments, including engineered soil solutions (e.g., open planters, soil cells, etc.)
    - In specifications and standard drawing notes, include references to relevant City policies and by-laws
- Implement new standards and specifications city-wide:
    - Ensure that in all internal tree-related resources (i.e., relevant Community Services, Planning and Building, and Transportation and Works policies, manuals and standard drawings) are consistent with new specifications and standards, or that new specifications and standards replace the existing ones.
    - Ensure that all external tree-related resources (web, manuals, etc.) include and/or are consistent with the new specifications and standards.

Current Practices: Existing specifications and standards are available for public and private projects but are not comprehensive or consistent, and require updating to current and appropriate best practices (e.g., *Community Services Subdivision Requirements Manual* (2002), Development and Design and Forestry Section standards (2008).

Best Practices: A number of municipalities have developed comprehensive tree preservation and planting specifications, standards and guidelines to help ensure consistent application of improved urban forestry practices. Some integrate many aspects of urban forestry in one document, while others focus on a single topic, such as tree establishment. Some examples include:

- Palo Alto, California - *Tree Technical Manual*
- Barrie, Ontario - *Tree Protection Manual*
- Markham, Ontario - *Trees for Tomorrow Streetscape Manual*
- York Region, Ontario – *Tree Planting Design Guidelines*
- London, Ontario – *Design Specifications and Requirements Manual*
- City of Toronto, Ontario – *Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual*

Rationale: Implementing updated tree preservation and tree planting specifications, standards and guidelines city-wide will improve protection of existing trees and support expansion of urban forest canopy, show the City is leading by example, and help ensure consistent approaches are followed.

ACTION #5: EXPAND AND IMPROVE PUBLIC TREE INVENTORY

Related NH&UFS Strategies: #15, #16, #20

Implementation Guidance:

- Expand knowledge of the City's tree resources by improving and enhancing the street and park tree inventory
    - Maintain GIS integration to facilitate information sharing among City departments
    - Include additional inventory attributes including: 1) site type description, 2) maintenance requirements, 3) risk assessment, 4) pest/pathogen identification, and 5) species approximate age (not a range)
    - During scheduled street tree maintenance, utilize Hansen 8 field solutions to update existing street tree inventory with enhanced inventory attributes
    - Expand inventory to actively-managed areas of municipal parks
- Utilize inventory to plan urban forest maintenance operations on streets as well as in parks, and to better manage tree-related risk on public lands
- Make the basic inventory information available to the public on the City's website so they can see what trees are on their streets and in their parks

Current Practices: The existing GIS-based tree inventory of 243,000-plus City trees is useful for knowing what species are where, and for sharing this information with other departments, but is missing key attributes that limit the inventory's use as an urban forest management planning tool.

Best Practices: To optimize its utility as an urban forest management tool, a tree inventory must be: 1) maintained and up-to-date, 2) user-friendly and integrated into municipal asset management systems and practices, and 3) sufficiently detailed to enable operational planning. A wide range of tree inventory options are available, and many jurisdictions have some type of municipal tree inventory, more commonly street tree management-oriented inventories, although inventories of trees in actively-managed parks are equally important. A high quality street tree inventory, such as in the one used in the City of Kitchener, ON, can include a large number of inventory attributes, such as insect/disease signs and symptoms, site type, deadwood levels, structural condition, and, most importantly, maintenance requirements.

Rationale: Improved knowledge of the condition and maintenance requirements of street and park trees, if used effectively through a coordinated asset management program, will improve urban forest health and sustainability, reduce future operating costs as maintenance is undertaken in a proactive and planned manner and reduce the incidence of tree-related risk as potential issues are identified and addressed before they become problematic or difficult to manage.

8.2 TREE HEALTH AND RISK ASSESSMENT

ACTION #6: IMPROVE STREET AND PARK TREE MAINTENANCE OPERATIONS

Related NH&UFS Strategies: #16

Implementation Guidance:

- Maintain maintenance frequency of street tree pruning cycle to once every 8 years (maximum)
- Change program title from Street Tree Elevation Program to Street Tree Maintenance Program to reflect broader scope of pruning
- Establish a 5-year inspection cycle for trees in actively-managed park areas (i.e., outside of City-owned Natural Areas), implementing maintenance on an as-needed basis

Current Practices: Current Street Tree Elevation Program pruning frequency is approximately 8 years per tree. Current park tree maintenance is reactive or request-based.

Best Practices: Best practices suggest that a four to five-year pruning cycle optimally balances operation costs and maintained tree value. However, longer cycles can be effective if supported by more comprehensive urban forest management programs. Many urban foresters agree that a seven or eight-year street tree pruning cycle is optimal. Cities with active urban forestry programs such as Burlington, ON; Calgary, AB; Edmonton, AB; Hamilton, ON; Toronto, ON and Vancouver, BC, attempt to operate on seven to nine-year street tree pruning cycles.

In most municipalities, park tree maintenance tends to be largely reactive in nature. According to the 2000 ISA Ontario Municipal Arborists and Urban Foresters Committee *Best Management Practices for Ontario Municipalities*, trees in active parks should be visually inspected annually. However, this is likely unachievable in most jurisdictions due to resource constraints. The maximum inspection cycle considered acceptable is once every five years. However, this cycle is difficult to achieve for most municipalities. For example, in Burlington, ON (a municipality of less than 200,000 with a canopy cover of about 23%) park trees are visually inspected approximately once every seven years, and maintenance is carried out on an as-needed basis.

Rationale: Increased maintenance frequency will result in improved tree health, reduction in tree-related risk, improved identification and monitoring of urban forest pests/pathogens. In addition, a combination of cyclical inspection and as-needed maintenance for park trees will balance the City's duty/standard of care for tree health and risk management with available resources.

ACTION #7: IMPLEMENT A YOUNG TREE MAINTENANCE PROGRAM

Related NH&UFS Strategies: #16

Implementation Guidance:

- Using Hansen 8 tree asset management system, schedule every newly-planted caliper-sized City-owned tree for inspection/pruning 3 times within 10 years following planting. Undertake ground-based structural pruning, as needed, for each tree included in the program by City crews or contractors
    - Schedule future inspections/maintenance by trained arborists until young trees are fully established and trained for good future structure
- Consider utilizing part-time summer employees (students, etc.) for program implementation
- Increase per-tree cost in General Fees and Charges by-law (No. 240-12) to $650 to fund improved young tree maintenance program (and ensure regular review of this charge)

Current Practices: Some young trees are structurally pruned, but the program is not comprehensive or formalized. Stake removal and other maintenance are undertaken for plantings under warranty, but active maintenance tapers off quickly after the warranty period expires (typically two years). Inspections of planted materials on private property at the end of the planning process are generally undertaken by Engineers or Landscape Architects rather than Forestry staff or other trained arborists.

Best Practices: A formal young tree pruning program can help to ensure the future development of healthy, large-statured and structurally stable trees. Best practices show that newly-planted caliper trees should be inspected and, if necessary, pruned at least three times in the first ten years following establishment. A formal program to track trees from establishment to maturity and schedule regular inspection and pruning is optimal.

If necessary due to resource constraints, the relatively non-technical task of young tree structural pruning can be undertaken by staff such as properly trained summer workers or even City-approved volunteers. Successful young tree pruning programs have been implemented in Calgary, AB, where young trees are inspected and pruned (if necessary) a minimum of three times in the first ten years, and New York, NY where a formalized "Citizen Tree Pruner" program has graduated more than 11,000 volunteers since inception and complements the City's staff-based neighbourhood pruning program which focuses on mature trees.

Rationale: Young tree maintenance is one of the most cost-effective ways to reduce incidence of tree-related risk, and improve future urban forest health and condition. Inspections by Forestry staff and/or qualified arborists will ensure proper planting/maintenance and assumption of good-quality trees for the future urban forest.

ACTION #8: DEVELOP AND IMPLEMENT A TREE RISK MANAGEMENT PROTOCOL

Related NH&UFS Strategies: #16

Implementation Guidance:

- Develop a tree risk management protocol or strategy that includes key considerations outlined in the UFMP
    - Balance need for conservation of large/old trees with risk issues
    - Utilize street tree inventory to prioritize areas for tree risk inspection (e.g., areas with predominantly larger and mid-sized trees)
- Implement proactive tree risk management for street trees, actively-managed park areas, and in proximity to formal woodland trails
- City-owned woodland risk tree management should be coordinated within a city-wide woodland management program
- Improve Forestry Section staff tree risk assessment training (e.g., ISA Tree Risk Assessment Qualification program)

Current Practices: Tree risk assessment and management are largely reactive and/or request-based. Risk can sometimes be identified and/or managed during the course of regularly scheduled street tree maintenance. Recently, emerald ash borer management requirements have reduced ability for Forestry Inspectors to undertake woodland tree risk assessment/management activities.

Best Practices: Implementation of a tree risk policy, strategy or protocol that that coordinates inspection, mitigation and proactive planning in order to improve safety and reduce risk, uncertainty and liability is a critical component of effective tree risk management. Recent advances in tree risk assessment have resulted in new levels of risk assessment training and qualification by bodies such as the International Society of Arboriculture (e.g., Tree Risk Assessor

Qualification). Forestry staff and local arboriculture contractors should be encouraged to seek advanced tree risk assessment training and, ultimately, such qualifications should be required by the City.

Basic visual inspection of trees in actively managed and high-traffic locations (e.g., streetscapes, parks and along woodland trails) should be undertaken on a regularly scheduled cycle of sufficient frequency to demonstrate the City's fulfillment of its duty of care. Annual inspection is optimal but likely unachievable given resource constraints and fiscal realities. As such, higher-risk trees and locations should be prioritized for tree risk assessment and management, ideally through an up-to-date inventory and proactive tree maintenance program.

Rationale: Improved tree risk management protocol will reduce incidence of tree-related risk and associated costs, reduce the City's potential liability with respect to municipal trees, and will also improve urban forest health.

ACTION #9: IMPLEMENT AN URBAN FOREST PEST MANAGEMENT PLAN

Related NH&UFS Strategies: #16

Implementation Guidance:

- Address prioritized management of forest pests and pathogens in natural and developed areas
- Incorporate active management (e.g., removal, control) along with education and avoidance
- Build on the format and framework developed for dealing with emerald ash borer (EAB) and be used for future pest invasions as required
- To work with neighbouring municipalities, the Region of Peel, the Canadian Food Inspection Agency (CFIA) and other agencies to coordinate research, monitoring and management monitoring efforts.

Current Practices: There is an EAB management plan that was approved in 2012 and is now in effect. However, there is no City-wide invasive species management strategy, nor a framework for future pest management. In the past, awareness of urban forest pests in southern Ontario municipalities has been relatively limited. However, with the extensive damage it is causing to both public and privately owned trees, the current spread of EAB presents an excellent opportunity to engage the community on urban forest pest issues.

Best Practices: A comprehensive urban forest pest management approach is needed to strategically identify and prioritize potential threats, identify areas at greatest risk, and outline potential strategies to proactively control, mitigate and adapt to invasive species. The Ontario Invasive Plan Council and Ontario Invasive Species Strategic Plan outline best practices for invasive species management, and provides some guidance regarding available resources and support networks.

Rationale: Improved urban forest pest management, if it is proactive and effective, can increase urban forest and natural areas ecosystem resilience to other stressors. Improved public awareness of invasive pest issues can also be an opportunity to highlight the ecosystem services provided by the urban forest, improve public support of urban forest pest and other management activities, and foster engagement in local tree and woodland care.

8.3 TREE ESTABLISHMENT AND URBAN FOREST EXPANSION

ACTION #10: WORK WITH CITY STAFF AND EXTERNAL PARTNERS TO IMPLEMENT URBAN FOREST EXPANSION

Related NH&UFS Strategies: #14

Implementation Guidance:

- Utilize the *City of Mississauga Urban Forest Study* (2011) mapping to help guide prioritization
- Incorporate priority areas for naturalization / reforestation identified through conservation authority subwatershed plans, as well as CVC's new Draft Natural Heritage System, Landscape Scale Analysis, and the current Lake Ontario Integrated Shoreline Strategy and Credit River Parks Strategy
- Prioritize planting in areas to be most heavily affected by Emerald ash borer-caused tree mortality
- Prioritize areas identified for naturalization in conservation authority subwatershed plans
- Prioritize lands for urban forest expansion where access is readily available
- Consult with private landowners and planning staff prior to seeking opportunities for planting on private lands
- Continue to identify and utilize currently unused street tree planting locations, improving soil conditions where required and possible
- Increase public promotion of and develop supporting materials for a request-based street tree planting program
- Through the One Million Trees Mississauga Program, implement a formalized tree establishment tracking program associated with all urban forest expansion (tree planting) activities, including streetscape and naturalization/restoration plantings.

Current Practices: Mississauga residents can request street or other public tree planting, but the program is not well-publicized and utilized. The One Million Trees Mississauga Program was launched in April 2013 to expand naturalization and restoration plantings., and include tracking of trees planted both by the City and other groups who participate.

Best Practices: Request-based street tree planting is available for residents city wide in Mississauga, helping promote citizen engagement in urban forest expansion and stewardship. City staff are currently working on the development of an on line self-serve process whereby residents can email in service requests for forestry functions, and would be one of the first municipalities in southern Ontario to provide such a service. Hamilton and Toronto also have effective resident request tree planting programs, with promotional materials available online and as brochures. In Toronto, a species list accompanies the request form, helping residents to easily select trees suited for their site.

Several best practices can guide larger-scale planting programs, such as restoration or naturalization plantings. In New York, the City has worked with over 8,000 volunteers through its MillionTreesNYC program to plant smaller trees in natural and landscaped areas. It also reaches out to developers and large landowners and business improvement districts to develop long-term greening plans in concert with the goal of planting over one million trees in the next decade. About 70% of the trees will be planted in parks and other publicly-owned spaces, with the remainder coming from private organizations and homeowners through this program. This prioritization of planting on public space will help to ensure longer-term survival for trees, as they will be protected from development and land use change. Through the New Forest Creation aspect of the program, the City selects species best adapted to specific sites, using existing natural forests as references. This program includes monitoring and opportunities for corrective action as needed.

Rationale: Strategic prioritization and implementation of opportunities for urban forest expansion will accelerate the provision of urban forest benefits where they are most needed, and support achieving UFMP and NH&UFS objectives.

ACTION #11: IMPLEMENT IMPROVED TREE ESTABLISHMENT PRACTICES

Related NH&UFS Strategies: #15

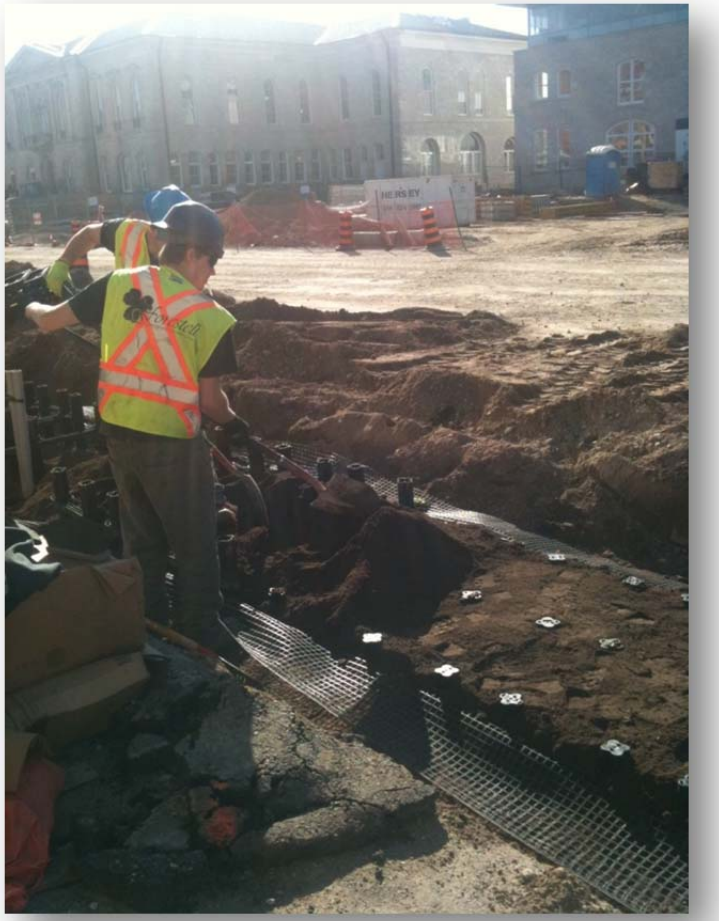
Implementation Guidance:

- Require implementation of Mississauga 'Stage One' Green Development Standards requirements for tree habitat, including minimum soil volumes and tree density requirements or alternate standards developed through revised and updated tree preservation and tree establishment specifications and standards
- Implement improved engineered tree growing environment solutions (e.g., open planters, structural cells, etc.) for all capital projects and, where appropriate, Site Plan and other controlled developments
- In conjunction with updated and revised tree planting specifications, standards and guidelines, ensure that all City forces and contractors involved in tree establishment implement improved practices
- Undertake species suitability trials for trees planted on public lands
- Provide training to Community Services, Planning and Building, and Transportation and Works staff involved in reviewing and overseeing implementation of planting specifications regarding tree establishment best practices (e.g., minimum soil volumes, soil quality parameters, how to assess if nursery stock is healthy, etc.)
- Ensure street tree plantings and maintenance are inspected by a qualified arborist and/or Forestry staff prior to final acceptance of planting of City-owned trees

Current Practices: City planting contractors are expected to adhere to existing standards, and site inspection of tree establishment is typically conducted in conjunction with inspection of other infrastructure elements. This inspection is not necessarily done by inspectors with specific knowledge of tree establishment requirements (e.g., stock quality, planting, depth, post-planting maintenance, etc.).

Best Practices: There is a wide range of best practices for tree establishment, which must be explored in detail through a comprehensive review and update of planting establishment practices, specifications, standards and guidelines. Required implementation of updated specifications, supported by effective inspection and compliance enforcement, will result in improved tree establishment practices.

Rationale: In the past as development occurred in Mississauga, inadequate consideration has been given to soil volume or quality. If urban forest targets are to be achieved, there needs to be a dramatic shift in planting practices so that trees are provided with adequate space and soil conditions.



8.4 TREE PROTECTION AND URBAN FOREST PRESERVATION

ACTION #12: UPDATE PUBLIC TREE PROTECTION BY-LAW TO BETTER SUPPORT URBAN FORESTRY OBJECTIVES

Related NH&UFS Strategies: #8

Implementation Guidance:

- In the updated Public Tree Protection by-law, ensure complete protection of all City-owned trees (street, park, natural areas, etc.) through:
    - clear definition of prohibited actions (injury, defacement, removal, tree protection zone encroachment etc.)
    - consistency with other tree protection policies (e.g., tree preservation standards)
    - sufficient penalties to act as deterrent and to issue stop-work orders
- Ensure effective public and internal communication regarding by-law updates

Current Practices: The current Street Tree By-law in effect is outdated and is being reviewed by City staff.

Best Practices: Many municipalities have by-laws regulating the injury or destruction of publicly-owned trees. Key components of such by-laws include:

- Clearly defined parameters of tree ownership, especially in cases where trees straddle public and private property lines
- Requirements for compensation if trees must be removed for development
- Ability to levy fines and stop work orders to prevent damage to publicly-owned trees

An effective by-law program must be supported by financial and human resources, and must be adequately promoted internally and to the community to ensure adherence.

Rationale: An effective Public Tree Protection by-law will demonstrate the City is leading by example, show the City's commitment to urban forest sustainability, and result in increased tree survival and improved urban forest health.

ACTION #13: UPDATE EROSION CONTROL BY-LAW AND THE NUISANCE WEEDS BY-LAW TO SUPPORT URBAN FORESTRY AND NATURAL HERITAGE OBJECTIVES

Related NH&UFS Strategies: #8

Implementation Guidance:

- For the Erosion Control By-law:
    - Change the permit exemption for topsoil removal from lands 1 ha and less to a smaller area (e.g., 0.2 ha)
    - Prohibit stockpiling of topsoil within the drip-line of any protected trees or vegetation
    - Provide more specific requirements for identification of vegetation on-site that specifies species, size and condition of all trees of 15 cm dbh or more, as well as more general identification (location, type) of other vegetation on site
    - Require that where more than two trees of 15 cm or more are being removed that they be replaced on site or compensated with cash in lieu (per the updated Private Tree Protection By-law)
    - Require that trees and vegetation being retained on site, as well as any potentially affected in adjacent lands, be protected with a clearly marked and fenced Tree Protection Zone
    - Require that an arborist report to be completed by a Certified Arborist retained for the duration of the project
- For the Nuisance Weeds by-law:
    - Incorporate flexibility to recognize naturalization benefits associated with vegetation greater than 30 cm in height, where appropriate.
    - Review 'Schedule A' to include a broader range of Nuisance Weeds, such as dog-strangling vine (*Cynanchum rossicum*), giant hogweed (*Heracleum mantegazzianum*) and others.

Current Practices: The current Erosion Control By-law in effect is outdated and is being reviewed by City staff. It currently exempts top soil removal from lots 1 ha and less in area, except for removal adjacent (within 30 m) to water bodies, which requires a permit in all cases. As part of the permitting process, applicants must provide the location and type of vegetative cover in the area to be effected, however, the by-law is not currently being used as a tool to support urban forestry or natural area objectives.

Best Practices: Many municipalities have, and enforce, erosion control and/or site alteration by-laws to the removal or placement of topsoil within a jurisdiction. Examples of cities in southern Ontario with such by-laws include the City of Markham, City of London, City of Kingston, Town of Oakville, City of Hamilton, City of Guelph, and the City of Niagara Falls.

Rationale: Erosion Control By-laws or Site Alteration By-laws typically require the identification and description of all trees that may be impacted by the proposed grade changes, and therefore provide an opportunity for the identification of tree preservation, tree replacement and/or compensation for trees approved for removal. The benefit, from an urban forest perspective, of these by-laws is that they require permits for activities that may not be under the purview of the *Planning Act* or other City by-laws, and therefore enable identification of opportunities for tree protection and replacement that may otherwise be overlooked. In Mississauga, where future development will largely be infill and intensification, it will be important to have a size threshold of much less than 1 ha if most proposed works are to be captured and regulated.

ACTION #14: UPDATE THE PRIVATE TREE PROTECTION BY-LAW TO SUPPORT URBAN FORESTRY OBJECTIVES

Related NH&UFS Strategies: #8

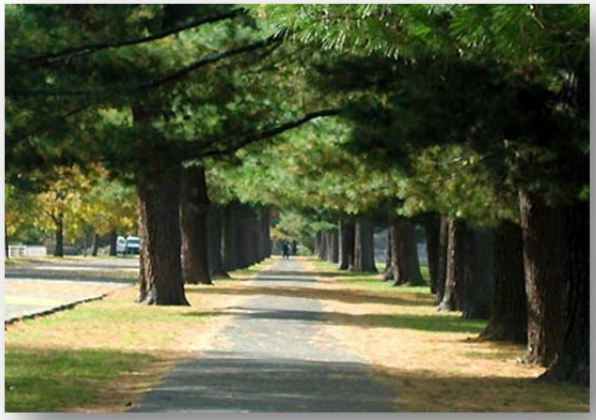
Implementation Guidance:

- Monitor and assess the effectiveness of the recently revised by-law in regulating the removal and replacement of trees, particularly mature trees, on private property for the next four to eight years
- In four to eight years, consider further strengthening the by-law to include all trees above a certain diameter, and making any other updates in response to issues identified over the assessment period
- Consider the cost implications of further strengthening the by-law
- As previously, undertake consultations with City staff, key stakeholders and the community as part of the by-law re-evaluation process

Current Practices: The current Private Tree Protection By-law (254-2012), which was updated over 2012 and enacted March 2013, regulates the removal of three or more healthy trees greater than 15 cm diameter per calendar year on any parcel of private property. It also establishes a replacement ratio for trees approved to be removed of 1:1 for trees between 15 and 49 cm diameter, and 2:1 for trees 50 cm in diameter or greater. If replacement trees cannot be planted on site due to space limitation or the owner's desire, the tree replacement securities will be applied to the Corporate Replacement Fund.

Best Practices: An increasing number of municipalities in southern Ontario have adopted private tree protection by-laws. In urban and area municipalities (as opposed to regions or counties), the by-laws tend to regulate the removal of individual trees, and tend to use diameter class. Regulated diameters range from 15 cm to more than 40 cm. Different municipalities also provide some different exemptions and exceptions that reflect their particular circumstances. In general, private tree by-laws are considered to be educational tools as much as they are regulatory tools, and are most effective when they are widely promoted and enforced when required.

Rationale: Mississauga's canopy cover is currently about 15% and likely to decrease more before it increases, largely as a result of emerald ash borer which is expected to kill most of the City's ash trees over the next decade. The remaining mature trees in the landscape play a significant role in sustaining the remaining canopy cover, and shifting towards expanding it. In cases where such trees cannot be saved, it is important that they at least be replaced in order to contribute to the City's future canopy.



ACTION #15: INCREASE EFFECTIVENESS OF TREE PRESERVATION IMPLEMENTATION AS PART OF PRIVATE PROJECTS

Related NH&UFS Strategies: #19

Implementation Guidance:

- Fast track (max. 3 days from receipt to final review) review of *Tree Injury or Destruction Questionnaire and Declaration* forms accompanying Building Permit, Pool Enclosure Permit and other development permit applications with legislated review and permit issuance requirements
- Using existing language required for Landscape Plans associated with Site Plan Applications, enable Forestry Inspectors to conduct periodic 'spot inspections' of development sites to ensure compliance with tree protection policies
- Increase the value of securities held against tree preservation to tree amenity value (as determined using accepted valuation methodologies) and withhold Letters of Credit for minimum of two years for all protected trees which may be adversely impacted during site development
- Require development proponents to retain an arborist prior to undertaking of site works and establish schedule for regular inspection of tree preservation methods implemented on site, accompanied by reports submitted to Forestry Section and Planning and Building department
- Enable Forestry staff to review and provide comment on all Committee of Adjustment and rezoning applications where trees may be adversely affected by proposed development upon request, and ensure Committee of Adjustment members are aware of this resource

Current Practices: Through discussions with Forestry staff, several gaps in current practices were identified where opportunities for tree preservation and/or replacement could be identified:

- Forestry requires arborist reports and follow-up inspections, but adherence to these requirements is not strictly enforced, and site inspections are rarely undertaken to ensure compliance with municipal requirements and policies.
- Absence of review and follow-up of 'Tree Declaration' forms means tree issues identified through Building Permit process may be overlooked. However, legislated permit issuance timelines constrain opportunities for comprehensive review.
- City staff are not directly involved in Committee of Adjustment (CoA) application reviews, arborist reports are only provided to support CoA applications when requested by CoA, and Forestry staff are only involved when consulted by Development and Design or Park Planning.

Best Practices: A wide range of practices can improve the effectiveness of tree preservation implementation during and following site development. Effective planning before development begins is critical to successful on-site outcomes, but does not guarantee effective implementation. However, the ability to impose conditions upon Site Plan and other development approvals or tree injury permits offers opportunities to promote tree preservation. For example, staff can require tree preservation measures such as root-sensitive excavation or root pruning as conditions of tree injury permits if construction is required within Tree Protection Zones. Similarly, regular arborist inspection and reporting can ensure tree preservation is implemented.

The Town of Oakville is a leading example of effective implementation of tree preservation during development. The Town's permitting processes and tree protection policies are sufficiently robust to encourage adherence, and Town staff exercise the ability to issue stop work orders or conduct site inspections as required. The Town's Tree Protection Audit process requires a minimum of three scheduled site inspections and written reports, which must include a number of factors including 'Tree Impact Evaluation', mitigation recommendations, soil amendments, and photographic records, as necessary.

Rationale: Increased preservation of trees during development will promote urban forest sustainability by maintaining existing trees. Working with landowners and the community to identify opportunities for tree preservation and replacement demonstrates the City's commitment to its urban forest targets, and also presents opportunities for increasing awareness and engagement.

ACTION #16: INCREASE EFFECTIVENESS OF TREE PRESERVATION AS PART OF MUNICIPAL OPERATIONS AND CAPITAL PROJECTS

Related NH&UFS Strategies: #19

Implementation Guidance:

- Update collaborative review and update of tree preservation specifications and standards (see **Action Item #X**) with affected City departments and staff
- Forestry Section should undertake field-based and pre-planning review of municipal infrastructure works or other projects A tree inventory and arborist reporting should be required for municipal works (as it is for private developments)
- Require the Parks and Forestry Division to hold securities for all infrastructure projects where street trees, or trees in greenbelt or park lands may be impacted and released upon inspection (by an arborist) of satisfactorily completed works

Current Practices: Currently, application of tree preservation during capital projects and other municipal works is not consistent. When tree preservation is implemented, either Parks Planning Landscape Architects or Transportation and Works technologists inspect. There is some pre-consultation with Forestry staff on capital projects or other municipal works, but often only after the overall designs are approved.

Best Practices: Involvement of Forestry staff at the planning stages of capital projects would allow for alternative designs to be considered to accommodate tree preservation where warranted, and ensure that adequate space for planted trees is provided in the original designs. Municipalities, like the City of Toronto are increasingly realizing the benefits of interdepartmental coordination and cooperation when planning large-scale capital projects or smaller scale maintenance operations, and ensuring there is more regular on-site involvement and supervision by trained arborists.

Rationale: Increased preservation of trees during municipal works, and creation of better plantable areas, will promote urban forest sustainability, show the City is leading by example, and avoid last minute retrofitting of designs to try and accommodate trees as an afterthought.

ACTION #17: DEVELOP AND IMPLEMENT CITY-OWNED WOODLAND MANAGEMENT THROUGH NATURAL AREA CONSERVATION PLANS

Related NH&UFS Strategies: #13

Implementation Guidance:

- Targeted management of City-owned woodlots is to be undertaken as dictated by short (5 to 10 page) Natural Area Conservation Plans that focus on operational needs and act as a "go to" document to guide management (as described in the NH&UFS)
- Build on existing data collected through the City's ongoing Natural Areas updates, EAB assessments being undertaken as part of the EAB Strategy (2012), and CVC's natural areas monitoring program.
- Ensure that management priorities include any potential risk trees identified along formalized trails in City-owned woodlands
- Continue to engage local community and stakeholder groups, including the conservation authorities, in management of high priority invasive species in City woodlands

Best Practices: Many municipalities own at least a few woodlands, but few have the resources to develop and implement management plans for them. "Conservation Master Plans" (e.g., City of London) or "Management Plans" (e.g., Huron Natural Area in the City of Kitchener, Hungry Hollow in the Town of Halton Hills, Crother's Woods in the City of Toronto) for selected City-owned woodlands. In a number of cases these plans have actively, and successfully, engaged local user groups (e.g., mountain bikers, cross-country skiers, anglers) who have a vested interest in the preservation of these places.

Rationale: As the population of Mississauga grows, more people will want to visit and recreate in its natural areas. Therefore there is a pressing need to keep these areas safe for public use, and to try and manage the level and types of use so the ecological value of the protected woodland are not eroded. Mississauga is in the unique position of having current inventory and management needs identified for almost all of the City-owned woodlands in its Natural Heritage System, greatly facilitating translation into site-specific operational plan.

8.5 PROMOTION, EDUCATION, STEWARDSHIP & PARTNERSHIPS

ACTION #18: DEVELOP A SHORT VIDEO SERIES AND MAKE THE CITY'S TREE INVENTORY PUBLIC TO SUPPORT OUTREACH, EDUCATION AND STEWARDSHIP

Related NH&UFS Strategies: #20, #23

Implementation Guidance:

- Develop a series of short videos on key topics designed to engage and educate a cross-section of Mississauga's community. Key topics could include:
  - Ecosystem services provided by the City's trees and natural areas
  - How to plant a tree and/or naturalize your garden
  - How to pick the right species
  - How to enjoy and respect the City's public natural areas
- Videos should be short (i.e., about 2 minutes), be illustrative, be in plain (non-technical) language, and if possible made available in languages other than English spoken by large sectors of the community
- Videos could be designed and marketed through the One Million Trees program launched in April 2013, and could also be featured on the City's main webpage, and advertised through the City's social media
- The City's tree inventory should, at least in part, be made available to the public in a readily usable on-line format that is compatible with the City's asset management system for trees so that residents can identify the location and species of the trees in the inventory, put in an on-line service request if needed, and verify the status of their request on-line

Current Practices: The City recently updated the urban forestry sections of its website and developed a creative stand alone website for the One Million Trees campaign, but does not have any informative or demonstrative video clips posted.

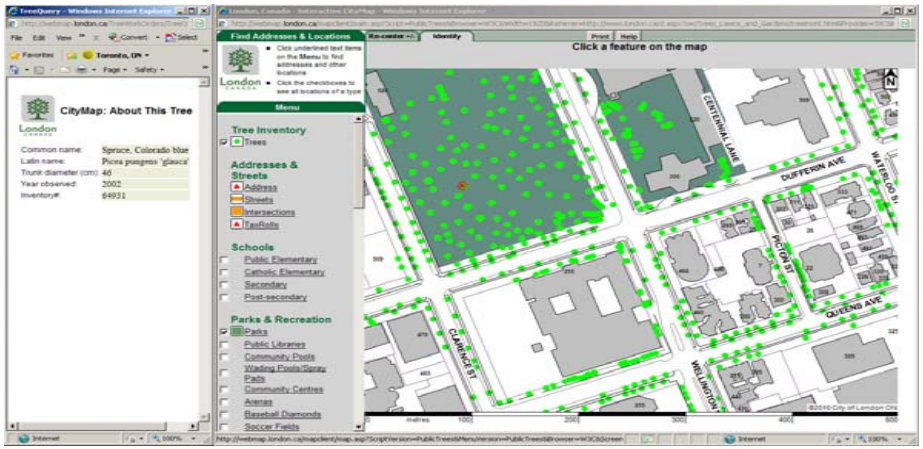
The City's tree inventory, which includes about 243,000 street trees as well as some park trees, is fairly comprehensive but requires updating, and is currently only used by and available to City staff.

Best Practices: Although an increasing number of municipalities are starting to build social media outreach into their day to day service, few have developed and posted video clips, particularly related to urban forest topics. The City of Calgary is one of the few that has posted videos on how to plant a tree, as has the non-profit Toronto-based organization LEAF.

A growing number of municipalities with active urban forestry programs are putting their municipal tree inventories on-line for use by City staff in other departments and the public. The City of London and Town of Oakville have had their inventories on-line for several years. The City of Ottawa recently launched their on-line tree inventory.

Rationale: Short video clips are an excellent tool to engage people of all ages who may not be so inclined to pick up a brochure or download a PDF pamphlet on-line. These can also be posted and shared in a variety of locations and through a variety of media.

Having the City's tree inventory, at least information about location and species, on-line is also a very applied way to get people engaged in the trees in their neighbourhood (e.g., they can check if the tree is on City or private property, what species it is). A further use of this tool could be to facilitate the work order request system related to City trees by allowing people to submit requests on-line and potentially check the status of their request, rather than calling City staff to inquire.



ACTION #19: IMPROVE AND MAINTAIN AWARENESS AMONG CITY DEPARTMENTS ABOUT CURRENT NATURAL HERITAGE AND URBAN FOREST POLICIES, BY-LAWS AND TECHNICAL GUIDELINES

Related NH&UFS Strategies: #1, #21

Implementation Guidance:

- Internal workshops and "lunch and learn" sessions need to be held by the City staff who regularly work with tree-related policies, by-laws and guidelines to educate all City staff about changes to and tools for implementation of these tree-related policies, by-laws and guidelines
- These sessions could incorporate outreach tools developed for the public (e.g., video clips, facts about ecosystem services) and be tailored to relate to the work of various staff and how they could better consider urban forest and natural heritage objectives in their daily practices
- Short reference documents focused on key topics could be developed as "take-away" resources for participants
- Senior management should require staff to attend these sessions as part of their job

Current Practices: City staff communicate with each other about natural heritage and urban forest policies, by-laws and guidelines on a largely "as needed" basis, but those not directly involved with a particular project or new development may not be fully informed about the item or how best to implement it. Changes in by-laws, for example, tend to be circulated internally as "news releases", and Forestry staff are consulted on various projects where trees and/or natural areas are involved. However, opportunities for including natural heritage and/or urban forest considerations where there are no triggers *per se* for involvement by Forestry staff may be overlooked.

Best Practices: In several urban and urbanizing municipalities the multi-disciplinary nature of dealing with trees and natural areas is addressed through the creation of "team" of key staff who work with different aspects of tree and natural area planning and/or management meeting on a regular basis (e.g., City of Guelph). In larger municipalities like Mississauga with more complex organizational frameworks, other tools (such as workshops) must be used for broad-based information sharing.

Rationale: Trees and natural areas in urban settings must, by the very nature, be considered from various perspectives if they are to be successfully integrated into an urban setting. Trying to genuinely achieve this integration while still ensuring all the other needs and requirements are met (e.g., servicing, safety, accessibility, parking, etc.) is a real challenge for all municipalities. However, this integration cannot happen until all staff are aware of the policies, by-laws and guidelines intended to make it happen.

ACTION #20: DESIGN AND IMPLEMENT A CITY ARBORETUM / MEMORIAL FOREST

Related NH&UFS Strategies: #22, #25

Implementation Guidance:

- The City should develop a design concept, and create an arboretum and memorial forest that:
  - Provides a central location for non-denominational commemoration of persons through tree planting
  - Serves as a demonstration arboretum of the range of native tree (and shrub) species that can thrive in Mississauga, as well as some of the habitat types
  - Provides opportunities for learning and stewardship, as well as research (e.g., potential location for testing the success of some more southern tree species)
- One, or potentially, two location(s) on City property need to be selected. Criteria for selection should include:
  - Accessibility via public transit
  - Adequacy of size to accommodate commemorative, educational and research uses
  - Ability to enhance and expand the City's Natural Heritage System, and contribute to the urban forest

Current Practices: The City currently has a Commemorative Tree program that is administered through the Forestry Section, in conjunction with the Commemorative Bench program. The purpose of the existing program is to provide members of the public a way to recognize or commemorate others through a lasting and tangible contribution. Trees are planted twice annually (spring and fall) and the locations of the trees are chosen with the assistance of Parks and Forestry Division staff to ensure that trees are planted in suitable locations. With the future creation of a "Memorial Forest" or arboretum, all future

commemorative trees would be planted in one central location instead of various sites across the City.

Best Practices: Many municipalities have commemorative tree and/or bench programs, and some larger municipalities also have arboreta (typically associated with an academic institution), however very few have commemorative programs tied to a central, municipally-owned arboretum that also serves as an educational and research centre. An example of a native tree arboretum is the Louise Pearson Memorial Arboretum in Tennessee, while other notable arboreta focused on educational and research objectives include Missouri Botanical Gardens in St. Louis and the Louise Kreher Forest Ecology Preserve. Closer to Mississauga are the Royal Botanical Gardens in Hamilton, and the University of Guelph Arboretum, which both have memorial components but are primarily focused on educational and research objectives.

Rationale: This is a unique pursuit in the City of Mississauga that will fulfill social, education and research needs related to natural heritage and the urban forest while also contributing their enhancement.

ACTION #21: SUPPORT VARIOUS PARTNERS AND ORGANIZATIONS IN THEIR EFFORTS TO UNDERTAKE TARGETED ENGAGEMENT OF LOCAL BUSINESSES AND SCHOOLS

Related NH&UFS Strategies: #22

Implementation Guidance:

- Build on the success of Partners in Project Green and other stewardship initiatives with local businesses, and continue to collaborate with CVC, TRCA and non-profits to encourage tree planting and naturalization on corporate business grounds, in industrial parks and in commercial plazas
- Approach businesses interested in "greening" their image to sponsor or support various natural heritage and/or urban forest projects or events (e.g. design and development of the Arboretum/Memorial Forest) in exchange for formal recognition
- Identify liaisons with all local school boards and private schools responsible for environmental education, and:
    - encourage the incorporation of existing TRCA, CVC and Conservation Halton school-directed programs into their curricula
    - explore opportunities for school grounds greening (and encourage exploration of funding opportunities if there is interest)
    - explore options for local schools to "adopt" nearby City-owned woodlands o other natural areas and participate in their stewardship
    - explore opportunities for older (e.g., high school students) to become involved in local monitoring activities
- Explore opportunities to coordinate with local groups with interest in working with youth (such as ACER)
- Create a Stewardship Coordinator position to organize and help implement the wide range of stewardship activities in partnership with businesses and schools

Current Practices: The City, over the past decade or more, has been gradually building partnerships with the local conservation authorities as well as some local businesses (e.g., businesses around the airport through Partners in Project Green) and a few schools (e.g., Erindale) to support stewardship initiatives on their properties.

Best Practices: The substantial opportunities for naturalization and forestation in Mississauga (as in other municipalities) on school grounds and in business parks is recognized by the agencies and non-profit groups (e.g., in Mississauga - CVC, TRCA and Evergreen) who have programs specifically targeting these two groups.

Rationale: Schools and properties associated with various businesses, particularly in business parks, present substantial opportunities for naturalization and forestation in Mississauga. It also engages the students who attend these schools and the workers of these businesses. If Mississauga is to achieve it s urban forest and natural heritage targets, it will require the commitment and active stewardship of lands beyond those under the City's control. Active stewardship of local schools and businesses is key.

ACTION #22: CONTINUE TO WORK WITH VARIOUS PARTNERS TO UNDERTAKE STEWARDSHIP ON PUBLIC AND PRIVATE LANDS

Related NH&UFS Strategies: #24

Implementation Guidance:

- Continue to work with CVC, TRCA and Halton Conservation to undertake stewardship activities on public and private lands, as opportunities arise, with members of the community and local volunteer groups
- Try to align stewardship activities with priority areas identified through either natural heritage and/or urban forest expansion priorities (as identified through NH&UFS Strategies #10 and #14)
- Continue to build the existing directory of local stakeholders interested in being involved in stewardship activities
- Create a Stewardship Coordinator position to organize and help implement the wide range of stewardship activities in partnership with other agencies and non-profits

Current Practices: The City, over the past decade or so, has been gradually building partnerships with some local community and environmental organizations to support and expand naturalization and reforestation efforts, primarily on public lands. Groups such as the Credit River Anglers Association, Riverwood Conservancy, and others have been active partners in a number of stewardship projects. The City maintains a database of these partners to keep interested parties aware of future events.

Best Practices: No municipality has enough resources to undertake all the potential naturalization and/or tree planting and/or care that is required to fully sustain and expand the urban forest and natural heritage areas. Therefore, many municipalities work to leverage partnerships with local agencies and non-profits. Where these activities are recognized as a high priority, some municipalities have created a full or part-time position dedicated to coordinating various stewardship activities (e.g., City of Kitchener, City of Guelph, City of Toronto).

Rationale: If Mississauga is to achieve it s urban forest and natural heritage targets, it will require the commitment and active stewardship of private landowners. This can be facilitated by having some active leadership and coordination from the City showing how stewardship is done by example, and providing resources to support such activities on private lands.

ACTION #23: PARTNER WITH LOCAL AGENCIES AND INSTITUTIONS TO PURSUE SHARED RESEARCH AND MONITORING OBJECTIVES (STRATEGY #25)

Related NH&UFS Strategies: #25

Implementation Guidance:

- Engage in discussions with University of Toronto in Mississauga, the non-profit group ACER, CVC, TRCA and others about undertaking some joint research projects that would inform the City's urban forestry program
- Engage in discussions with other non-profit organizations and agencies (e.g., EAB injection trials with the Canadian Food Inspection Agency), as well as the Region, to explore opportunities to pursue joint research projects
- Consider providing places on City lands to conduct research trials, and helping to establish study plots in exchange for the development of study design, data collection, analysis and reporting of results
- Potential projects could include:
    - responses of different native tree species to different soil types and conditions in the city
    - evaluation of the use of structural soils, subsurface cells and other enhanced rooting environment techniques for street trees
    - working with local growers to diversify stock and reduce reliance on clones
    - development of a seed collection program for native ash species (to bank the genetic stock) in partnership with TRCA, CVC and the National Tree Seed Centre

Current Practices: The City was recently involved in the collection and analysis of urban forestry data to support the Peel Region and City of Mississauga urban forest studies undertaken through the Peel Urban Forest Working Group. Although the City is interested in pursuing additional joint research and monitoring projects, it is currently a challenge to meet all the requirements of undertaking the day-to-day operations, management and outreach, and there is little to no time left for pursuing joint research projects.

Best Practices: The USDA Forest Service, in collaboration with the University of Vermont, has been an excellent source of urban forest information and have worked with many municipalities (including Peel Region) in the U.S. and Canada to develop and undertake urban forest canopy assessments using the latest tools and technologies. In Canada, there is no comparable government body dedicated to urban forest issues, and therefore research collaborations are often the by-product of a keen municipal staff person who pursues particular areas or interest. An Arboretum in the City of Mississauga, as recommended in Action #20, presents a good potential place to support such collaborations.

Rationale: Urban forestry is still a relatively "young" practice and there is still many unanswered questions about how best to undertake different operational and management practices. Working with local agencies and institutions to try and answer questions of joint interest can help better inform day-to-day urban forest activities, and also provide opportunities for educating and engaging youth and the community.

ACTION #24: BUILD ON EXISTING PARTNERSHIPS WITH THE REGION OF PEEL AND NEARBY MUNICIPALITIES TO FACILITATE INFORMATION SHARING AND COORDINATE RESPONSES TO ENVIRONMENTAL ISSUES

Related NH&UFS Strategies: #25

Implementation Guidance

- Maintain and build on working relationship with the existing Peel Region Urban Forest Working Group (PUFWG)[23] by:
    - Remaining actively involved in bi-monthly working group meetings
    - Continuing to partner on data sharing and analysis related to canopy cover assessment and monitoring
    - Working together to pursue funding and/or other forms of support from the Provincial and/or federal governments regarding urban forest issues
    - Continuing to seek or provide assistance from/to the group on urban forest planning or management tasks as appropriate
    -
- Broaden and formalize the PUFWG-type collaboration to include other nearby municipal and agency partners (e.g., by having bi-annual meetings) to engage in:
    - Information sharing on shared urban forest issues (e.g., invasive pest management, responses to climate change)
    - Joint and coordinated responses to environmental threats related to the urban forest (e.g., invasive pests, air quality management)
    - Pooling resources regarding monitoring of key environmental stressors, and joint responses to them
    - Pursuing support (financial and other) for urban forestry initiatives

Best Practices: Urban forestry has not been recognized as a core activity, or responsibility, of municipalities in Canada until relatively recently, and it could be argued it is still not nearly well enough recognized. Nonetheless, there are several local examples of effective inter-jurisdictional collaboration on urban forestry issues, a couple of which are listed below.

The Canadian Food Inspection Agency (CFIA) has worked very effectively with Mississauga and other municipalities (i.e., Toronto and Vaughan) to control the spread of Asian long-horned beetle (which affects a broad range of deciduous tree species) over the past decade, and in April 2013 it was announced that the pest had been eradicated from Canada.

Toronto Region Conservation Authority has also been very active with municipalities across the GTA (including Mississauga) in providing technical assistance in terms of conducting urban forest plot data collection, data analysis (based on both field plots and aerial imagery), report development and, in some cases, facilitating stakeholder consultations.

Current Practices: Mississauga has been a member of the Peel Region Urban Forest Working Group, along with Conservation Authority (CVC, TRCA), Brampton and Caledon staff, since inception in 2009. To date this collaboration has resulted in the production of the *Peel Region Urban Forest Strategy* and *Mississauga Urban Forest Study*, and has also allowed for ongoing information exchange and discussion between municipalities. Current collaborative work involves detailed analyses of current tree canopy cover to generate ranges of potential canopy cover and targets Region-wide and for each area municipality.

Mississauga has also collaborated with the CFIA (on the assessment and monitoring of high priority key pests, as well as the implementation of some targeted pest management activities), and keeps in touch with the urban foresters in other nearby municipalities on an informal basis.

Rationale: Continuation of the current working relationship with the PUFWG will be of mutual benefit, and facilitate future studies and planning exercises, as well as help ensure consistency and conformance with Regional planning objectives and policies. Broadening this collaboration in a more formal way with other nearby municipalities (and agencies where appropriate) will facilitate the exchange of best practices and information sharing, which will contribute to improved outcomes in urban forest management and planning, and may also provide more leverage in requests to the higher levels of government related to urban forest issues.

[23] The PUFWG currently consists of staff active in urban forest planning and management from the Region of Peel, Town of Caledon, City of Brampton, City of Mississauga, Credit Valley Conservation and Toronto Region Conservation Authority.

9 GLOSSARY OF TECHNICAL TERMS

Adaptive Management: A systematic process for continuously improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning.

Atmospheric Carbon: Carbon dioxide gas (CO^2) suspended in the Earth's atmosphere. A greenhouse gas, atmospheric carbon dioxide is known to be a primary contributor to climate change.

Boundary Tree: "Every tree whose trunk is growing on the boundary between adjoining lands is the common property of the owners of the adjoining lands," as defined by the *Forestry Act, 1990.*

Canopy Cover: The proportion of land area that lies directly beneath the crown or canopy of trees and tall shrubs. The extent of urban forest canopy cover is typically expressed as a percentage of land area. It is generally recognized that increasing canopy cover is an objective of urban forest management.

Ecological Goods and Services: The products and processes of nature that are directly and inextricably linked to human health and survival. Ecological services include processes such as air and water purification, flood and drought mitigation, waste detoxification and decomposition, pollination of crops and other vegetation, carbon storage and sequestration, and maintenance of biodiversity. Ecological goods generated by these services include fundamental items like clean air, fresh water, food, fiber, timber, and medicines, as well as less tangible items like mental health and spiritual well-being. While ecological goods and services are required and used by all living organisms, they are primarily considered in terms of their value (quantified or not) to humans.

Enhanced Rooting Environment Technology: Methods and materials implemented and installed to provide urban trees with greater soil volumes and higher quality soils than used in most current practices, with the objective of promoting improved root growth and urban tree health.

Evapotranspiration: The combined process of water evaporation and plant transpiration, whereby liquid water is converted into water vapour. The process of evapotranspiration is beneficial in urban areas for its cooling effects.

Family: For plants, the family includes plants with many botanical features in common and is the highest classification normally used. Modern botanical classification assigns a type plant to each family, which has the distinguishing characteristics of this group of plants, and names the family after this plant.

Genetic Potential: A tree's inherent potential to reach a maximum size, form and vigour. Achievement of maximum genetic potential enables a tree to provide the greatest number and extent of benefits possible. Urban trees are frequently unable to reach their genetic potential.

Genus: For plants, the genus is the taxonomic group containing one or more species. For example, all maples are part of the genus called *"Acer"* and their Latin or scientific names reflect this (e.g. Sugar maple is called *Acer saccharum*, while Black maple is called *Acer nigrum*).

Green Infrastructure: A concept originating in the mid-1990s that highlights the contributions made by natural areas to providing important municipal services that would cost money to replace. These include storm water management, filtration of air pollution and provision of shade.

Grid Pruning: The maintenance and inspection of municipally owned trees at regularly scheduled intervals. This type of management is often planned on a grid-based pattern for ease of implementation.

Invasive Species: A plant, animal or pathogen that has been introduced to an environment where it is not native may become a nuisance through rapid spread and increase in numbers, often to the detriment of native species.

Native Species: A species that occurs naturally in a given geographic region that may be present in a given region only through natural processes and with no required human intervention.

Qualified Arborist: A person who maintains his or her certification through the International Society of Arboriculture and/or the American Society of Consulting Arborists as a competent practitioner of the art and science of arboriculture.

Replacement Value: A monetary appraisal of the cost to replace one or more trees, as described by the Council of Tree and Landscape Appraisers.

Right-of-Way: A portion of land granted through an easement or other legal mechanism for transportation purposes, such as for a rail line, highway or roadway. A right-of-way is reserved for the purposes of maintenance or expansion of existing services. Rights-of-way may also be granted to utility companies to permit the laying of utilities such as electric power transmission lines (hydro wires) or natural gas pipelines.

Street Trees: Municipally owned trees, typically found within the road right-of-way along roadsides and in boulevards, tree planters (pits) and front yards.

Tree Protection Zone (TPZ): An area within which works such as excavation, grading and materials storage are generally forbidden. The size of a TPZ is generally based upon the diameter or drip-line of the subject tree.

Urban Forest: All trees, shrubs and understorey plants, as well as the soils that sustain them, located on public and private property within a given jurisdiction. This includes trees in natural areas as well as trees in more manicured settings such as parks, yards and boulevards.

APPENDIX A.

Criteria and Indicators for assessing Mississauga's urban forest. *NOTE: STILL TO BE TAILORED TO MISSISSAUGA.*

Vegetation Resource

Criteria	Performance indicators				Key Objectives
	Low	Moderate	Good	Optimal	
Urban Forest Canopy Cover	Total UF canopy cover in 2033 is less than 15% (2013 level)	Total UF canopy cover is maintained at 15% by 2033	Total UF canopy cover is 20% by 2033.	Total UF canopy cover exceeds 20% by 2033.	To maintain or expand urban forest canopy cover and meet or exceed canopy cover targets
Relative Canopy Cover	The existing canopy cover equals 0-25% of the potential.	The existing canopy cover equals 25-50% of the potential.	The existing canopy cover equals 50-75% of the potential.	The existing canopy cover equals 75-100% of the potential.	Achieve climate-appropriate degree of tree cover, community-wide
Canopy Cover Distribution	Canopy cover difference between wards is not equitable and exceeds ±15% (of total canopy cover)	Canopy cover difference between wards is moderately equitable and does not exceed ±15% (of total canopy cover)	Canopy cover difference between wards is fairly equitable and does not exceed ±10% (of total canopy cover)	Canopy cover difference between wards is equitable and does not exceed ±5% (of total canopy cover)	To provide equitable urban forest canopy coverage across the City (excluding Ward 5, which includes airport lands)
Age distribution of trees in the community	Any Relative DBH (RDBH) class (0-25% RDBH, 26-50% RDBH, etc.) represents more than 75% of the tree population.	Any RDBH class represents between 50% and 75% of the tree population	No RDBH class represents more than 50% of the tree population	25% of the tree population is in each of four RDBH classes.	Provide for uneven-aged distribution city-wide as well as at the neighbourhood level.
Species suitability	Less than 50% of trees are of species considered suitable for the area.	50% to 75% of trees are of species considered suitable for the area.	More than 75% of trees are of species considered suitable for the area.	All trees are of species considered suitable for the area.	Establish a tree population suitable for the urban environment and adapted to the regional environment.
Species distribution	Fewer than 5 species dominate the entire tree population city-wide.	No species represents more than 20% of the entire tree population city-wide.	No species represents more than 10% of the entire tree population city-wide. And 30% on a given street.	No species represents more than 5% of the entire tree population city-wide or more than 20% on a given street.	Establish a genetically diverse tree population city-wide as well as at the neighbourhood level.
Condition of Publicly-owned Trees (trees managed intensively)	No tree maintenance or risk assessment. Request based/reactive system. The condition of the urban forest is unknown	Sample-based inventory indicating tree condition and risk level is in place.	Complete tree inventory which includes detailed tree condition ratings.	Complete tree inventory which includes detailed tree condition and risk ratings.	Detailed understanding of the condition and risk potential of all publicly-owned trees
Publicly-owned natural areas (trees managed extensively, e.g. woodlands, ravine lands, etc.)	No information about publicly-owned natural areas.	Publicly-owned natural areas identified in a "natural areas survey" or similar document.	The level and type of public use in publicly-owned natural areas is documented	The ecological structure and function of all publicly-owned natural areas are documented and included in the city-wide GIS	Detailed understanding of the ecological structure and function of all publicly-owned natural areas.
Native vegetation	No program of integration	Voluntary use of native species on publicly and privately- owned lands; invasive species are	The use of native species is *encouraged* on a project-appropriate basis in both intensively and extensively	The use of native species is *required* on a project-appropriate basis in both intensively and extensively	Preservation and enhancement of local natural biodiversity by reducing the proportion

		recognized.	managed areas; invasive species are recognized and their use is discouraged.	managed areas; invasive species are recognized and prohibited.	and populationof non-native and invasive species

Community Framework

Criteria	Performance indicators				Key Objective
	Low	Moderate	Good	Optimal	
Public agency cooperation	Conflicting goals among departments and or agencies.	Common goals but no cooperation among departments and/or agencies.	Informal teams among departments and or agencies are functioning and implementing common goals on a project-specific basis.	Municipal policy implemented by formal interdepartmental/ interagency working teams on ALL municipal projects.	Insure all city department cooperate with common goals and objectives
Involvement of large private and institutional land holders	Ignorance of issues	Educational materials and advice available to landholders.	Clear goals for tree resource by landholders. Incentives for preservation of private trees.	Landholders develop comprehensive tree management plans (including funding).	Large private landholders embrace city-wide goals and objectives through specific resource management plans.
Green industry cooperation	No cooperation among segments of the green industry (nurseries, tree care companies, etc.) No adherence to industry standards.	General cooperation among nurseries, tree care companies, etc.	Specific cooperative arrangements such as purchase certificates for “right tree in the right place”	Shared vision and goals including the use of professional standards.	The green industry operates with high professional standards and commits to city-wide goals and objectives.
Neighbourhood action	No action	Isolated or limited number of active groups.	City-wide coverage and interaction.	All neighbourhoods organized and cooperating.	At the neighbourhood level, citizens understand and cooperate in urban forest management.
Citizen-municipality-business interaction	Conflicting goals among constituencies	No interaction among constituencies.	Informal and/or general cooperation.	Formal interaction e.g. Tree board with staff coordination.	All constituencies in the community interact for the benefit of the urban forest.
General awareness of trees as a community resource	Trees seen as a problem, a drain on budgets.	Trees seen as important to the community.	Trees acknowledged as providing environmental, social and economic services.	Urban forest recognized as vital to the communities environmental, social and economic well-being.	The general public understanding the role of the urban forest.
Regional cooperation	Communities cooperate independently.	Communities share similar policy vehicles.	Regional planning is in effect	Regional planning, coordination and /or management plans	Provide for cooperation and interaction among neighbouring communities and regional groups.

Resource Management Approach

Criteria	Performance Indicators				Key Objective
	Low	Moderate	Good	Optimal	
Tree Inventory	No inventory	Complete or sample-based inventory of publicly-owned trees	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees.	Complete inventory of publicly-owned trees AND sample-based inventory of privately-owned trees included in city-wide GIS	Complete inventory of the tree resource to direct its management. This includes: age distribution, species mix, tree condition, risk assessment.
Canopy Cover Inventory	No inventory	Visual assessment	Sampling of tree cover using aerial photographs or satellite imagery.	Sampling of tree cover using aerial photographs or satellite imagery included in city-wide GIS	High resolution assessments of the existing and potential canopy cover for the entire community.
City-wide management plan	No plan	Existing plan limited in scope and implementation	Comprehensive plan for publicly-owned intensively- and extensively-managed forest resources accepted and implemented	Strategic multi-tiered plan for public and private intensively- and extensively-managed forest resources accepted and implemented with adaptive management mechanisms.	Develop and implement a comprehensive urban forest management plan for private and public property.
Municipality-wide funding	Funding for reactive management	Funding to optimize *existing* urban forest.	Funding to provide for net increase in urban forest benefits.	Adequate private and public funding to sustain maximum urban forest benefits.	Develop and maintain adequate funding to implement a city-wide urban forest management plan
City staffing	No staff.	No training of existing staff.	Certified arborists and professional foresters on staff with regular professional development.	Multi-disciplinary team within the urban forestry unit.	Employ and train adequate staff to implement city-wide urban forestry plan
Tree establishment planning and implementation	Tree establishment is *ad hoc*	Tree establishment occurs on an annual basis	Tree establishment is directed by needs derived from a tree inventory	Tree establishment is directed by needs derived from a tree inventory and is sufficient to meet canopy cover objectives (see Canopy Cover criterion in Table 1)	Urban Forest renewal is ensured through a comprehensive tree establishment program driven by canopy cover, species diversity, and species distribution objectives
Tree habitat suitability	Trees planted without consideration of site conditions.	Tree species are considered in planting site selection.	Community-wide guidelines are in place for the improvement of planting sites and the selection of suitable species.	All trees planted in sites with adequate soil quality and quantity, and growing space to achieve their genetic potential	All publicly-owned trees are planted in habitats which will maximize current and future benefits provided to the site.
Maintenance of publicly-owned, intensively managed trees	No maintenance of publicly-owned trees	Publicly-owned trees are maintained on a request/reactive basis. No systematic (block) pruning.	All publicly-owned trees are systematically maintained on a cycle longer than five years.	All mature publicly-owned trees are maintained on a 5-year cycle. All immature trees are structurally pruned.	All publicly-owned trees are maintained to maximize current and future benefits. Tree health and condition ensure maximum longevity.

Resource Management Approach

Criteria	Performance Indicators				Key Objective
	Low	Moderate	Good	Optimal	
Tree Risk Management	No tree risk assessment/ remediation program. Request based/reactive system. The condition of the urban forest is unknown	Sample-based tree inventory which includes general tree risk information; Request based/reactive risk abatement program system.	Complete tree inventory which includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one month from confirmation of hazard potential.	Complete tree inventory which includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one week from confirmation of hazard potential.	All publicly owned trees are safe.
Tree Protection Policy Development and Enforcement	No tree protection policy	Policies in place to protect public trees.	Policies in place to protect public and private trees with enforcement.	Integrated municipal wide policies that ensure the protection of trees on public and private land are consistently enforced and supported by significant deterrents	The benefits derived from large-stature trees are ensured by the enforcement of municipal wide policies.
Publicly-owned natural areas management planning and implementation	No stewardship plans or implementation in effect.	Reactionary stewardship in effect to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned natural area to facilitate public use (e.g. hazard abatement, trail maintenance, etc.)	Stewardship plan in effect for each publicly-owned natural area focused on sustaining the ecological structure and function of the feature.	The ecological structure and function of all publicly-owned natural areas are protected and, where appropriate, enhanced.

APPENDIX B.

Implementation matrix for the action items identified in the Urban Forest Management Plan.

(to be provided in the pre-final draft)

APPENDIX C.

Summary of how the 27 recommendations from the *City of Mississauga Urban Forest Study* (2011)[24] have been addressed through this Urban Forest Management Plan and the broader Natural Heritage & Urban Forest Strategy.

Mississauga Urban Forest Study (2011) Recommendation	Relationship to Mississauga's Urban Forest Management Plan (UFMP) and broader Natural Heritage Urban Forest Strategy (NH&UFS)
1. Neighbourhoods identified by the Priority Planting Index should be targeted for strategic action that will increase tree cover and leaf area in these areas.	Consideration for the canopy cover analysis done is incorporated into NH&UFS Strategy #14 and supporting UFMP Action #10.
2. Use the parcel-based TC metrics together with the City's GIS database to identify and prioritize contiguous parcels that maintain a high proportion of impervious cover and a low percent canopy cover.	Consideration for the canopy cover analysis done is incorporated into NH&UFS Strategy #14 and supporting UFMP Action #10.
3. Increase leaf area in canopied areas by planting suitable tree and shrub species under existing tree cover. Planting efforts should be focused in areas where mature and aging trees are over-represented, including the older residential neighbourhoods located south of the Queensway. Neighbourhoods in these areas that maintain a high proportion of ash species should be prioritized.	Consideration for underplanting and areas dominated by ash is incorporated into NH&UFS Strategy #14 and supporting UFMP Action #10.
4. Utilize the Pest Vulnerability Matrix during species selection for municipal tree and shrub planting.	Evaluation of local pest priorities is incorporated into NH&UFS Strategy #16 and supporting UFMP Action #19, and will also inform NH&UFS Strategy #14.
5. Establish a diverse tree population in which no single species represents more than 5 percent of the tree population, no genus represents more than 10 percent of the tree population, and no family represents more than 20 percent of the intensively managed tree population both city-wide and the neighbourhood level.	Increasing street and park tree diversity is addressed through UFMP Target #5 and is also Incorporated into NH&UFS Strategy #15 and supporting UFMP Actions #4 and #11.
6. In collaboration with the Toronto Region Conservation Authority and Credit Valley Conservation, develop and implement an invasive species management strategy that will comprehensively address existing infestations as well as future threats posed by invasive insect pests, diseases and exotic plants.	Invasive plant management is incorporated into NH&UFS Strategy #13 and supporting UFMP Action #17; invasive tree pest management is incorporated into NH&UFS Strategy #16 and supporting UFMP Action #9.
7. Utilize native planting stock grown from locally adapted seed sources in both intensively and extensively managed areas.	The broader use of native planting stock is to be implemented through Strategy #15 and supporting UFMP Action #4.
8. Evaluate and develop the strategic steps necessary to increase the proportion of large, mature trees in the urban forest. Focus must be placed on long-term tree maintenance and by-law enforcement to ensure that healthy specimens can reach their genetic growth potential. The value of the services provided by mature trees must be effectively communicated to all residents.	A number of strategies and actions are designed to support the preservation of mature trees in the City. These include: NH&UFS Strategies #4, #6, #7, #8 (and supporting Actions #12 and #14), Strategy #13 (and related Action #17), Strategy #16 (and supporting Actions #6 and #8), strategy #19 (and supporting Actions #15 and #16), as well as Strategies #20, #21, #22, #23 (and supporting Actions #18, #20, #21 and #22).
9. Determine the relative dbh of the tree population in Mississauga; consider utilizing relative dbh as an indicator of urban forest health.	This recommendation is not being pursued through the UFMP or NH&UFS.

[24] This study was undertaken by the Peel Urban Forest Working Group which includes the Region of Peel, the three area municipalities (Mississauga, Brampton and Caledon) and the two conservation authorities whose jurisdictions cover most of the Region – Toronto Region Conservation and Credit Valley Conservation.

10. Conduct an assessment of municipal urban forest maintenance activities (e.g. pruning, tree planting) to determine areas where a reduction in fossil fuel use can be achieved.	An analysis of municipal urban forest maintenance practices was done through the UFMP, but efficiencies related to fossil fuel use were not specifically identified, although the increasing shift towards proactive management is intended to ensure that more work is done in fewer trips to the same location.
11. Reduce energy consumption and associated carbon emissions by providing direction and assistance to residents and businesses for strategic tree planting and establishment around buildings.	Direction and assistance to residents and businesses in terms of planting to maximize the cooling benefits of trees on their properties is provided through various sources under the One Million Trees Program, as per NH&UFS Strategy #24 (and related Action #22), as well as Strategy #27.
12. Focus tree planting and establishment in "hot-spots" identified by thermal mapping analysis.	Consideration for the hot spot data is incorporated into NH&UFS Strategy #14 and supporting UFMP Action #10.
13. Review and enhance the Tree Permit By-law 474-05 to include the protection all trees that are 20 cm or greater in diameter at breast height.	The City's Private Tree Protection By-law was recently updated. As discussed under Action#14, it is recommended it be reviewed again in four to eight years.
14. Develop a comprehensive Public Tree By-law that provides protection to all trees on publically owned and managed lands.	As per Action #12, the City is currently in the process of updating its Street Tree By-law to be a more comprehensive Public Tree By-law.
15. Develop a Tree Protection Policy that outlines enforceable guidelines for tree protection zones and other protection measures to be undertaken for all publically and privately owned trees	Action #4 recommends the development, and implementation, of improved city-wide tree protection and planting specifications for trees on public and private lands.
16. Allocate additional funding to the Urban Forestry Unit for the resources necessary to ensure full public compliance with Urban Forestry By-laws and policies.	Resource requirements above and beyond what is currently approved for the various Actions are identified through the Implementation Matrix (Appendix B).
17. Create a Community Animator Program that assists residents and groups acting at the neighbourhood scale in launching local conservation initiatives.	Although a Community animator is not specifically recommended through this Plan, a number of engagement strategies and actions are identified through the NH&UFS and the UFMP.
18. Conduct a detailed assessment of opportunities to enhance urban forest stewardship through public outreach programs that utilize community-based social marketing.	As assessment of stewardship opportunities has been completed through the NH&UFS and UFMP (see Appendix H in the NH&UFS), and recommendations to build on these programs and incorporate social marketing are made through Strategies #20, #22 and #24, and Actions #18, #20 and #22.
19. Develop and implement a comprehensive municipal staff training program as well as information sharing sessions that target all departments and employees that are stakeholders in sustainable urban forest management.	The importance of and need for internal training and education is identified though Strategy #1, and supporting Action #19.
20. Increase genetic diversity in the urban forest by working with local growers to diversify stock and reduce reliance on clones.	Identified in Action #23 as a potential project.
21. Utilize the UTC analysis together with natural cover mapping to identify priority planting and restoration areas within the urban matrix.	Consideration for the canopy cover analysis done is incorporated into NH&UFS Strategy #14 and supporting UFMP Action #10.
22. Implement the target natural heritage system in the Etobicoke and Mimico Creeks Watersheds; work with CVC to identify and implement the target natural heritage system in the Credit Valley Watershed.	The CVC and TRCA watershed target Natural Heritage Systems have been considered in the identification of potential expansion areas identified and recommended through Strategy #10, and should continue to be considered in future identification of expansion areas, as well as in the identification of future acquisition areas (Strategy #18).

23. Develop and implement an urban forest monitoring program that tracks trends in the structure and distribution of the urban forest using the i-Tree Eco analysis and Urban Tree Canopy analysis. The structure and distribution of the urban forest should be comprehensively evaluated at regular 5-year intervals and reported on publically.	Urban forest monitoring is recommended through Strategy #29, and supporting Actions #1 and #2, and is to utilize established criteria and indicators.
24. Develop a seed collection program for native ash species in partnership with TRCA, CVC and National Tree Seed Centre.	Identified in Action #23 as a potential project.
25. Develop municipal guidelines and regulations for sustainable streetscape and subdivision design that 1) ensure adequate soil quality and quantity for tree establishment and 2) eliminate conflict between natural and grey infrastructure.	This recommendation is to be implemented through Strategy #15 and supporting UFMP Action #4.
26. Apply and monitor the use of structural soils, subsurface cells and other enhanced rooting environment techniques for street trees. Utilizing these technologies at selected test-sites in the short-term may provide a cost-effective means of integrating these systems into the municipal budget.	Assessment of the use of structural soils identified in Action #23 as a potential research project.
27. Utilize the criteria and performance indicators developed by Kenney et al. (2011) to guide the creation of a strategic management plan and to assess the progress made towards sustainable urban forest management and planning.	Urban forest monitoring is recommended through Strategy #29, and supporting Actions #1 and #2, and is to utilize established criteria and indicators framework by Kenney at al. (2011).